



## COLORADO DIVISION OF RECLAMATION, MINING AND SAFETY

1313 Sherman Street, Room 215, Denver, Colorado 80203 ph(303) 866-3567

### REQUEST FOR TECHNICAL REVISION (TR) COVER SHEET

File No.: M- \_\_\_\_\_ Site Name: \_\_\_\_\_

County \_\_\_\_\_ TR# \_\_\_\_\_ (DRMS Use only)

Permittee: \_\_\_\_\_

Operator (If Other than Permittee): \_\_\_\_\_

Permittee Representative: \_\_\_\_\_

Please provide a brief description of the proposed revision: \_\_\_\_\_

As defined by the Minerals Rules, a Technical Revision (TR) is: “a change in the permit or application which does not have more than a minor effect upon the approved or proposed Reclamation or Environmental Protection Plan.” The Division is charged with determining if the revision as submitted meets this definition. If the Division determines that the proposed revision is beyond the scope of a TR, the Division may require the submittal of a permit amendment to make the required or desired changes to the permit.

The request for a TR is not considered “filed for review” until the appropriate fee is received by the Division (as listed below by permit type). Please submit the appropriate fee with your request to expedite the review process. After the TR is submitted with the appropriate fee, the Division will determine if it is approvable within 30 days. If the Division requires additional information to approve a TR, you will be notified of specific deficiencies that will need to be addressed. If at the end of the 30 day review period there are still outstanding deficiencies, the Division must deny the TR unless the permittee requests additional time, in writing, to provide the required information.

There is no pre-defined format for the submittal of a TR; however, it is up to the permittee to provide sufficient information to the Division to approve the TR request, including updated mining and reclamation plan maps that accurately depict the changes proposed in the requested TR.

Required Fees for Technical Revision by Permit Type - Please mark the correct fee and submit it with your request for a Technical Revision.

<u>Permit Type</u>	<u>Required TR Fee</u>	<u>Submitted</u> (mark only one)
110c, 111, 112 construction materials, and 112 quarries	\$216	<input type="checkbox"/>
112 hard rock (not DMO)	\$175	<input type="checkbox"/>
110d, 112d(1, 2 or 3)	\$1006	<input type="checkbox"/>





May 2, 2018

Subject : Kiewit Pit Saltcedar Control

The saltcedar trees leaves are just starting to bud out. T-P Enterprises, Inc. plans to wait 10-14 days to allow the buds to leaf out before applying herbicide control. Herbicide control will be completed by the end of May. The Russian Olive trees on site have been cut down and removed.

Sincerely,

Lynn Smitherman  
T-P Enterprises, Inc.  
719-291-4460 cell



November 29, 2017

Subject: Kiewit Pit Saltcedar Control

T-P Enterprises, Inc. was unable to spray for control of Saltcedar trees prior to leaves dropping. T-P enterprises will spray these trees next year when trees have leafed out and are actively growing.

Sincerely,

Lynn Smitherman  
T-P Enterprises, Inc.  
719-291-4460 cell



# T-P Enterprises, Inc.

# INVOICE

7340 Utah Lane  
Colorado Springs, CO. 80923

719-447-9180

**SOLD TO:**

Kiewit Infrastructures CO.  
3527 Wabash  
Colorado Springs, CO. 80906

INVOICE NUMBER	8957
INVOICE DATE	October 31, 2017
TERMS	Net 30

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
1.000	<b>Kiewit Pit</b> LS thistle herbicide control	400.00	400.00
		SUBTOTAL	400.00
			\$400.00
			PAY THIS AMOUNT

**MAKE ALL CHECKS PAYABLE TO:**  
T-P Enterprises, Inc.  
5055 East 39th Ave.  
Denver, CO. 80207

**THANK YOU FOR YOUR BUSINESS!**

# COOPERATIVE EXTENSION

*Bringing the University to You*

Fact Sheet FS-02-93

(Replaces Fact Sheet FS 95-15)

## Managing Saltcedar

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Saltcedars (*Tamarix chinensis*, *T. ramosissima*, and *T. parvifolia*) are invasive, shrubby trees that are rapidly colonizing riparian areas in Nevada. *Tamarix ramosissima* is the principle invader. They were introduced into the United States in the early 1800's as ornamentals and to prevent soil erosion along streams. These trees have escaped cultivation and are spreading rapidly throughout the desert southwest, Rocky Mountains and Great Basin. A fourth species, Athel (*T. aphylla*) is a very tall single-trunked, evergreen that is invasive in Southern Nevada. Less hardy than the others, it grows in Clark and southern Nye Counties.

In Nevada, saltcedar occupies Baltic rush meadows along the Walker River, saltgrass communities or former croplands at Stillwater and the Humboldt Sink, and arroyos in the upper pinyon/juniper zone of the Stillwater Range at Fence Maker Pass. The Colorado, Muddy and Virgin Rivers are heavily infested in southern Nevada. Native plant communities surrounding springs, seeps, streams and lakes are also threatened. Even isolated arroyos are being occupied by saltcedar throughout Nevada.

### DESCRIPTION AND HABITAT

Saltcedar (*T. ramosissima*) is a deciduous shrub or small tree that grows 20 to 25 feet tall. Its gray-green leaves and wispy limbs give it a feathery appearance. The striking, small, pink to white flowers cover the upper branches in spring with occasional sparse flowering over the season (Fig. 1). It profusely produces tiny seeds each year that are spread by wind, water and animals.

Unlike native willows and cottonwoods that produce seeds for a short period in the spring, saltcedar



Figure 1. Wispy saltcedar limbs in bloom.

produces seeds over the entire summer as long as soil moisture is available. Spring-produced saltcedar seed has near 100 percent germination over a wide range of constant or alternating temperatures. Seed produced later has less viability. Each plant can produce 500,000 or more seeds. One hundred seeds per square inch have been produced within a saltcedar forest. Once wetted, embedded in soil or not, saltcedar seeds germinate in 24 hours. If the soil dries rapidly, the seedlings die. For establishment, the soil must dry slowly enough for the roots to grow into moisture deeper in the soil profile.

Saltcedar also reproduces vegetatively from the stems, crown and roots. New growth occurs readily when young plants are grazed or mowed, or the trunk or shoots are removed or killed by fire or severe drought.

Saltcedar uses more water than native cottonwoods, poplars and willows. It grows best in riparian sites such as stream banks, saline meadows, seasonally saturated washes, and lands that have seasonally high



water tables. It is classified as a phreatophyte, meaning it uses very large amounts of groundwater. Therefore, it lowers the water table that supplies springs and shallow wells. Dried up springs in Nevada have recovered after the surrounding saltcedar has been removed.

Saltcedar is able to use salty water. It does this by absorbing the salts through cell membranes. It avoids the toxic effects by using special glands to excrete the salts and by dropping salt-filled leaves. The leaves dropped each fall accumulate to a considerable depth under the canopy. Through this process, saltcedar acts as a salt pump concentrating salts from deep in the ground onto the soil surface. Over time, salts in the mulch layer kill existing plants and prevent others, especially desirable forage species, from becoming established. As a result, the ground under a saltcedar or within a saltcedar bosque is void of plants except, on occasion, another salt tolerant species.

#### SALTCEDAR ASSOCIATED PROBLEMS

Studies in New Mexico and Utah show saltcedar uses four to thirteen acre-feet of water a year; much more water than native trees and shrubs. It has an extensive, deep root system that absorbs water from the surrounding soil lowering the water table and killing most native plants. Competition for water resources in the west is growing yearly, especially where large saltcedar communities exist.

A normally functioning, healthy river (Fig. 2) has a

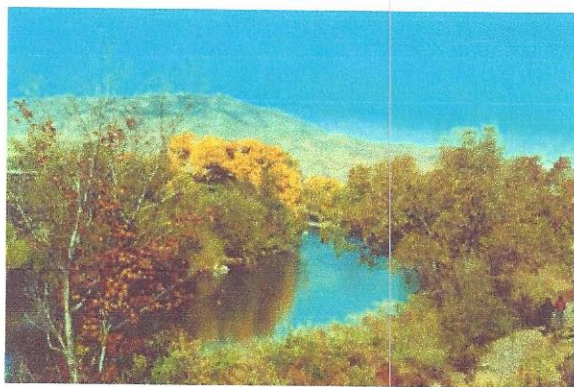


Figure 2. A variety of plants contribute to a healthy, functioning, beautiful river or stream.

narrow, deep, meandering flow. Saltcedar reduces a river's flow of water. It uses soil moisture that would usually contribute to the stream and traps sediment along the banks and in the river. This increases the size of the flood plain spreading water over a larger area, which increases evaporation and water use by plants (often extensive saltcedar woods). When infested with saltcedar, a healthy river becomes an impenetrable, unproductive saltcedar forest that may use one third more water from the river than a similar

stand of native trees (Fig. 3). A saltcedar-dominated stream functions poorly, is unattractive, changes native habitats, supports less wildlife, spoils recreational uses and affects water quality.

Cattle, sheep and goats will graze saltcedar but it is nutritionally poor forage for both livestock and wildlife. They prefer not to eat it and only do so when little else is available. Cattle eat only the young sprouts early in the year. Aggressive grazing by sheep may provide some control, but overgrazing stimulates suckering and speeds the area's conversion to a pure saltcedar stand.

Saltcedar provides cover for wildlife, but animal and plant diversity is reduced. The impenetrable stands make recreational access almost impossible on foot, horse or vehicle. Hunting and fishing are greatly restricted. Rounding up livestock hiding in a thicket is a chore.

#### CONTROL STRATEGIES

Effective management requires determination and a



Figure 3. Saltcedar stands along the Muddy River at Glendale, NV prevent fishing.

multi-year commitment. Efforts should be taken to prevent site disturbances by fire, overgrazing, and mechanical damage, that leave the site open for saltcedar invasion. Elimination of upstream infestations is required to effectively control saltcedar in a watershed. Eradication of the plant immediately after discovery is best before saltcedar becomes well established. After saltcedar is removed, it is requisite that a competitive stand of desirable plants be established to prevent reinvasion of the area by saltcedar.

#### BIOLOGICAL CONTROL

Biological control applies natural enemies to weeds. Insects, disease causing organisms, and livestock have all been used in successful biological control efforts on a variety of invasive weeds.

Two insects, a mealy bug (*Trabutina mannipara*) and leaf beetle (*Diorhabda elongata*), have been released in the United States to attack saltcedar. The



mealy bug is not adapted to colder, drier environments and was released outside Nevada. The leaf beetle was released at Schurz, Stillwater, and Lovelock, Nevada after it was established that it eats only saltcedar and not valuable natives, ornamentals or crops. Research continues on its adaptability, reproductive ecology and predation of saltcedar in Nevada.

### MECHANICAL CONTROL

Plowing, cutting, mowing, chaining and burning have been attempted to control saltcedar. All have failed on large-scale projects because saltcedar resprouts profusely following mechanical treatments. Success has been achieved after a fire when the root crowns are removed before the next growing season and all new growth is removed as it occurs.

Flooding saltcedar for one or two years is effective. Small plants, if completely covered, easily succumb. The root crown and most of the shoots must be covered completely for months to successfully kill larger plants.

### CHEMICAL CONTROL

Only two herbicides effectively control saltcedar: triclopyr (Garlon 4) and imazapyr (Arsenal). After applying either product, do not disturb the saltcedar for two years. This allows the herbicide time to move throughout the entire plant, especially the root system, and kill it. Applying 2,4-D, picloram, or glyphosate to saltcedar does not control it.

Saltcedar usually produces a multi-stemmed shrubby tree. In the Walker River Delta, there are 60,000 stems per acre, many of them less than one inch in diameter. This makes navigating the area and applying chemicals difficult, even hazardous. Exercise care in handling herbicides while moving among the stems to avoid spilling it on yourself, others, or contaminating the area.

Cut saltcedar stems off at ground level and immediately paint the cut surface with full strength Garlon 4, the ester formulation of triclopyr. (Specific instructions limit the use of triclopyr near water and in wetlands.) Apply the herbicide with a brush within ten minutes, sooner is better. Triclopyr can also be applied as a basal stem treatment mixed with metylated seed oil as a carrier (see the label for directions on mixing the two). Stems must be treated all the way around, which can be difficult in heavy stands. Stem treatments can be used on stems up to three inches in diameter. This requires less labor than painting the cut surface of stems. Both applications use large amounts of herbicide per acre, are labor intensive, and time consuming.

The only effective foliar-applied herbicide for saltcedar is imazapyr. Follow the label instructions regarding application rates, use of an oil carrier, and

the types of application equipment to use. Again, do not disturb saltcedar treated with imazapyr for two years or burn the treated stand after it has dried. For additional insights see Table 1.

When applying herbicides, always follow the directions on the label. Failure to do so violates the law. Following the instructions protects the applicator, other workers, non-target plants and animals, and our environment. It also reduces liability for any damages incurred.

### SUSTAINABLE MANAGEMENT

Treated areas should be revegetated and properly managed. Successful saltcedar control and revegetation is difficult for these reasons:

- The accumulation of salt on the soil's surface hinders the establishment of desirable plants.
- The understory species in many saltcedar infestations is desert saltgrass, which is damaged or killed by imazapyr. The area has to be tilled to break up the saltgrass sod and turn the salts under before seed of other species can be broadcast or drilled.
- Removal of the limbs and roots of saltcedar is difficult and expensive. If the trees are large, chainsaws and a caterpillar are used to remove the biomass and deep rip the roots.
- Burning the treated area results in sprouting from the roots. Two growing seasons must elapse for the herbicide to kill the roots so that the saltcedar will not regrow when the shoots are removed or burned.

Other aspects must be considered when controlling and removing saltcedar. The plant plays an important part in bank stabilization on Nevada's desert river systems. Loss of stabilization must be compensated for in any control program. Control of saltcedar in the Walker River Delta and the Virgin River Valley may result in additional erosion of highly salt-affected soils, increasing the salt content of nearby waters.

Along the Carson, Humboldt, Muddy, Truckee, Walker and Virgin Rivers or other riparian communities where saltcedar is established, selective control is necessary. Reestablishment of native woody vegetation may prove difficult requiring changes in management of the riparian woodlands to prevent pollution of nearby waters and re-establishment of saltcedar.



Table 1. Considerations for effective chemical treatments to control saltcedar.

Considerations	Treatment Methods		
	Cut-stump Surface	Basal Bark	Foliar Spray
<b>Plant Stage</b>	All stages, triclopyr in summer and fall.	All stages, but most effective applied to stems less than 3" in diameter treated when dormant compared to spring or summer applications.	Best results occur with an aerial application of imazapyr in the late summer to early fall (August – September). Stop when fall dormancy begins.
<b>Treatment Process</b>	Paint the cut stumps immediately with triclopyr; within 10 minutes, sooner is better. Use a water-soluble dye to track the treated plants.	Spray the lower uncut 15" of the plant with triclopyr in an oil carrier. Be sure to spray the entire bark surface of the stem.	Herbicide and wetting agent are applied via spray devices. Ground based sprayers (ATV's or trucks) and aircraft are effective.
<b>Herbicide Application</b>	Thoroughly treat each stump, especially the cambium layer just inside the bark. Stumps must be wetted completely for good control.	Low-volume application: mix 25 to 30 gallons Garlon 4* with oil to make a 100-gallon mixture. Apply to plants with stems less than 3" in diameter. Inconsistent results.	Apply Arsenal* (Imazapyr) with the proper surfactant until the saltcedar is wet, but not dripping. Do not disturb the crown and roots of large trees for 2 years to allow imazapyr to move throughout the tree to prevent re-sprouting from the roots.
<b>Effectiveness</b>	Most popular and effective in areas unsuitable for aerial or ground rig applications. Use near water to avoid drift and contamination of water.	Retreatment of the stems that were not killed is difficult compared with the cut stump treatment. Use where it is very rocky or labor is not available for treating cut stumps.	Effective on large stands with few non-target plants growing among the saltcedar. The shoots normally die within one year, the roots within two years.
<b>Retreatment</b>	Is necessary to clean up missed stumps.	May need to retreat the following year.	If necessary.

\*Trade or common names have been used to simplify information; no endorsement by the University of Nevada Cooperative Extension is intended nor implied. Likewise criticism of products not listed is neither implied nor intended.

Be cautious when using chemicals. Be careful not to treat irrigation ditches, non-target plants, or surface waters. For more information contact your local University of Nevada Cooperative Extension office.

## BENEFITS OF SALT CEDAR CONTROL

Controlling saltcedar and revegetating the land improves riparian habitats and increases biodiversity. Using the woody biomass of saltcedar for value added manufacturing in rural Nevada may be a viable option. Conversion of saltcedar woodlands to more water efficient plants allows water in a watershed to be utilized for more beneficial uses. Until alternative vegetation becomes established on the infested land, actual measurements cannot be taken to determine whether or not water is conserved and available. Control of saltcedar also improves grazing, wildlife habitat, and recreational uses along waterways.

## ADDITIONAL RESOURCES

- 1) Ball, D., P.J.S. Hutchinson, T.L. Miller, D.W. Morishita, R. Parker, R.D. William and J.P. Yenish. 2001 Pacific Northwest Weed Management Handbook. Oregon State University. Corvallis, OR. pp. 184-203.
- 2) Bussan, A.J., S.A. Dewey, W.E. Dyer, M.A. Ferrell, S.D. Miller, J. Mickelson, B. Mullin, R. Sheley, R. Stougaard, M.A. Trainor, T.D. Whitson and D. Wichman. 2001-2002 Weed Management Book. Montana, Utah and Wyoming Cooperative Extension Services. pp. 222, 224, 273.

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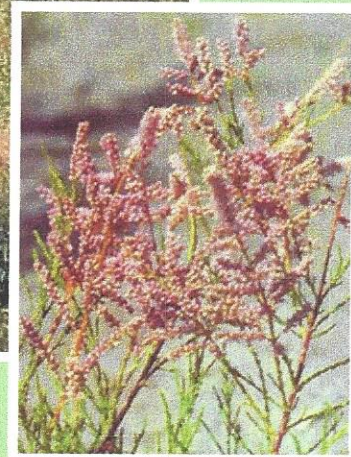
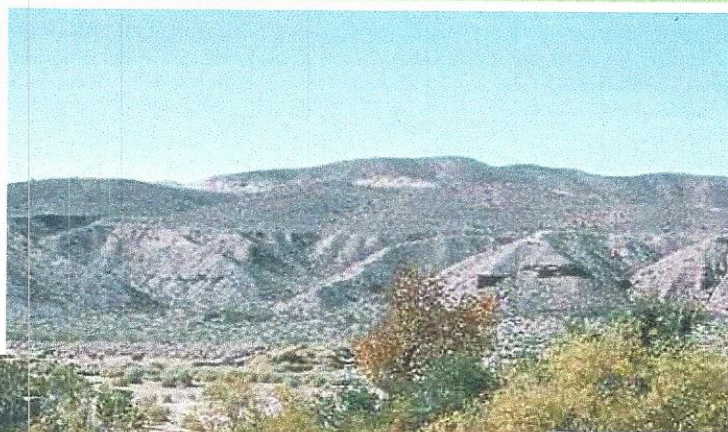
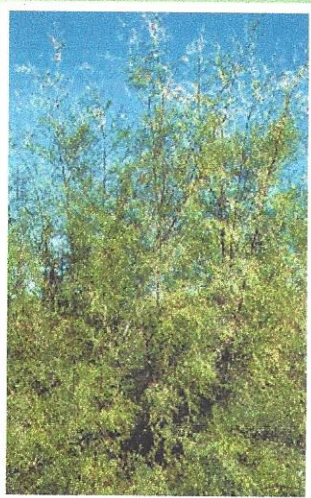
Forest  
Service

**Southwestern  
Region**

TP-R3-16-2

January 2010

# Field Guide for Managing Saltcedar





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# Saltcedar (*Tamarix spp.*)

Tamarisk family (Tamaricaceae)

Saltcedar is an invasive plant common to southwestern states and has been listed as a noxious weed in New Mexico.

This field guide is intended to serve as the U.S. Forest Service's recommendations for management of saltcedar in forests, woodlands, riparian areas, and rangelands associated with the Forest Service's Southwestern Region. The region consists of 11 national forests in Arizona and New Mexico together with 3 national grasslands in New Mexico, Oklahoma, and Texas.

## Description

*Tamarix* is one of four genera in the Tamaricaceae and is represented by 54 species worldwide. *Tamarix* taxonomy is somewhat disputed, and authors can have nomenclatures different from each other. The common names of tamarisk and saltcedar have been applied to many species of the genus; however, these terms usually refer to *T. chinensis* or *T. ramosissima* in the southwestern United States. Although these species can hybridize, many taxonomists consider them to be the same species since they are indistinguishable from one another; in which case, *T. chinensis* is the proper taxonomic name.

## Growth Characteristics

- Perennial, deciduous, small shrub or tree, 5 to 25 feet tall.
- Shallow, lateral rhizomes and deep roots can penetrate to a depth of 30 feet or more. Sprouting commonly occurs from disturbed root crowns or from stems or roots lying near the soil surface.
- Small, scaly, bluish-green flat leaves resemble evergreen "needles."
- Reddish-brown branches are smooth, slender, and flexible but snap off easily. Bark becomes furrowed and ridged with age.
- Flowers March through October. Thousands of tiny, pink-to-white flowers with five petals produce extremely small seeds that resemble pepper. Tips of

short-lived seeds have tufts of hair that aid in wind and animal dispersal.

## Ecology

**Impacts/threats** – Saltcedar alters the ecology and hydrology of native riparian systems and generally diminishes habitat quality. Leaf drop increases soil salinity and lessens microbial activity. Evapotranspiration rates for saltcedar are higher than for native riparian species which may reduce streamflows. Soils become drier under dense saltcedar stands; however, saltcedar can provide nesting for birds and may be an important pollen source for honeybees.

**Location** – Found throughout most of the United States except for parts of New England, Middle Atlantic States, and the Midwest. Common along disturbed and undisturbed streams, riverbanks, desert springs, flood plains, drainages, and irrigation waterways. Seedlings require saturated soil to establish.

**Spread** – Rapid colonization and expansion most commonly occurs with flood events or water inundation. Seeds float on water and require damp soil moisture for germination and seedling survival.

**Contributing Factors** – The saltcedar root system is dominated by a root crown that lies 12 to 18 inches below the soil surface. Buds on the root crown and shallow lateral roots will sprout new stems rapidly when aerial portions of the plant are removed.

## Management

Saltcedar may be managed to enhance downstream waterflow, recreation, fire prevention, grazing, flood control, and aesthetics. Strategies to control saltcedar often vary depending on specific management objectives and location within a watershed. For example, an eradication strategy in headwater areas may be used to prevent the downstream spread of saltcedar along waterways. In transitional zones, such as river edges or riparian areas, saltcedar may be removed to enhance waterflow and channel characteristics.

In depositional or flood plain areas, goals for saltcedar control can vary widely and may include enhancing wildlife habitat, minimizing potential fire hazard, regenerating native riparian communities, or meeting other multiple-use needs.

Saltcedar potentially serves as nesting habitat for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) which is protected under the Endangered Species Act of 1973. To avoid harm to this species, information should be obtained from the U.S. Fish and Wildlife Service (Arizona, phone (602) 242-0210; New Mexico, phone (505) 248-6920) before implementing treatment of saltcedar stands of a quarter acre or more in riparian or wetland areas. A formal survey for flycatcher

nesting habitat by a surveyor with a scientific permit may be required for a saltcedar site prior to treatment if the nesting status of the site is undetermined. Within occupied or suitable flycatcher habitat, saltcedar treatment operations (including ground or aerial herbicide spraying) should not occur during the flycatcher nesting period of April 15 to August 30. **Other migratory birds also nest from April through August**, and saltcedar treatment during this period should be avoided if possible. When nesting habitat of the southwestern willow flycatcher is present, a quarter mile buffer surrounding the nest(s) is necessary.

Control and restoration of saltcedar infested areas over the long term requires an integrated management approach. Selection of effective control methods depends on specific

**Table 1. Control Decisions**

Site Factor	Physical Control	Cultural Control	Biological Control <sup>1</sup>	Chemical Control
Goal is to eradicate or provide high mortality.	Excavation, grubbing, and root plowing/raking.	NA	NA	Targeted application with a lethal herbicide. Methods include cut stump, foliage spray, and aerial application.
Goal is to suppress.	Mowing, shredding, mulching, scraping, and fire.	Grazing by goats or other livestock.	NA	Sublethal herbicide application that defoliates but does not kill the tree.
Site is easily accessible and targeted control is needed.	Excavation and grubbing.	NA	NA	Cut stump method, IPT <sup>2</sup> foliage spray, aerial application by helicopter.
Site is difficult to access and targeted control is needed.	NA	NA	NA	Cut stump, IPT foliage spray, aerial application by helicopter.
Open areas on a flood plain.	Excavation, grubbing, and root plowing/raking.	NA	NA	Aerial application.
Protection of other resources (cultural resources, wildlife, endangered species, etc.) is necessary.	Hand removal or selective mechanical removal.		NA	Cut stump method, IPT foliage spray.
Emergent seedlings are on tillable land.	Shallow disking.	Prolonged flooding	NA	Low volume broadcast spray.
Sparse to moderate stands of young saltcedar or re-growth.	Excavation and grubbing.	Grazing with goats	NA	IPT or broadcast foliage spray.
Older growth, dense uniform stands.	Large-scale clearing (root plowing/raking).	NA	NA	Aerial application by helicopter or fixed-wing aircraft.

<sup>1</sup> Although saltcedar leaf beetles (*Diorhabda elongata*) have been released as biological control agents in portions of the western U.S., the beetle species currently cannot be released in Arizona or New Mexico pending review of regulations by the U.S. Fish and Wildlife Service.

<sup>2</sup> IPT – Individual plant treatment



stand and site characteristics. The methods are based either on individual plant treatment (IPT) or stand treatment.

Control methods that target and destroy the root system are the only techniques that provide complete plant control.

Methods that damage or remove aboveground growth without destroying the root crown will suppress saltcedar but will not kill the plant. Aboveground control methods include fire, mowing, grazing with goats or other livestock, defoliating herbicides, foliage feeding insects, etc. Since saltcedar is difficult to eradicate completely, saltcedar control programs should be based on the degree of control necessary to achieve management objectives. The control decision table (table 1) summarizes approaches for many common situations.

## Physical Control

### Manual Methods

Hand removal by hoeing or digging can be used to target individual plants in relatively small areas. Some commercially available hand implements are practical for uprooting small saltcedar plants; however, a shovel or hoe is most commonly used. The root crown and associated layered roots must be entirely removed from the soil. Uprooted material should be stacked into piles and dried before burning or mulching.

### Mechanical Methods

Mechanical methods to treat saltcedar range in scale from individual plant excavation (from hand-operated equipment to excavators) to broad scale clearing (from tillers to bulldozers). Clearing saltcedar stands with a mechanical method often requires repeated applications.

**Grubbing** with a tractor mounted implement is particularly useful for control of scattered individual trees. A grubbing tool mounted on a tractor's hydraulic system drives a blade into the soil to sever roots below the root crown and force the root crown onto the surface. To prevent re-rooting, grubbed saltcedar should be piled, dried, and then burned or mulched rather than left on the surface.

**Excavating** can be used to remove individual trees selectively. Operators of excavating equipment must be skilled in placing the extracting bucket beneath the root crown of the target plant and grasping the tree with an opposing hydraulic arm so that it can be pulled directly upward in a vertical motion. Extracting the tree vertically rather than sideways minimizes excessive breakage of the root material at or near the ground surface.

**Mulching and excavating** can be used in combination by first eliminating top growth of saltcedar quickly through mulching and then using excavation to destroy the remaining root system. Mulching requires mobile, high horsepower machinery to operate a high speed rotating drum equipped with cutting teeth. The mulching equipment mows saltcedar top growth to ground level and simultaneously grinds it into fine segments. Mulching by itself may be used to reduce fuel loading for fires by clearing significant acreage of saltcedar in a relatively short period of time. Mulching operations leave the roots intact; therefore, saltcedar will re-sprout when growth conditions become favorable and will typically reach 2 to 5 feet in height within the first or second season after mulching. A track mounted excavator may be employed to remove the remaining live root crowns and layered roots as indicated by the re-sprouting.

**Root plowing and raking** is a combined mechanical treatment designed to clear large, mature saltcedar stands on relatively level areas. A 2-phase approach is generally followed. In the first phase, aerial trunks and stems are cut at the soil surface and piled using a D-7 or D-8 class bulldozer equipped with a front-mounted brush blade. An articulated loader equipped with a brush rake working in tandem with a bulldozer may be used to facilitate piling. Piles should be allowed to dry for a month or longer prior to burning. The work may be accomplished during winter months to avoid over-heating of equipment and summer nesting of birds. The second phase of control should occur during hot and dry summer months (usually May and June) when root material will dry out after removal from the soil. A 12-foot-wide root plow pulled by a bulldozer (e.g., D-7 class) can be used to sever the root crown from the remaining root system about

12 to 18 inches below the soil surface depending on the maturity of the saltcedar stand. Root material near the soil surface can then be raked by a bulldozer (e.g., D-8 class) equipped with a 21-foot-wide hydraulic root rake containing teeth that are 4 feet in length and are spaced 15 inches apart. The material can then be windrowed and piled using an articulated loader. The piles are subsequently burned.

### Prescribed Fire

Prescribed fire as a single control method is not recommended for long-term saltcedar management since saltcedar is fire adapted and re-grows rapidly. Natural or prescribed fires in mature or decadent stands of saltcedar are hazardous as flame lengths in these fires can be extremely high, and crown fires can be difficult to stop with standard fire-fighting methods. However, burning may be useful or necessary to remove brush piles or dead saltcedar left standing after herbicide spraying.

### Cultural Control

Education and monitoring can be important components to saltcedar control. Some nurseries still stock saltcedar as a decorative plant which could serve as sources of escaped stock in non-invaded areas.

### Biological Control

#### Grazing

Livestock will browse saltcedar, but the foliage has little nutritional value and is usually not preferred. Grazing with goats may be used to suppress re-sprouting after other treatments have been made.

#### Classical Biological Agents

Saltcedar is typically damaged by a number of organisms in its native Mediterranean and Asian habitat. The saltcedar leaf beetle

(*Diorhabda elongata*) is a host-specific species currently under study as an option for saltcedar control (see table 2). Different subspecies of this beetle with specific requirements for climate and day length have been released in the U.S. according to their corresponding needs. Four other insect species feed on saltcedar (including the cicadellid leafhopper, *Opsiurus stactogalus*) but have not been observed to cause more than minimal damage. Currently, further releases of *Diorhabda* beetles have been suspended pending review of regulations for release by the U.S. Fish and Wildlife Service.

### Chemical Control

Herbicides are a primary method of saltcedar control and can be applied by a number of methods including fixed-wing aircraft, helicopter, tractor, truck or ATV-mounted boom sprayers, power sprayers, backpack sprayers, and carpet rollers. Treatment success depends on care taken during herbicide application. Most compounds available for saltcedar control have post-emergence activity and provide limited pre-emergence control (see "Table 3. Herbicide Recommendation Table").

#### Herbicide Control Methods

IPT basal bark treatment can be made on individual saltcedar plants by using herbicide mixed with oil and an adjustable nozzle (X0 to X1 orifice size) to deliver a mist spray from the base of the stem up to 6 inches above the ground. Triclopyr ester herbicide should be mixed with

Table 2. Classical Biological Agents

Species	Type of Agent	Site of Attack	Impact/ Availability	Considerations for Release
<i>Diorhabda elongata</i>	beetle	Larvae and adults feed on foliage.	Varies by <i>D. elongata</i> subspecies but has been released in Nevada, Utah, Colorado, California, and Texas.	Potentially impacts saltcedar habitat of endangered southwestern willow flycatcher. Presently, these insects cannot be released in accordance with regulations of the U.S. Fish and Wildlife Service.



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crop oil in a 50:50 v/v (volume to volume) ratio. Imazapyr may also be used for this application. Although basal bark treatment provides fair control, it is very tedious and time consuming, especially when the saltcedar is multistemmed. Applications on older stems with thick, furrowed bark should be avoided since success may be limited. Basal bark treatments are more easily made in winter when foliage is shed; however, summer treatment is recommended in Texas.

**IPT cut stump treatment** is often used in areas where mechanical treatments or foliar applied herbicide spraying are restricted due to logistical considerations or when there is a need to be highly selective and protect non-target vegetation. The treatment involves hand cutting or chain sawing the saltcedar trunk or stems as close to the ground surface as reasonable, and then applying herbicide to the cut stump surface by paintbrush, hand-held spray bottle, or backpack sprayer. The cut surface should be horizontal to the ground to minimize runoff, and any residual sawdust over the cut surface should be removed prior to herbicide application. A solution of triclopyr ester or imazapyr mixed with bark or crop oil must be immediately applied within 15 minutes. The herbicide:oil mixture ratio can vary from 33:67 to 50:50 v/v depending on the number and size of plants to be treated and the application technique used. The lower ratio is typically used when applications are made with a low volume backpack sprayer or hand-held spray bottle, whereas the higher ratio can be used when the solution is brushed directly onto the cut stump. Cut surfaces of plants with less than 4 inches diameter must be thoroughly wetted with herbicide to kill the roots; however, the herbicide should be applied to the cambial layer just inside the bark ring if the diameter of the saltcedar stump exceeds 4 inches. A blue indicator dye should be added to the spray mixture to show prior treatment of stumps. Disposal of trunks, limbs, and other top growth should follow acceptable practices (e.g., stack piles or chips).

Mortality rates from cut-stump treatments are directly related to care taken when treating cut surfaces. Control can be 60 to 80 percent under optimal conditions, but plant kills

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may be less than 40 percent due to difficulties associated with this method. Therefore, followup treatment using ground-based foliar applications should be anticipated.

**IPT foliar spray** may be used to control small saltcedar that is less than 5 feet in height and is relatively small in acreage. Saltcedar foliage should be completely covered and the terminal ends of all branches, including blooms, should be wetted without allowing dripping to occur. The interior of the plant should then be laced with the spray solution to complete treatment. Ground application of 1 percent imazapyr solution by volume to saltcedar foliage can be made with a variety of sprayers including hand-held pump-up or backpack sprayers; cattle or trailer sprayers; or ATV-mounted low and high powered sprayer systems. An adjustable cone nozzle (X6 to X8 orifice size) can be used to deliver a coarse spray (large droplets). A nonionic surfactant (0.25 percent by volume) and a blue indicator spray dye should be added to the mixture. Since absorption of herbicide into the foliage is relatively slow, chemical penetration into the plant should be increased by spraying during weather conditions of low wind, high relative humidity, and low air temperature. After spraying, the top growth should remain undisturbed for at least 2 years after treatment. Although plants may appear dead (i.e., completely defoliated) in the first growing season after spraying, the plant is still trying to grow. If branches (top growth) are removed too early after spraying, saltcedar will shift stored carbohydrate reserves toward apical root buds and will resprout.

**Airplane or helicopter applications** can be used to spray saltcedar successfully if the aircraft is equipped with the proper spray system. Helicopters can spray "tight," difficult areas that require precision application such as edges of meandering rivers or saltcedar stands interspersed with nontarget vegetation. Fixed-wing aircraft are better for spraying large, monotypic blocks of saltcedar where an overlapping spray pattern can be delivered at a lower operational cost than by a helicopter. Aircraft should be equipped with a satellite guidance system, a variable rate flow meter, and an onboard GIS display system for spraying



in wildland situations. Areas to be sprayed should be premapped, and the onboard computer spray system should be preprogrammed to apply herbicide only on defined treatment areas. Swaths should be overlapped to prevent streaking whereby plants are left untreated or slightly damaged.

For aerial applications, the spray volume should be sufficiently high to insure maximum spray coverage. Spray nozzles should be fitted to deliver moderate to large sized droplets ranging from 450 to 1,200  $\mu\text{m}$ . As indicated by table 3, a spray mixture may include 2 quarts of imazapyr or a 1.5 quart imazapyr plus 1.5 quart glyphosate mixture applied in water. A nonionic surfactant (0.25 percent by volume) and a drift control agent (0.07 percent by volume) should be added to the mixture. For optimum plant control, an aerial application should leave the entire saltcedar canopy glistening with spray liquid long after spraying has occurred. This can partially be accomplished by

equipping the aircraft with the correct spray system and by spraying under optimal environmental conditions. Moderate temperatures (60 to 80 °F), high relative humidity (65 to 90 percent), and light winds (3 to 7 mph) are ideal to maximize herbicide activity. Late summer (August through September) is usually the best time to spray saltcedar by aircraft. Plants to be sprayed should be in a healthy state with full foliage that has not been stressed by drought, damaged by hail, or is beginning to turn yellow late in the season.

### Control Strategies

Numerous research and practical integrated approaches have been developed to manage saltcedar. Successful long-term management programs (typically more than 5 years) usually include a combination of mechanical, fire, and chemical control methods. A combination of methods is particularly necessary if the primary objective is to achieve long-term native plant stability.

**Table 3. Herbicide Recommendations**

Common Chemical Name	Product Example <sup>1</sup>	Product Example Rate per Acre	Individual Plant Treatment (IPT)	Time of Application	Remarks
Triclopyr ester	Garlon 4	NA	50:50 mixture of triclopyr and crop oil with a blue indicator dye	Anytime	For cut stump treatment, apply to fresh cut stump within 15 minutes of cutting.
Imazapyr	Arsenal	2 quart	1 percent mixture for foliage spray (1 gallon per 100 gallons of water with 0.25 percent surfactant and a blue indicator dye)	Late summer to early fall when plants are taking up nutrients —plants should be healthy and not stressed.	For IPT, spray to wet all foliage especially the terminal ends of branches.  For aerial broadcast spraying, add 0.25 percent nonionic surfactant. Use a high spray volume; 15 gallons per acre total solution when applied by helicopter. Allow two full growing seasons before followup treatment.
Imazapyr + glyphosate	Arsenal + Rodeo	1.5 quarts + 1.5 quarts	1/2 to 1 gallon + 1/2 to 1 gallon (1 to 2 pounds + 2 to 4 pounds per 100 gallons of water with 0.25 percent surfactant and a blue indicator dye)	Same as imazapyr.	Same as imazapyr.

<sup>1</sup>Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with saltcedar.

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Assessing revegetation potential is a critical first step before proceeding with saltcedar control. Costs for saltcedar control and revegetation are expensive, and careful selection of areas with a high potential for re-establishment is necessary to provide sustainable saltcedar control in the long term. In some situations, a treated area will recover naturally after aerial spraying without revegetation. In other situations, artificial plantings or seeding may be necessary. Sites that have dense saltcedar stands, poor hydrologic integrity, elevated salinity, or related conditions may have limited revegetation potential. A soil survey may be used to determine the soil texture, ground water depth, salinity levels, and other related factors that ultimately influence replacement of the vegetation community.

The literature provides many examples of integrated saltcedar management and restoration programs. The herbicide-burn-mechanical control program, for example, has emerged as a practical strategy for controlling saltcedar in large, monotypic tracts on valley bottoms and flood plains. The initial intervention step is to apply herbicide aerially which typically provides 70 to 90 percent saltcedar mortality. After 2 years, prescribed burning is used to remove dead aerial trunks and stems. When prescribed burning cannot be done, then mechanical treatments such as chaining, cabling, bulldozing, or roller chopping may be used to drop standing dead debris. Surviving saltcedar plants can be removed in the fourth or fifth year after spraying with an excavator, grubber, or root plow and raking. In some instances, IPT foliage spraying may be used to control saltcedar re-sprouting.

Once saltcedar has been removed, aggressive revegetation is often required. Managers should be cognizant of subsequent restoration processes and/or revegetation requirements when selecting a control strategy. Without special planning and care, treated areas may be rapidly re-invaded by saltcedar or other invasive species. In such instances, sustainable control over the long term is best accomplished by planting competitive native plants that have a high exclusionary ability. Native riparian woody

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species such as cottonwood (*Populus deltoides*), Goodings willow (*Salix gooddingii*), and coyote willow (*S. exigua*) have a rapid growth potential under conditions of low environmental stress and are good candidate species for plantings.

## Further Information

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The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.



**CAUTION:** Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.



# ARSENAL<sup>®</sup>

herbicide

SPECIMEN

For control of undesirable vegetation growing within specified aquatic sites, forestry sites, pasture/rangeland, and nonagricultural lands; and for establishment and maintenance of wildlife openings, release of unimproved Bermudagrass and Bahiagrass, bareground weed control, and for use under certain paved surfaces

**Active Ingredient:**

isopropylamine salt of imazapyr: (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid)\* ..... 27.8%

**Other Ingredients:** ..... 72.2%

**Total:** ..... 100.0%

\* Equivalent to 22.6% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon

**EPA Reg. No. 241-346**

**EPA Est. No.**

## KEEP OUT OF REACH OF CHILDREN CAUTION/PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

See inside for complete **First Aid, Precautionary Statements, Directions For Use, Conditions of Sale and Warranty**, and state-specific crop and/or use site restrictions.

**In case of an emergency endangering life or property involving this product, call day or night 1-800-832-HELP (4357).**

**Net Contents:**

BASF Corporation  
26 Davis Drive  
Research Triangle Park, NC 27709

 **BASF**  
The Chemical Company



FIRST AID	
<b>If swallowed</b>	<ul style="list-style-type: none"> <li>• Call a poison control center or doctor immediately for treatment advice.</li> <li>• Have person sip a glass of water if able to swallow.</li> <li>• <b>DO NOT</b> induce vomiting unless told to by a poison control center or doctor.</li> <li>• <b>DO NOT</b> give anything by mouth to an unconscious person.</li> </ul>
<b>If in eyes</b>	<ul style="list-style-type: none"> <li>• Hold eyes open and rinse slowly and gently with water for 15 to 20 minutes.</li> <li>• Remove contact lenses, if present, after first 5 minutes; then continue rinsing eyes.</li> <li>• Call a poison control center or doctor for treatment advice.</li> </ul>
<b>If on skin or clothing</b>	<ul style="list-style-type: none"> <li>• Take off contaminated clothing.</li> <li>• Rinse skin immediately with plenty of water for 15 to 20 minutes.</li> <li>• Call a poison control center or doctor for treatment advice.</li> </ul>
<b>If inhaled</b>	<ul style="list-style-type: none"> <li>• Move person to fresh air.</li> <li>• If person is not breathing, call 911 or an ambulance; then give artificial respiration, preferably by mouth to mouth, if possible.</li> <li>• Call a poison control center or doctor for further treatment advice.</li> </ul>
HOTLINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact BASF Corporation for emergency medical treatment information: 1-800-832-HELP (4357).	

## Precautionary Statements

### Hazards to Humans and Domestic Animals

**CAUTION.** Harmful if swallowed. Avoid contact with eyes or clothing.

### Personal Protective Equipment (PPE)

Some materials that are chemically resistant to this product are listed below. If you want more options, follow the instructions for **Category A** on an EPA chemical-resistance category selection chart.

**Mixers, loaders, applicators, and other handlers must wear:**

- Long-sleeved shirt and long pants
- Chemical-resistant gloves made of any waterproof material
- Shoes plus socks

Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions are given for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate.

**DO NOT** reuse them.

### Engineering Controls

Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(6)].

## USER SAFETY RECOMMENDATIONS

**Users should:**

- Wash hands with plenty of soap and water before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

## Physical and Chemical Hazards

Spray solutions of **Arsenal® herbicide** must be mixed, stored, and applied only in stainless steel, fiberglass, plastic, and plastic-lined steel containers.

Thoroughly clean application equipment, including landing gear, immediately after use of this product. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part. The maintenance of an organic coating (paint) may prevent corrosion.

## Environmental Hazards

This product is toxic to plants. Drift and runoff may be hazardous to plants in water adjacent to treated areas. **DO NOT** apply to water except as specified in this label. Treatment of aquatic weeds may result in oxygen depletion or loss because of decomposition of dead plants. This oxygen loss may cause suffocation of some aquatic organisms. **DO NOT** treat more than 1/2 of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. **DO NOT** contaminate water when disposing of equipment washwater or rinsate.



This pesticide is toxic to vascular plants and must be used strictly in accordance with the drift precautions on the label.

## Directions For Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

**Arsenal® herbicide** must be used only in accordance with the instructions on the label attached to the container. Keep containers closed to avoid spills and contamination.

**DO NOT** apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

### AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

**DO NOT** enter or allow worker entry into treated areas during the restricted-entry interval (REI) of **48 hours**.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Shoes plus socks
- Chemical-resistant gloves made of any waterproof material
- Protective eyewear

### NONAGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

**DO NOT** enter or allow others to enter treated areas until sprays have dried.

## STORAGE AND DISPOSAL

**DO NOT** contaminate water, food, or feed by storage or disposal.

### Pesticide Storage

**DO NOT** store below 10° F.

### Pesticide Disposal

Wastes resulting from the use of this product must be disposed of on-site or at an approved waste disposal facility.

### Container Handling

**Nonrefillable Container. DO NOT reuse or refill this container.** Triple rinse or pressure rinse container

(or equivalent) promptly after emptying; then offer for recycling, if available, or reconditioning, if appropriate, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures approved by state and local authorities.

#### Triple rinse containers small enough to shake

**(capacity ≤ 5 gallons) as follows:** Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times.

#### Triple rinse containers too large to shake

**(capacity > 5 gallons) as follows:** Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Repeat this procedure two more times.

**Pressure rinse as follows:** Empty the remaining contents into application equipment or mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank, or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

**Refillable Container.** Refill this container with pesticide only. **DO NOT** reuse this container for any other purpose. Triple rinsing the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller.

(continued)



## STORAGE AND DISPOSAL *(continued)*

### Container Handling *(continued)*

**Triple rinse as follows:** To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10% full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

When this container is empty, replace the cap and seal all openings that have been opened during use; return the container to the point of purchase or to a designated location. This container must only be refilled with a pesticide product. Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices. Check for leaks after refilling and before transport. **DO NOT** transport if this container is damaged or leaking. If the container is damaged, or leaking, or obsolete and not returned to the point of purchase or to a designated location, triple rinse emptied container and offer for recycling, if available, or dispose of container in compliance with state and local regulations.

### In Case of Emergency

In case of large-scale spillage regarding this product, call:

- CHEMTREC 1-800-424-9300
- BASF Corporation 1-800-832-HELP (4357)

In case of medical emergency regarding this product, call:

- Your local doctor for immediate treatment
- Your local poison control center (hospital)
- BASF Corporation 1-800-832-HELP (4357)

### Steps to be taken in case material is released or spilled:

- Dike and contain the spill with inert material (sand, earth, etc.) and transfer liquid and solid diking material to separate containers for disposal.
- Remove contaminated clothing and wash affected skin areas with soap and water.
- Wash clothing before reuse.
- Keep the spill out of all sewers and open bodies of water.

## Product Information

**Arsenal® herbicide** is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control undesirable vegetation growing within specified aquatic sites, forestry sites, pasture/rangeland and nonagricultural lands. Aquatic sites consist of standing and flowing water, estuarine/marine, wetland, and riparian areas. Nonagricultural lands include private, public and military lands as follows: uncultivated nonagricultural areas (including airports, highway, railroad and utility rights-of-way, and sewage disposal areas); uncultivated agricultural areas - noncrop producing (including farmyards, fuel

storage areas, fence rows, nonirrigation ditchbanks, and barrier strips); industrial sites - outdoor (including lumberyards, pipeline and tank farms); and natural areas (including wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails). **Arsenal** may also be used for the release of unimproved Bermudagrass and Bahiagrass, for bareground weed control, and for use under certain paved surfaces.

### Herbicidal Activity

**Arsenal** will control most annual and perennial grass and broadleaf weeds in addition to many brush and vine species with some residual control of undesirable species that germinate above the waterline. **Arsenal** is readily absorbed through emergent leaves and stems and is translocated rapidly throughout the plant with accumulation in the meristematic regions. For maximum activity, weeds should be growing vigorously at the time of application, and the spray solution should include a surfactant (see **Adjuvants** section for specific use directions). Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into and kills underground or submerged storage organs, which prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until 2 or more weeks after application. Complete kill of plants may not occur for several weeks. **Arsenal** applications are rainfast 1 hour after treatment.

### Product Use and Restrictions

Applications may be made for control of undesirable vegetation growing within specified aquatic sites, forestry sites, pasture/rangeland and nonagricultural lands. Aquatic sites consist of standing and flowing water; estuarine/marine, wetland, and riparian areas; for control of most annual and perennial grass weeds, broadleaf weeds, vines and brambles, and hardwood brush and trees for forestry site preparation and release of conifers from woody and herbaceous competition. **Arsenal** may also be used for selective woody and herbaceous weed control in natural regeneration of certain conifers (see **Conifer Release Treatment**).

Nonagricultural lands include private, public and military lands as follows: uncultivated nonagricultural areas (including airports, highway, railroad and utility rights-of-way, and sewage disposal areas); uncultivated agricultural areas - noncrop producing (including farmyards, fuel storage areas, fence rows, nonirrigation ditchbanks, and barrier strips); industrial sites - outdoor (including lumberyards, pipeline and tank farms); and natural areas (including wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails).



## Restrictions and Limitations

- **DO NOT** use on food crops.
- **DO NOT** apply this product within 1/2 mile upstream of an active potable water intake in flowing water (i.e. river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water, such as a lake, pond, or reservoir.
- **DO NOT** apply to water used for irrigation except as described in **Product Use and Restrictions** section of this label.
- Keep from contact with fertilizers, insecticides, fungicides, and seeds.
- **DO NOT** drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the treated soil may be washed or moved into contact with their roots.
- **DO NOT** use on lawns, walks, driveways, tennis courts, or similar areas.
- **DO NOT** side trim desirable vegetation with this product unless severe injury and plant death can be tolerated. Prevent drift of spray to desirable plants.
- Clean application equipment after using this product by thoroughly flushing with water.

## Nonagricultural Lands and Forestry Sites

- **DO NOT** apply more than 1.5 lbs acid equivalent (ae) imazapyr (equivalent to 96 fl ozs of **Arsenal® herbicide**) per acre per year.

## Pasture/Rangeland Sites

- For spot treatment only.
- **DO NOT** treat more than 1/10 of the available area to be grazed or cut for hay.
- **DO NOT** apply more than 0.75 lb ae imazapyr (equivalent to 48 fl ozs of **Arsenal**) per acre per year.

## Aquatic Sites

- **DO NOT** apply more than 1.5 lbs ae imazapyr (equivalent to 96 fl ozs of **Arsenal**) per acre per year.
- **Public waters** - Application of **Arsenal** to water can only be made by federal or state agencies, such as Water Management District personnel, municipal officials, and the U.S. Army Corps of Engineers, or those applicators who are licensed or certified as aquatic pest control applicators and are authorized by the state or local government. Treatment to other than non-native invasive species is limited to only those plants that have been determined to be a nuisance by a federal or state government entity.
- **Permitting** - Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.
- **Private waters** - Applications may be made to private waters that are still, such as ponds, lakes, and drainage ditches where there is minimal or no outflow to public waters.
- **Aerial application** - Aerial application to aquatic sites is restricted to helicopter only.

- **Irrigation water** - Application to water used for irrigation that results in **Arsenal** residue greater than 1.0 ppb **MUST NOT** be used for irrigation purposes for 120 days after application or until **Arsenal** residue levels are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less. When applications are made within 500 feet of an active irrigation intake, **DO NOT** irrigate for at least 24 hours following application to allow for dissipation.

## Recreational Use of Water in Treatment Area

There are no restrictions on the use of water in the treatment area for recreational purposes, including swimming and fishing.

## Livestock Use of Water in/from Treatment Area

There are no restrictions on livestock consumption of water from the treatment area.

## Restrictions for Potable Water Intakes

**DO NOT** apply **Arsenal** directly to water within 1/2 mile upstream of an active potable water intake in flowing water (i.e. river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water such as a lake, pond, or reservoir. To make aquatic applications around and within 1/2 mile of active potable water intakes, the water intake must be turned off during application and for a minimum of 48 hours after application. These aquatic applications may be made only in cases where there are alternative water sources or holding ponds that would permit turning off an active potable water intake for a minimum period of 48 hours after applications.

**NOTE:** Existing potable water intakes that are no longer in use, such as those replaced by connections to wells or a municipal water system, are not considered to be active potable water intakes. This restriction does not apply to intermittent, inadvertent overspray of water in terrestrial use sites.

## Quiescent or Slow-moving Waters

In lakes and reservoirs, **DO NOT** apply **Arsenal** within 1 mile of an active irrigation water intake during the irrigation season. Applications less than 1 mile from an active irrigation water intake may be made during the off-season if the irrigation intake will remain inactive for a minimum of 120 days after application or until **Arsenal** residue levels are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less.



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## Precautions for Avoiding Injury to Nontarget Plants

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Untreated desirable plants can be affected by root uptake of **Arsenal® herbicide** from treated soil. Injury or loss of desirable plants may result if **Arsenal** is applied on or near desirable plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. When making application along shorelines where desirable plants may be present, use caution to avoid spray contact with their foliage or spray application to the soil in which they are rooted. Shoreline plants that have roots which extend into the water in an area where **Arsenal** has been applied generally will not be adversely affected by uptake of the herbicide from the water.

If treated vegetation is to be removed from the application site, **DO NOT** use the vegetative matter as mulch or compost on or around desirable species.

## Managing Off-target Movement

### Aerial Application

- Applicators are required to use a coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater for release heights below 10 feet. Applicators are required to use a very coarse or coarser droplet size or, if specifically using a spinning atomizer nozzle, applicators are required to use a VMD of 475 microns or greater for release heights above 10 feet. Applicators must consider the effects of nozzle orientation and flight speed when determining droplet size.
- Applicators are required to use upwind swath displacement.
- The boom length must not exceed 60% of the wingspan or 90% of the rotor-blade diameter to reduce spray drift.
- Applications with wind speeds less than 3 mph and with wind speeds greater than 10 mph are prohibited.
- Applications into temperature inversions are prohibited.

### Ground Boom Application

- Applicators are required to use a nozzle height below 4 feet above the ground or plant canopy and coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater.
- Applications with wind speeds greater than 10 mph are prohibited.
- Applications into temperature inversions are prohibited.

### Wind Erosion

Avoid treating powdery, dry, or light sandy soils when conditions are favorable for wind erosion. Under these conditions, the soil surface should first be settled by rainfall or irrigation.

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## Adjuvants

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Postemergence applications of **Arsenal** require the addition of a spray adjuvant. When making aquatic applications, only spray adjuvants approved or appropriate for aquatic use must be used.

### Nonionic Surfactant

Use a nonionic surfactant (NIS) at the rate of 0.25% volume/volume (v/v) or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with a hydrophilic-to-lipophilic balance (HLB) ratio between 12 and 17 with at least 70% surfactant in the formulated product. Alcohol, fatty acid, oil, ethylene glycol, or diethylene glycol should not be considered as surfactants to meet the above requirements.

### Methylated Seed Oil or Vegetable Oil Concentrate

Instead of a surfactant, a methylated seed oil (MSO) or vegetable-based seed oil concentrate may be used at the rate of 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, mix MSO or vegetable-based seed oil concentrates at a rate of 1% of total spray volume, or alternatively use a nonionic surfactant as described above. Research indicates that these oils may aid in **Arsenal** deposition and uptake by plants under moisture or temperature stress.

### Silicone-based Surfactant

See manufacturer's label for specific rates. Silicone-based surfactants may reduce the surface tension of the spray droplet allowing greater spreading on the leaf surface as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly, limiting herbicide uptake.

### Invert Emulsions

**Arsenal** can be applied as an invert emulsion. The spray solution results in an invert (water-in-oil) spray emulsion designed to minimize spray drift and spray runoff, resulting in more herbicide on the target foliage. The spray emulsion may be formed in a single tank (batch mixing) or injected (in-line mixing). Consult the invert chemical label for proper mixing directions.

### Other

An antifoaming agent, spray pattern indicator, or drift-reducing agent may be applied at the product labeled rate if necessary or desired.

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## Tank Mixes

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**Arsenal** may be tank mixed with other herbicides.

Consult manufacturer's labels for specific rate restrictions and weeds controlled. Always follow the more restrictive label restrictions and precautions for all products used when making an application involving tank mixes.



## Application Methods

**Arsenal® herbicide** may be selectively applied using low-volume directed application techniques or may be broadcast-applied using ground equipment, watercraft, or aircraft. Aerial applications to aquatic sites must be made by helicopter. In addition, **Arsenal** may also be applied using cut-stump, cut-stem, and frill or girdle treatment techniques within nonagricultural lands, pasture/rangeland, and aquatic sites; see **Aerial Application** and **Ground Application** sections for additional details.

### Aerial Application

All precautions must be taken to minimize or eliminate spray drift. Both fixed-wing aircraft and helicopters can be used to apply **Arsenal** on nonagricultural lands, but only helicopters can be used for aquatic applications. **DO NOT** make applications by fixed-wing aircraft or helicopter unless appropriate buffer zones can be maintained to prevent spray drift out of the target area; or when treating open tracts of land, spray drift as a result of fixed-wing aircraft application can be tolerated. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a **Microfoil™ boom**, **Thru-Valve™ boom**, or raindrop nozzles, must be used and calibrated. Except when applying with a **Microfoil boom**, a drift control agent may be added at the specified label rate. **DO NOT** side trim with **Arsenal** unless death of treated tree can be tolerated.

Uniformly apply the specified amount of **Arsenal** in 2 to 30 gallons of water per acre. A foam-reducing agent may be added at the specified label rate, if needed.

Thoroughly clean application equipment, including landing gear, immediately after use of this product. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part. The maintenance of an organic coating (paint) may prevent corrosion.

### Ground Application

#### Foliar Application

##### Low-volume Foliar Application

Use equipment calibrated to deliver 5 to 20 gallons of spray solution per acre. To prepare the spray solution, thoroughly mix in water 0.5% to 5% **Arsenal** plus surfactant; see the **Adjuvants** section of this label for specific use directions. A foam-reducing agent may be applied at the specified label rate, if needed. For difficult-to-control species (see **Aquatic Weed Control** and **Terrestrial Weed Control** sections for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but **DO NOT** apply more than 3 quarts of **Arsenal** per acre in aquatic sites and nonagricultural lands and 1.5 quarts per acre in pasture/rangeland. Excessive wetting of foliage is not necessary.

For low-volume foliar application, select proper nozzles to avoid overapplication. Proper application is critical to ensure desirable results. Best results are achieved when spray covers the crown and approximately 70 percent of the plant. The use of an even, flat-fan tip with a spray angle of 40 degrees or less will aid in proper deposition.

Appropriate tip sizes include 4004E or 1504E. For a straight-stream and cone pattern, adjustable cone nozzles, such as 5500 X3 or 5500 X4, may be used. Attaching a rollover valve onto a Spraying Systems Model 30 gunjet or other similar spray gun allows for the use of both flat-fan and cone tips on the same gun.

Moisten, but **DO NOT** drench target vegetation causing spray solution to run off.

**Low-volume Foliar Application with Backpack.** For low-growing species, spray down on the crown, covering crown and penetrating approximately 70% of the plant.

For target species 4 to 8 feet tall, swipe the sides of target vegetation by directing spray to at least 2 sides of the plant in smooth vertical motions from the crown to the bottom. Make sure to cover the crown whenever possible.

For target species over 8 feet tall, lace sides of target vegetation by directing spray to at least 2 sides of the target in smooth zigzag motions from crown to bottom.

**Low-volume Foliar Application with Hydraulic Handgun Application Equipment.** Use the same technique as described for **Low-volume Foliar Application with Backpack**.

For broadcast application, simulate a gentle rain near the top of target vegetation allowing spray to contact the crown and penetrate the target foliage without falling to the understory. Herbicide spray solution that contacts the understory may result in severe injury or death of plants in the understory.

##### High-volume Foliar Application

For optimum performance when spraying medium-density to high-density vegetation, use equipment calibrated to deliver up to 100 gallons of spray solution per acre (GPA). Spray solutions exceeding 100 GPA may result in excessive spray runoff, causing increased ground cover injury and injury to desirable species.

To prepare the spray solution, thoroughly mix **Arsenal** in water and add a surfactant; see **Adjuvants** section for specific use directions and rates for surfactants. A foam-reducing agent may be added at the specified label rate, if needed. For difficult-to-control species (see **Aquatic Weed Control** and **Terrestrial Weed Control** sections for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but **DO NOT** apply more than 3 quarts of **Arsenal** per acre in aquatic sites and nonagricultural lands and 1.5 quarts per acre in pasture/rangeland. Uniformly cover the foliage of the vegetation to be controlled, but **DO NOT** apply to runoff. Excessive wetting of foliage is not necessary.



## Side Trimming

**DO NOT** side trim with **Arsenal® herbicide** unless severe injury or death of the treated tree can be tolerated. **Arsenal** is readily translocated and can result in death of the entire tree.

## Cut-surface Treatment

**Arsenal** may be used to control undesirable woody vegetation by applying the **Arsenal** solution to the cambium area of freshly cut stump surfaces or to fresh cuts on the stem of target woody vegetation. Application can be made any time of the year except during periods of heavy sap flow in the spring. **DO NOT** overapply solution causing runoff from the cut surface.

Injury may occur to desirable woody plants if shoots extend from the same root system or their root systems are grafted to those of the treated tree.

## Cut-surface Application with Dilute and Concentrate Solutions

**Arsenal** may be mixed as either a concentrate or dilute solution. The dilute solution may be used for application to the cut surface of the stump or to cuts on the stem of target woody vegetation. Concentrate solutions may be used for application to cuts on the stem. Use of the concentrate solution permits application to fewer cuts on the stem, especially for large-diameter trees. Follow application instructions for proper application techniques for each type of solution.

- To prepare a dilute solution, mix 8 to 12 fluid ounces of **Arsenal** with 1 gallon of water. A surfactant or penetrating agent may improve uptake through partially callused cambiums.
- To prepare a concentrate solution, mix 2 quarts of **Arsenal** with no more than 1 quart of water.

## Cut-stump Treatment

**Dilute Solution.** Spray or brush the solution onto the cambium area of the freshly cut stump surface. Ensure that the solution thoroughly wets the entire cambium area (the wood next to the bark of the stump).

## Cut-stem Treatment (injection, hack-and-squirt)

**Dilute Solution.** Using standard injection equipment, apply 1 milliliter (mL) of solution at each injection site around the tree with no more than 1-inch intervals between cut edges. Ensure that the injector completely penetrates the bark at each injection site.

**Concentrate Solution.** Using standard injection equipment, apply 1 mL of solution at each injection site. Make at least 1 injection cut for every 3 inches of diameter at breast height (DBH) on the target tree. For example, a 3-inch DBH tree will receive 1 injection cut, and a 6-inch DBH tree will receive 2 injection cuts. On trees requiring more than 1 injection site, place the injection cuts at approximately equal intervals around the tree.

## Frill or Girdle Treatment

Using a hatchet, machete, or chainsaw, make cuts through the bark and completely around the tree to expose the cambium. The cut should angle downward extending into the cambium enough to expose at least 2 growth rings. Using a spray applicator or brush, apply a 25% to 100% solution of **Arsenal** into each cut until thoroughly wet. Avoid applying so much herbicide that runoff to the ground or water occurs.

## Forestry Use

### Site Preparation Treatment

**Arsenal** may be used to control labeled grass weeds, broadleaf weeds, vines and brambles, and woody brush and trees on forest sites in advance of regeneration for the following conifer crop species:

Common Name	Scientific Name	Rate (fl ozs/A)
Loblolly pine	<i>Pinus taeda</i>	48 to 80
Loblolly X pitch hybrid		
Longleaf pine	<i>Pinus palustris</i>	
Shortleaf pine	<i>Pinus echinata</i>	
Virginia pine	<i>Pinus virginiana</i>	
Slash pine	<i>Pinus elliotii</i>	40 to 64
Coastal redwood	<i>Sequoia sempervirens</i>	24 to 48
Douglas fir	<i>Pseudotsuga menziesii</i>	
Western hemlock	<i>Tsuga heterophylla</i>	24 to 40
California red fir	<i>Abies magnifica</i>	
California white fir	<i>Abies concolor</i>	24 to 32
Jack pine	<i>Pinus banksiana</i>	
Lodgepole pine	<i>Pinus contorta</i>	
Pitch pine	<i>Pinus rigida</i>	
Ponderosa pine	<i>Pinus ponderosa</i>	
Sugar pine	<i>Pinus lambertiana</i>	
White pine	<i>Pinus strobus</i>	
Black spruce	<i>Picea mariana</i>	
Red spruce	<i>Picea rubens</i>	
White spruce	<i>Picea glauca</i>	

Use the label rate of **Arsenal** per acre applied as a broadcast foliar spray for long-term control of labeled woody plants and residual control of herbaceous weeds. Within 4 to 6 weeks of treatment, grass and other herbaceous weeds will be controlled and may provide fuel to facilitate a site preparation burn, if desired, to control conifers or other species tolerant to the herbicide.

Apply the label rate of **Arsenal** per acre in 5 to 30 gallons total spray solution for helicopter applications or 5 to 100 gallons total spray solution for mechanical ground spray and backpack applications. Use a minimum of 0.5% by volume nonionic surfactant (NIS). Use the higher label rates of **Arsenal** and higher spray volumes when



controlling particularly dense or multilayered canopies of hardwood stands or difficult-to-control species.

In certain cases, tank mixes may be necessary for chemical control of conifers and other species tolerant to **Arsenal® herbicide**. Observe all precautions and restrictions on the product labels. Always follow the most restrictive label. Combinations with other products labeled for forest site preparation may kill certain plants such as legumes and blackberry, which are desirable for wildlife habitat.

Where quick initial brownout (deadening of foliage) is desired for burning, apply a tank mixture of 32 fl ozs to 64 fl ozs **Arsenal** with 16 fl ozs to 64 fl ozs glyphosate or 16 fl ozs to 48 fl ozs triclopyr ester per acre. For control of seedling pines, apply 32 fl ozs to 64 fl ozs **Arsenal** with 3 to 4 quarts glyphosate. For site preparation, rates less than 48 fl ozs **Arsenal** will provide suppression of hardwood brush and trees; some resprouting may occur.

**DO NOT** plant seedlings of black spruce (*Picea mariana*) or white spruce (*Picea glauca*) on sites broadcast-treated with **Arsenal** or into the treated zone of spot or banded applications for 3 months following application or injury may occur.

## Herbaceous Weed Control

Use **Arsenal** for selective weeding in the following conifers:

Common Name	Scientific Name	Rate (fl ozs/A)
Loblolly pine	<i>Pinus taeda</i>	12 to 20
Loblolly X pitch hybrid		
Virginia pine	<i>Pinus virginiana</i>	
Longleaf pine <sup>1</sup>	<i>Pinus palustris</i>	8 to 12
Slash pine <sup>1</sup>	<i>Pinus elliotii</i>	
Douglas fir <sup>1</sup>	<i>Pseudotsuga menziesii</i>	

<sup>1</sup> Use of surfactant is not recommended.

**Arsenal** may be applied as a broadcast treatment, banded over tree rows, or as a directed spray for release of young conifers from herbaceous weeds. To prevent possibility of conifer injury, **DO NOT** apply **Arsenal** when conifers are under stress from drought, disease, animal or winter injury, planting shock, or other stresses reducing conifer vigor. Broadcast applications may be made by helicopter, ground, or backpack sprayer. For difficult-to-control weeds, use the higher labeled rates. Where herbaceous weeds have overtopped conifer seedlings, a nonionic surfactant may be added to improve weed control (except for slash pine, long-leaf pine, and Douglas fir), at a rate not to exceed 0.5% of spray solution volume. Some minor conifer growth inhibition may be observed when herbaceous weed control treatments are made during periods of active conifer growth.

**Arsenal** may also be applied using backpack or handheld sprayers to control herbaceous weeds around individual conifer seedlings. Mix 0.8 fl oz to 1.2 fl ozs **Arsenal** and 0.2 oz nonionic surfactant per gallon of water. Direct the spray to the weeds and minimize the amount applied to

conifer foliage for best conifer tolerance. Ensure that maximum labeled rates per acre for previously listed crop species are not exceeded.

**Arsenal** may be tank mixed with sulfometuron to broaden the spectrum of weeds controlled. For loblolly pine, apply 8 fl ozs to 12 fl ozs **Arsenal** plus 1 oz to 2 ozs sulfometuron per acre. The application of **Arsenal** plus sulfometuron on other conifer species may cause growth suppression.

## Conifer Release Treatment

**Arsenal** may be applied as a broadcast or directed spray application for suppression of labeled brush, tree, and herbaceous weed species. Directed spray applications may be made with low-volume applications in conifer stands of all ages by targeting the unwanted vegetation and avoiding direct application to the conifer. Ensure that maximum labeled rates per acre listed for the following crop species are not exceeded.

### Broadcast Applications

for release of the following conifers from hardwood competition:

Common Name	Scientific Name	Rate (fl ozs/A)
Loblolly pine <sup>3</sup>	<i>Pinus taeda</i>	24 to 40
Loblolly X pitch hybrid <sup>3</sup>		
Virginia pine <sup>3</sup>	<i>Pinus virginiana</i>	
Longleaf pine	<i>Pinus palustris</i>	24 to 32
Pitch pine	<i>Pinus rigida</i>	
Shortleaf pine	<i>Pinus echinata</i>	
Slash pine	<i>Pinus elliotii</i>	
White pine <sup>1</sup>	<i>Pinus strobus</i>	16 to 32
California red fir	<i>Abies magnifica</i>	16 to 24
California white fir	<i>Abies concolor</i>	
Lodgepole pine <sup>2</sup>	<i>Pinus contorta</i>	
Douglas fir <sup>2</sup>	<i>Pseudotsuga menziesii</i>	
Jack pine <sup>2</sup>	<i>Pinus banksiana</i>	12 to 24
Black spruce <sup>2</sup>	<i>Picea mariana</i>	
Red spruce <sup>2</sup>	<i>Picea rubens</i>	
White spruce <sup>2</sup>	<i>Picea glauca</i>	

<sup>1</sup> **DO NOT** make applications to white pine stands younger than three years old. To minimize potential white pine injury, release treatments should not be made prior to July 15.

<sup>2</sup> Applications should be made after formation of final conifer resting buds in the fall or height growth inhibition may occur.

<sup>3</sup> **Mid-rotation release:** For broadcast applications below the pine canopy in established stands of loblolly pine, loblolly X pitch hybrid, and Virginia pine, use 32 fl ozs to 64 fl ozs product per acre. For mid-rotation release of other species, use rates listed in chart above.

**For slash pine and longleaf pine, broadcast release treatments over the top of pines for the purpose of woody plant control must be made after August 15 and only in stands 2 through 5 years old. For applications over the top of slash pine and longleaf pine, DO NOT add surfactant and use lower labeled rates on sandy soils.**



Apply the label rate of **Arsenal® herbicide** per acre when making broadcast applications with helicopter or ground spray equipment. Refer to mixing and application instructions for proper spray volumes. A nonionic surfactant may be added at no more than 0.25% by volume.

Use the higher label rates of **Arsenal** when controlling particularly dense stands or difficult-to-control species.

Some minor conifer growth inhibition may be observed when release treatments are made during periods of active conifer growth. To minimize potential conifer height growth inhibition, **DO NOT** make broadcast applications to conifer stands except loblolly pine before the end of the second growing season. To minimize potential conifer height growth inhibition, broadcast release treatments may be made late in the growing season. To prevent possibility of conifer injury, **DO NOT** apply **Arsenal** when conifers are under stress from drought, disease, animal or winter injury, or other stresses reducing conifer vigor.

**Arsenal** may be used to release loblolly pine seedlings during the first growing season following planting or for one-year-old natural loblolly pine regeneration. For one-year-old loblolly pine release, apply 24 fl ozs to 40 fl ozs per acre of **Arsenal** after July 15. Rates below 32 fl ozs per acre are intended for hardwood growth suppression; expect hardwood resprouting.

### Spot Treatment of Undesirable Hardwood Vegetation

**Arsenal** may be used as a directed foliar or cut-stem application to control undesirable brush and hardwoods in the management of stands of all ages for the conifer species listed in the broadcast application section above. Refer to mixing and application instructions in the directed foliar or cut-stem sections above for proper use rates, equipment, and application techniques. **DO NOT** exceed maximum labeled rates per acre listed for crop species. Cut-stem applications may be used for spot treatment of undesirable hardwoods in Ponderosa pine stands using 24 fl ozs or less of **Arsenal** per acre.

Avoid direct application to desired plant species or injury may occur. Injury may occur to nontarget or desirable hardwoods or conifers if they extend from the same root system, or their root systems are grafted to those of the treated tree, or their roots extend into the treated zone.

### Late Rotation Vegetation Control in Western Conifer

In California, the Pacific Northwest and Inland Northwest, broadcast aerial applications of **Arsenal** up to 48 fl ozs per acre are permissible in conifer stands that are targeted for harvesting the year following treatment. Use minimum spray volume of 15 gallons per acre. Significant conifer injury or mortality must be expected. **DO NOT** use this treatment if conifer injury or mortality cannot be tolerated.

## Bag and Spray Application for Conifer Release

In Douglas fir and Ponderosa pine stands, broadcast applications of **Arsenal** up to 32 fl ozs per acre are permissible when the trees are covered by bags prior to the application. The bags must prevent the spray mix from contacting the conifer foliage. On sites with coarse textured soils (e.g. decomposed granite, pumice, sandy or rocky sites) or low levels of soil organic matter (generally 5% or less), significant conifer growth inhibition and mortality is possible. **DO NOT** use this treatment on these types of sites if conifer growth inhibition and mortality cannot be tolerated.

## Nonagricultural Land Use

**Arsenal** may be used for woody and herbaceous weed control in nonagricultural lands including private, public and military lands as follows: uncultivated nonagricultural areas (including airports, highway, railroad and utility rights-of-way, and sewage disposal areas); uncultivated agricultural areas - noncrop producing (including farmyards, fuel storage areas, fence rows, nonirrigation ditchbanks, and barrier strips); industrial sites - outdoor (including lumberyards, pipeline and tank farms); and natural areas (including wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails).

Applications to nonagricultural lands are not applicable to treatment of commercial timber or other plants grown for sale or other commercial use, or for commercial seed production, or for research purposes.

## Brush Control

Use the specified rate of **Arsenal** with the preferred application technique for control of undesirable brush.

### Tank Mixes and Application Rates for Low-volume Foliar Brush Control\*

Target Vegetation	Arsenal Rate (% by volume)	Tank Mix
Mixed hardwoods without elm, locust, or pine	1.0 to 1.5	Surfactant
Mixed hardwoods containing elm, locust, and pine	0.5 to 1.0	<b>Accord®</b> at 2% to 3% by volume plus surfactant
Mixed hardwoods with locust and pine but no elm		<b>Krenite®</b> at 2% to 5% by volume plus surfactant
Mixed hardwoods with locust and elm but no pine		<b>Escort®</b> at 2 ozs/A or 2.3 grams/gal plus surfactant

\* Tank mixes with 2,4-D or products containing 2,4-D have resulted in reduced **Arsenal** efficacy.



## Backpack and Handheld Spray Mixing Guide

% solution	Product per gallon of mix (fl ozs)	Product per 4-gallon backpack (fl ozs)
0.25	0.3	1.3
0.5	0.6	2.6
1.0	1.3	5.1
2.0	2.6	10.2
3.0	3.8	15.4
5.0	6.4	25.6

## Measuring Chart

128 fluid ounces	=	1 gallon
16 fluid ounces	=	1 pint
8 pints	=	1 gallon
4 quarts	=	1 gallon
2 pints	=	1 quart

## Selective Control of Undesirable Weeds in Unimproved Bermudagrass and Bahiagrass

**Arsenal® herbicide** may be used on unimproved Bermudagrass and Bahiagrass turf such as roadsides, utility rights-of-way, and other nonagricultural lands. **Arsenal** application on established common and coastal Bermudagrass and Bahiagrass provides control of labeled broadleaf and grass weeds. Competition from these weeds is eliminated, releasing the Bermudagrass and Bahiagrass. Treatment of Bermudagrass with **Arsenal** results in a compacted growth habit and seedhead inhibition.

Uniformly apply with properly calibrated ground equipment using at least 10 gallons of water per acre.

Temporary yellowing of grass may occur when treatment is made after growth begins.

- **DO NOT** add surfactant in excess of the specified rate (1 fl oz per 25 gallons of spray solution).
- **DO NOT APPLY** to grass during its first growing season.
- **DO NOT APPLY** to grass under stress from drought, disease, insects, or other causes.

## Dosage Rate and Timing

**Bermudagrass.** Apply **Arsenal** at 6 fl ozs to 12 fl ozs per acre when Bermudagrass is dormant. Apply **Arsenal** at 6 fl ozs to 8 fl ozs per acre after Bermudagrass has reached full greenup. Applications made during greenup will delay greenup. Include a surfactant in the spray solution.

For additional preemergence control of annual grass and small-seeded broadleaf weeds, add **Pendulum® AquaCap™ herbicide** at the rate of 3.1 to 6.3 pints per acre. Consult the **Pendulum AquaCap** label for weeds controlled and for other use directions and precautions.

For control of Johnsongrass in Bermudagrass turf, apply **Arsenal** at 8 fl ozs per acre, plus **Roundup® herbicide** at 12 fl ozs per acre, plus surfactant. For additional control of broadleaves and vines, **Garlon® 3A herbicide** may be added to the above mix at 1 to 2 pints per acre. Observe all precautions and restrictions on the **Garlon 3A** and **Roundup** labels.

**Bahiagrass.** Apply **Arsenal** at 4 fl ozs to 8 fl ozs per acre when Bahiagrass is dormant or after grass has initiated greenup but has not exceeded 25% greenup. Include a surfactant in the spray solution; see **Adjuvants** section for specific use directions for surfactants.

## Weeds Controlled in Unimproved Bermudagrass and Bahiagrass

Common Name	Scientific Name
Bedstraw*	<i>Galium</i> spp.
Bishopweed*	<i>Ptilimnium capillaceum</i>
Buttercup*	<i>Ranunculus parviflorus</i>
Carolina geranium	<i>Geranium carolinianum</i>
Fescue	<i>Festuca</i> spp.
Foxtail	<i>Setaria</i> spp.
Little barley	<i>Hordeum pusillum</i>
Seedling Johnsongrass	<i>Sorghum halepense</i>
White clover	<i>Trifolium repens</i>
Wild carrot	<i>Daucus carota</i>
Yellow woodsorrel	<i>Oxalis stricta</i>

\* Use not permitted in California unless otherwise directed by supplemental labeling.

## Grass Growth and Seedhead Suppression

**Arsenal** may be used to suppress growth and seedhead development of certain turfgrass in unimproved areas. When **Arsenal** is applied to desirable turf, it may result in temporary turf damage and/or discoloration. Effects to the desirable turf may vary with environmental conditions. For optimum performance, apply before culm elongation. Applications may be made before or after mowing. If applied before mowing, allow at least 3 days of active growth before mowing. If applied after mowing, allow sufficient time for grass to recover before applying this product or injury may be amplified.

**DO NOT APPLY** to turf under stress (drought, cold, insect damage, etc.) or severe injury or death may occur.

**Bermudagrass.** Apply **Arsenal** at 6 fl ozs to 8 fl ozs per acre from early greenup to before seedhead initiation.

**DO NOT** add surfactant for this application.

**Cool-season Unimproved Turf.** Apply **Arsenal** at 2 fl ozs per acre plus 0.25% nonionic surfactant. For increased suppression, **Arsenal** may be tank mixed with products such as **Embark® growth regulator** (8 fl ozs per acre). Tank mixes may increase injury to desired turf. Consult each product label for labeled turf species and other use directions and precautions. Tank mixes with 2,4-D or products containing 2,4-D may decrease the effectiveness of **Arsenal**.



## Total Vegetation Control where Bare Ground is Desired

**Arsenal® herbicide** is an effective herbicide for pre-emergence or postemergence control of many annual and perennial broadleaf and grass weeds where bare ground is desired. **Arsenal** is particularly effective on hard-to-control perennial grasses. **Arsenal** at 1.5 to 6 pints per acre can be used alone or in tank mix with herbicides approved for use in bare ground. The degree and duration of control are dependent on **Arsenal** rate used, tank mix partner, volume of carrier, soil texture, rainfall, and other conditions.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label restrictions and precautions for all products used when making an application involving tank mixes.

Applications of **Arsenal** may be made any time of the year. Use equipment calibrated to deliver desired gallons per acre spray volume and uniformly distribute the spray pattern over the treated area.

**Postemergence Application.** Always use a spray adjuvant (see **Adjuvants** section of this label) when making a postemergence application. For optimum performance on tough-to-control annual grass weeds, apply **Arsenal** at a total volume of 100 gallons per acre or less. For quicker burndown or brownout of target weeds, **Arsenal** may be tank mixed with **Roundup® herbicide**. Tank mixes with 2,4-D or products containing 2,4-D may reduce the performance of **Arsenal**. Always follow the most restrictive label restrictions and precautions for all products used when tank mixing.

**Spot Treatment.** **Arsenal** may be used as a follow-up treatment to control escapes or weed encroachment in a bareground situation. To prepare the spray solution, thoroughly mix in each gallon of water 0.5% to 5% **Arsenal** plus an adjuvant. For increased burndown, include **Roundup** as a tank mixture. For added residual weed control or to increase the weed spectrum, add **Pendulum® AquaCap™ herbicide, Overdrive® herbicide**, or diuron. Always follow the most restrictive label restrictions and precautions for all products used when tank mixing.

## Control of Undesirable Weeds under Paved Surfaces

**Arsenal** can be used under asphalt, pond liners, and other paved areas, **ONLY** in industrial sites or where the pavement has a suitable barrier along the perimeter that prevents encroachment of roots of desirable plants.

Use **Arsenal** only where the area to be treated has been prepared according to good construction practices. If rhizomes, stolons, tubers, or other vegetative plant parts are present in the site, remove them by scalping with a grader blade to a depth sufficient to ensure their complete removal.

Follow **Arsenal** applications with paving as soon as possible. **DO NOT** apply where **Arsenal** may contact the roots of desirable trees or other plants.

**Arsenal** is not to be used under pavement on residential properties, such as driveways or parking lots, or for use in recreational areas, such as under bike or jogging paths, golf cart paths, or tennis courts, or where landscape plantings could be anticipated.

Injury or death of desirable plants may result if **Arsenal** is applied where roots are present or where roots may extend into the treated area. Roots of trees and shrubs may extend a considerable distance beyond the branch extremities (drip line).

Apply to the soil surface only when final grade is established. **DO NOT** move soil following **Arsenal** application.

Apply **Arsenal** in sufficient water (at least 100 gals per acre) to ensure thorough and uniform wetting of the soil surface, including shoulder areas. Add **Arsenal** at a rate of 3 quarts per acre (2.2 fluid ounces per 1000 square feet) to clean water in the spray tank during filling operation. Agitate before spraying.

If soil is not moist before treatment, incorporation of **Arsenal** is needed for herbicide activation. Incorporate **Arsenal** into the soil to a depth of 4 to 6 inches using a rototiller or disc. Rainfall or irrigation of 1 inch will also provide uniform incorporation. **DO NOT** allow treated soil to wash or move into untreated areas.

## Spot Treatment and Crack-and-crevice Treatment

Use **Arsenal** as an initial or follow-up treatment to control weed escapes or weed encroachment in a bareground situation, including cracks and crevices in paved surfaces such as roadways, runways, and parking areas.

## Grass Pasture and Rangeland Spot Treatment Weed Control

For control of undesirable vegetation in grass pasture and rangeland, **Arsenal** may be applied as a spot treatment at a rate of 2 to 48 fluid ounces of product per treated acre using any of the described ground application methods. Spot applications to grass pasture and rangeland may not exceed more than 1/10 of the area to be grazed or cut for hay. See appropriate sections of this label for specific use directions for the application method and vegetation control desired. **DO NOT** apply more than 48 fluid ounces of **Arsenal** per acre per year.

## Grazing and Haying Restrictions

- There are no grazing restrictions following **Arsenal** application.
- **DO NOT** cut forage grass for hay for 7 days after **Arsenal** application.



## Rangeland Use Instructions

**Arsenal® herbicide** may be applied to rangeland for control of undesirable vegetation to achieve one or more of the following vegetation management objectives:

- Control of undesirable (nonnative, invasive, and noxious) plant species
- Control of undesirable vegetation to aid in the establishment of desirable rangeland plant species
- Control of undesirable vegetation to aid in the establishment of desirable rangeland vegetation following a fire
- Control of undesirable vegetation to reduce wildfire fuel
- Release of existing desirable rangeland plant communities from the competitive pressure of undesirable plant species
- Control of undesirable vegetation for wildlife habitat improvement

To ensure the protection of threatened and endangered plants when applying **Arsenal** to rangeland:

- Federal agencies must follow NEPA regulations to ensure protection of threatened and endangered plants.
- State agencies must work with the Fish and Wildlife Service or the Service's designated state conservation agency to ensure protection of threatened and endangered plants.
- Other organizations or individuals must operate under a habitat conservation plan if threatened or endangered plants are known to be present on the land to be treated.

See the appropriate section(s) of this label for specific use directions for the desired rangeland vegetation management objective.

**Arsenal** must only be applied to a given rangeland acre as specific weed problems arise. Long-term control of undesirable weed species ultimately depends on the successful use of land management practices that promote the growth and sustainability of desirable rangeland plant species.

## Rotational Crop Instructions

Rotational crops may be planted 12 months after applying **Arsenal** at the specified pasture and rangeland rate. Following 12 months after an **Arsenal** application and before planting any crop, a successful field bioassay must be completed. The field bioassay consists of a test strip of the intended rotational crop planted in the previously treated area in the grass pasture/rangeland and grown to maturity. The test strip should include low areas and knolls and include variations in soil type and pH within the treated area. If no crop injury is evident in the test strip, the intended rotational crop may be planted the following year.

Use of **Arsenal** in accordance with label directions is expected to result in normal growth of rotational crops in most situations; however, various environmental and agronomic factors make it impossible to eliminate all risks associated with the use of this product and, therefore, rotational crop injury is always possible.

## Aquatic Weed Control

**Arsenal** may be applied for control of floating and emergent undesirable vegetation (see **Aquatic Weeds Controlled** and **Terrestrial Weeds Controlled**) in or near bodies of water that may be flowing, nonflowing, or transient. **Arsenal** may be applied to aquatic sites that include lakes, rivers, streams, ponds, seeps, drainage ditches, canals, reservoirs, swamps, bogs, marshes, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites, riparian sites, and seasonal wet areas. See **Product Use and Restrictions** section of this label for restrictions and instructions on aquatic uses.

Read and observe the following directions if aquatic sites are present in nonagricultural lands and are part of the intended treatment area.

**Arsenal** must be applied to the emergent foliage of the target vegetation and has little-to-no activity on submerged aquatic vegetation. **Arsenal** concentrations resulting from direct application to water are not expected to be of sufficient concentration or duration to control target vegetation. Apply **Arsenal** to maximize spray interception by target vegetation while minimizing the amount of overspray that enters the water.

**Arsenal** does not control plants that are completely submerged or have a majority of their foliage under water.

**Arsenal** may be applied with surface or helicopter application equipment in a minimum of 2 gallons of water per acre. When applying by helicopter, follow directions under the **Aerial Application** section of this label; otherwise, refer to the **Ground Application** section when using surface equipment.

Applications to moving bodies of water should be made while traveling upstream to prevent concentration of this herbicide in water. **DO NOT** apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

When applying to target vegetation that covers a large percentage of the surface area of impounded water, treating the area in strips may avoid oxygen depletion because of decaying vegetation. Oxygen depletion may result in the suffocation of some sensitive aquatic organisms. If oxygen depletion is a concern, treat no more than 1/2 of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas.

Avoid washoff of sprayed foliage by spray boat or recreational boat backwash for 1 hour after application.

Apply **Arsenal** at 1 to 3 quarts per acre depending on species present and weed density. **DO NOT** exceed the maximum label rate of 3 quarts per acre (1.5 lbs ae/A) per year. Use the higher labeled rates for heavy weed pressure. Consult **Aquatic Weeds Controlled** and **Terrestrial Weeds Controlled** for specific rates.



**Arsenal® herbicide** may be applied as a draw-down treatment in areas described above. Apply **Arsenal** to weeds after water has been drained and allow 14 days before reintroduction of water.

## Weeds Controlled

### Aquatic Weeds Controlled

**Arsenal® herbicide** will control the following target species as specified in the **Use Rates and Application Directions** column of the table. Rates are expressed in terms of product volume for broadcast applications and as a % solution for directed applications including spot treatments. **For % solution applications, DO NOT apply more than the equivalent of 3 quarts of Arsenal per acre.**

Common Name	Scientific Name	Use Rates and Application Directions
<b>Floating Weeds</b>		
*Floating heart	<i>Nymphodes</i> spp.	2 to 4 pints/A (0.5 to 1.0% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Frogbit	<i>Limnobium spongia</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Spatterdock	<i>Nuphar luteum</i>	Apply a tank mix of: 2 to 4 pints/A <b>Arsenal</b> + 4 to 6 pints/A glyphosate (0.5% <b>Arsenal</b> + 1.5% glyphosate) in 100 GPA water for best control. Ensure 100% coverage of actively growing emergent foliage.
*Water hyacinth	<i>Eichhornia crassipes</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water to actively growing foliage.
*Water lettuce	<i>Pistia stratiotes</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
<b>Emerged Weeds</b>		
*Alligatorweed	<i>Alternanthera philoxeroides</i>	1 to 4 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Arrowhead, duck-potato	<i>Sagittaria</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Bacopa, lemon	<i>Bacopa</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Parrot feather	<i>Myriophyllum aquaticum</i>	Foliage must be above water for sufficient <b>Arsenal</b> uptake. Apply 2 to 4 pints/A <b>Arsenal</b> to actively growing emergent foliage.
*Pennywort	<i>Hydrocotyle</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Pickerelweed	<i>Pontederia cordata</i>	2 to 3 pints/A (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Taro, wild Coco yam Dasheen Elephant's ear	<i>Colocasia esculentum</i>	4 to 6 pints/A (1.5% solution) applied in 100 GPA with a high quality sticker adjuvant. Ensure good coverage of actively growing emergent foliage.

\* Use not permitted in California unless otherwise directed by supplemental labeling.

(continued)



## Aquatic Weeds Controlled *(continued)*

Common Name	Scientific Name	Use Rates and Application Directions
<b>Emerged Weeds</b> <i>(continued)</i>		
*Water chestnut	<i>Trappa natans</i>	4 to 6 pints/A (1.5% solution) applied in 100 GPA with a high quality sticker adjuvant. Ensure good coverage of actively growing emergent foliage.
*Water lily	<i>Nymphaea odorata</i>	2 to 3 pints/A (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Water primrose	<i>Ludwigia uruguayensis</i>	4 to 6 pints/A (1.5% solution). Ensure 100% coverage of actively growing emergent foliage.
<b>Terrestrial/Marginal Weeds</b>		
*Aquatic nightshade Soda apple	<i>Solanum tampicense</i>	2 pints/A applied to foliage
*Bamboo, Japanese	<i>Phyllostachys</i> spp.	3 to 4 pints/A applied to foliage when plant is actively growing; before setting seedhead. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Beach, vitex	<i>Vitex rotundifolia</i>	5% solution + 1% MSO foliar spray 17% solution stem injection (hack and squirt)
Brazilian pepper Christmasberry	<i>Schinus terebinthifolius</i>	2 to 4 pints/A applied to foliage
Cattail	<i>Typha</i> spp.	2 to 4 pints/A (1% solution) applied to actively growing green foliage after full leaf elongation. Lower rates will control cattail in the North; higher rates are needed in the South.
Chinese tallow tree	<i>Sapium sebiferum</i>	16 to 24 fl ozs/A applied to foliage
Cogongrass	<i>Imperata cylindrica</i>	Burn foliage, till area; then fall-spray 2 quarts/A <b>Arsenal® herbicide</b> + MSO applied to new growth.
Cordgrass, prairie	<i>Spartina</i> spp.	4 to 6 pints/A applied to actively growing foliage
*Cutgrass	<i>Zizaniopsis miliacea</i>	4 to 6 pints/A applied to actively growing foliage
*Elephant grass Napier grass	<i>Pennisetum purpureum</i>	3 pints/A applied to actively growing foliage
*Flowering rush	<i>Butomus umbellatus</i> L.	2 to 3 pints/A applied to actively growing foliage
Giant reed Wild cane	<i>Arundo donax</i>	4 to 6 pints/A applied in spring to actively growing foliage
*Golden bamboo	<i>Phyllostachys aurea</i>	3 to 4 pints/A applied to foliage when plant is actively growing; before setting seedhead. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Junglerice	<i>Echinochloa colonum</i>	3 to 4 pints/A applied to actively growing foliage
Knapweed	<i>Centaurea</i> spp.	<b>Russian knapweed:</b> 2 to 3 pints/A + 1 quart/A MSO fall-applied after senescence begins
Knotweed, Japanese	<i>Polygonum cuspidatum</i> <i>Fallopia japonica</i>	3 to 4 pints/A applied postemergence to actively growing foliage

\* Use not permitted in California unless otherwise directed by supplemental labeling.

*(continued)*

## Aquatic Weeds Controlled (continued)

Common Name	Scientific Name	Use Rates and Application Directions
<b>Terrestrial/Marginal Weeds</b> <small>(continued)</small>		
Melaleuca Paperbark tree	<i>Melaleuca quinquenervia</i>	<ul style="list-style-type: none"> <li>• <b>Established stands</b> - Apply 6 pints/A <b>Arsenal</b><sup>®</sup> herbicide + 6 pints/A glyphosate + spray adjuvant. For best results, use 4 quarts/A MSO as an adjuvant.</li> <li>• <b>Ground foliar application</b> - Uniformly apply to ensure 100% coverage.</li> <li>• <b>Broadcast foliar control</b> - Apply aerially in a minimum of 2 passes at 10 gallons/A applied cross treatment.</li> <li>• <b>Spot treatment</b> - Use a 25% <b>Arsenal</b> + 25% solution of glyphosate + 1.25% MSO in water applied as a frill or stump treatment.</li> </ul>
*Nutmeg Kili'p'opu	<i>Cyperus rotundus</i>	2 pints/A <b>Arsenal</b> + 1 quart/A MSO applied early postemergence
*Nutsedge	<i>Cyperus</i> spp.	2 to 3 pints/A postemergence to foliage or preemergence incorporated; nonincorporated preemergence applications will not control.
Phragmites Common reed	<i>Phragmites australis</i>	4 to 6 pints/A applied to actively growing green foliage after full leaf elongation. Ensure 100% coverage. If stand has a substantial amount of old stem tissue, mow or burn; allow to regrow to approximately 5 feet tall before treatment. Lower rates will control phragmites in the North; higher rates are needed in the South.
*Poison hemlock	<i>Conium maculatum</i>	2 pints/A <b>Arsenal</b> + 1 quart/A MSO applied preemergence to early postemergence to rosette before flowering
Purple loosestrife	<i>Lythrum salicaria</i>	1 pint/A applied to actively growing foliage
Reed canarygrass	<i>Phalaris arundinacea</i>	3 to 4 pints/A applied to actively growing foliage
Rose, swamp	<i>Rosa palustris</i>	2 to 3 pints/A applied to actively growing foliage
Russian olive	<i>Elaeagnus angustifolia</i>	2 to 4 pints/A (1% solution) applied to foliage
Saltcedar Tamarisk	<i>Tamarix</i> spp.	<b>Aerial application</b> - 2 quarts <b>Arsenal</b> + 0.25% v/v NIS applied to actively growing foliage during flowering. <b>Spot treatment</b> - Use 1% solution of <b>Arsenal</b> + 0.25% v/v NIS and spray to wet foliage. After application, wait at least 2 years before disturbing treated saltcedar. Earlier disturbance can reduce overall control.
Smartweed	<i>Polygonum</i> spp.	2 pints/A applied early postemergence
Sumac	<i>Rhus</i> spp.	2 to 3 pints/A applied to foliage
Swamp morningglory Kangkong Water spinach	<i>Ipomoea aquatica</i>	1 to 2 pints/A <b>Arsenal</b> + 1 quart/A MSO applied early postemergence
Torpedo grass	<i>Panicum repens</i>	4 pints/A (1.0 to 1.5% solution). Ensure good coverage to actively growing foliage.
*White top Hoary cress	<i>Cardaria draba</i>	1 to 2 pints/A applied in spring to foliage during flowering
Willow	<i>Salix</i> spp.	2 to 3 pints/A <b>Arsenal</b> applied to actively growing foliage. Ensure good coverage.

\* Use not permitted in California unless otherwise directed by supplemental labeling.



## Terrestrial Weed Control

In terrestrial sites, **Arsenal® herbicide** will provide pre-emergence or postemergence control with residual control of the following target vegetation species at the rates listed. Residual control refers to control of newly germinating seedlings in both annuals and perennials. In general, annual weeds may be controlled by preemergence or postemergence applications of **Arsenal**. For established biennials and perennials, postemergence applications of **Arsenal** will provide the best control.

The rates shown below refer to broadcast applications and indicate the relative sensitivity of these weeds. The relative sensitivity should be referenced when preparing low-volume spray solutions (see **Low-volume Foliar Application** section of **Ground Application**); low-volume applications may provide control of the target species with less **Arsenal** per acre than is shown for the broadcast treatments. Use **Arsenal** only in accordance with the specific use directions on this label and the leaflet label.

Use the relative sensitivity of the species listed following to determine the relative risk of nontarget plant injury if any of the species listed following are considered to be desirable within the area to be treated.

**Resistant Biotypes.** Naturally occurring biotypes (a plant within a given species that has a slightly different but distinct genetic makeup from other plants of the same species) of some weeds listed on this label may not be effectively controlled. If naturally occurring resistant biotypes are present in an area, tank mix **Arsenal** or apply sequentially with an appropriate registered herbicide having a different mode of action to ensure control.

## Terrestrial Weeds Controlled

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Grass Weeds</b>		
<b>Apply 2 to 3 pts/A<sup>1</sup></b>		
Annual bluegrass	<i>Poa annua</i>	A
Broadleaf signalgrass	<i>Brachiaria platyphylla</i>	A
Canada bluegrass	<i>Poa compressa</i>	P
Downy brome	<i>Bromus tectorum</i>	A
Fescue	<i>Festuca</i> spp.	A/P
Foxtail	<i>Setaria</i> spp.	A
Italian ryegrass	<i>Lolium multiflorum</i>	A
Johnsongrass <sup>4</sup>	<i>Sorghum halepense</i>	P
Kentucky bluegrass	<i>Poa pratensis</i>	P
Napier grass <sup>5</sup>	<i>Pennisetum purpureum</i>	P
Orchardgrass	<i>Dactylis glomerata</i>	P
Paragrass	<i>Brachiaria mutica</i>	P
Quackgrass	<i>Agropyron repens</i>	P

(continued)

## Terrestrial Weeds Controlled (continued)

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Grass Weeds (continued)</b>		
<b>Apply 2 to 3 pts/A<sup>1</sup> (continued)</b>		
Sandbur	<i>Cenchrus</i> spp.	A
Smooth brome	<i>Bromus inermis</i>	P
Vaseygrass	<i>Paspalum urvillei</i>	P
Wild oats	<i>Avena fatua</i>	A
Witchgrass	<i>Panicum capillare</i>	A
<b>Apply 3 to 4 pts/A<sup>1</sup></b>		
Barnyardgrass	<i>Echinochloa crus-galli</i>	A
Beardgrass	<i>Andropogon</i> spp.	P
Bluegrass, annual	<i>Poa annua</i>	A
Bulrush <sup>5</sup>	<i>Scirpus validus</i>	P
Cheat	<i>Bromus secalinus</i>	A
Cogongrass	<i>Imperata cylindrica</i>	P
Crabgrass	<i>Digitaria</i> spp.	A
Crowfootgrass	<i>Dactyloctenium aegyptium</i>	A
Fall panicum	<i>Panicum dichotomiflorum</i>	A
Goosegrass	<i>Eleusine indica</i>	A
Itchgrass	<i>Rottboellia exaltata</i>	A
Lovegrass <sup>4</sup>	<i>Eragrostis</i> spp.	P
Maidencane <sup>5</sup>	<i>Panicum hemitomom</i>	A
Panicum, browntop	<i>Panicum fasciculatum</i>	A
Panicum, Texas	<i>Panicum texanum</i>	A
Prairie threeawn	<i>Aristida oligantha</i>	P
Sandbur, field	<i>Cenchrus incertus</i>	A
Signalgrass	<i>Brachiaria platyphylla</i>	A
Wild barley	<i>Hordeum</i> spp.	A
Woolly cupgrass	<i>Eriochloa villosa</i>	A
<b>Apply 4 to 6 pts/A<sup>1</sup></b>		
Bahiagrass	<i>Paspalum notatum</i>	P
Bermudagrass <sup>3,4</sup>	<i>Cynodon dactylon</i>	P
Big bluestem	<i>Andropogon gerardii</i>	P
Dallisgrass	<i>Paspalum dilatatum</i>	P
Feathertop	<i>Pennisetum villosum</i>	P
Guineagrass	<i>Panicum maximum</i>	P
Saltgrass <sup>3</sup>	<i>Distichlis stricta</i>	P
Sand dropseed	<i>Sporobolus cryptandrus</i>	P
Sprangletop	<i>Leptochloa</i> spp.	A
Timothy	<i>Phleum pratense</i>	P
Wirestem muhly	<i>Muhlenbergia frondosa</i>	P

<sup>1</sup> Use higher rate where heavy or well-established infestations occur.

<sup>2</sup> Growth Habit: A = Annual, B = Biennial, P = Perennial

<sup>3</sup> Use a minimum of 75 GPA.

<sup>4</sup> Use higher labeled rates.

<sup>5</sup> Use not permitted in California unless otherwise directed by supplemental labeling.



## Terrestrial Weeds Controlled *(continued)*

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Broadleaf Weeds</b>		
<b>Apply 2 to 3 pts/A<sup>1</sup></b>		
Burdock	<i>Arctium</i> spp.	B
Carolina geranium	<i>Geranium carolinianum</i>	A
Carpetweed	<i>Mollugo verticillata</i>	A
Clover	<i>Trifolium</i> spp.	A/P
Common chickweed	<i>Stellaria media</i>	A
Common ragweed	<i>Ambrosia artemisiifolia</i>	A
Dandelion	<i>Taraxacum officinale</i>	P
Dogfennel	<i>Eupatorium capillifolium</i>	A
Filaree	<i>Erodium</i> spp.	A
Fleabane	<i>Erigeron</i> spp.	A
Hoary vervain	<i>Verbena stricta</i>	P
Indian mustard	<i>Brassica juncea</i>	A
Kochia	<i>Kochia scoparia</i>	A
Lambsquarters	<i>Chenopodium album</i>	A
Lespedeza <sup>3</sup>	<i>Lespedeza</i> spp.	P
Miner's lettuce	<i>Montia perfoliata</i>	A
Mullein	<i>Verbascum</i> spp.	B
Nettleleaf goosefoot	<i>Chenopodium murale</i>	A
Oxeye daisy	<i>Chrysanthemum leucanthemum</i>	P
Pepperweed	<i>Lepidium</i> spp.	A
Pigweed	<i>Amaranthus</i> spp.	A
Puncturevine	<i>Tribulus terrestris</i>	A
Russian thistle	<i>Salsola kali</i>	A
Smartweed	<i>Polygonum</i> spp.	A/P
Sorrell	<i>Rumex</i> spp.	P
Sunflower	<i>Helianthus</i> spp.	A
Sweet clover	<i>Melilotus</i> spp.	A/B
Tansymustard	<i>Descurainia pinnata</i>	A
Western ragweed	<i>Ambrosia psilostachya</i>	P
Wild carrot	<i>Daucus carota</i>	B
Wild lettuce	<i>Lactuca</i> spp.	A/B
Wild parsnip	<i>Pastinaca sativa</i>	B
Wild turnip	<i>Brassica campestris</i>	B
Woollyleaf bursage	<i>Franseria tomentosa</i>	P
Yellow woodsorrel	<i>Oxalis stricta</i>	P

*(continued)*

## Terrestrial Weeds Controlled *(continued)*

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Broadleaf Weeds <i>(continued)</i></b>		
<b>Apply 3 to 4 pts/A<sup>1</sup></b>		
Broom snakeweed <sup>4</sup>	<i>Gutierrezia sarothrae</i>	P
Bull thistle	<i>Cirsium vulgare</i>	B
Burclover	<i>Medicago</i> spp.	A
Chickweed, mouseear	<i>Cerastium vulgatum</i>	A
Clover, hop	<i>Trifolium procumbens</i>	A
Cocklebur	<i>Xanthium strumarium</i>	A
Cudweed	<i>Gnaphalium</i> spp.	A
Desert camelthorn	<i>Alhagi pseudalhagi</i>	P
Dock	<i>Rumex</i> spp.	P
Fiddleneck	<i>Amsinckia intermedia</i>	A
Goldenrod	<i>Solidago</i> spp.	P
Henbit	<i>Lamium amplexicaule</i>	A
Knotweed, prostrate	<i>Polygonum aviculare</i>	A/P
Pokeweed	<i>Phytolacca americana</i>	P
Purslane	<i>Portulaca</i> spp.	A
Pusley, Florida	<i>Richardia scabra</i>	A
Rocket, London	<i>Sisymbrium irio</i>	A
Rush skeletonweed <sup>4</sup>	<i>Chondrilla juncea</i>	B
Saltbush	<i>Atriplex</i> spp.	A
Shepherdspurse	<i>Capsella bursa-pastoris</i>	A
Spurge, annual	<i>Euphorbia</i> spp.	A
Stinging nettle <sup>4</sup>	<i>Urtica dioica</i>	P
Velvetleaf	<i>Abutilon theophrasti</i>	A
Yellow starthistle	<i>Centaurea solstitialis</i>	A
<b>Apply 4 to 6 pts/A<sup>1</sup></b>		
Arrowwood	<i>Pluchea sericea</i>	A
Canada thistle	<i>Cirsium arvense</i>	P
Giant ragweed	<i>Ambrosia trifida</i>	A
Gray rabbitbrush	<i>Chrysothamnus nauseosus</i>	P
Little mallow	<i>Malva parviflora</i>	B
Milkweed	<i>Asclepias</i> spp.	P
Primrose	<i>Oenothera kunthiana</i>	P
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	P
Sowthistle	<i>Sonchus</i> spp.	A
Texas thistle	<i>Cirsium texanum</i>	P

<sup>1</sup> Use higher rate where heavy or well-established infestations occur.

<sup>2</sup> Growth Habit: A = Annual, B = Biennial, P = Perennial

<sup>3</sup> Use not permitted in California unless otherwise directed by supplemental labeling.

<sup>4</sup> For best results, early postemergence applications are required.



## Terrestrial Weeds Controlled (continued)

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Vines and Brambles</b>		
<b>Apply 1 pt/A</b>		
Field bindweed	<i>Convolvulus arvensis</i>	P
Hedge bindweed	<i>Calystegia sepium</i>	A
<b>Apply 2 to 3 pts/A<sup>1</sup></b>		
Wild buckwheat	<i>Polygonum convolvulus</i>	P
<b>Apply 3 to 4 pts/A<sup>1</sup></b>		
Greenbriar	<i>Smilax</i> spp.	P
Honeysuckle <sup>3</sup>	<i>Lonicera</i> spp.	P
Morningglory	<i>Ipomoea</i> spp.	A/P
Poison ivy	<i>Rhus radicans</i>	P
Redvine	<i>Brunnichia cirrhosa</i>	P
Wild rose <sup>3</sup>	<i>Rosa</i> spp.	P
including:		
Multiflora rose	<i>Rosa multiflora</i>	P
Macartney rose	<i>Rosa bracteata</i>	P

<b>Apply 4 to 6 pts/A<sup>1</sup></b>		
Trumpet creeper	<i>Campsis radicans</i>	P
Virginia creeper	<i>Parthenocissus quinquefolia</i>	P
Wild grape	<i>Vitis</i> spp.	P

<sup>1</sup> Use higher rate where heavy or well-established infestations occur.

<sup>2</sup> Growth Habit: A = Annual, B = Biennial, P = Perennial

<sup>3</sup> Use higher labeled rates.

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Brush Species</b>		
<b>Apply 2 to 4 pts/A<sup>1</sup></b>		
Brazilian peppertree	<i>Schinus terebinthifolius</i>	P
Chinese tallow tree	<i>Sapium sebiferum</i>	P
Popcorn tree		
Russian olive	<i>Elaeagnus angustifolia</i>	P
Sumac	<i>Rhus</i> spp.	P
Willow	<i>Salix</i> spp.	P

<b>Apply 4 to 6 pts/A<sup>1</sup></b>		
Alder	<i>Alnus</i> spp.	P
American beech	<i>Fagus grandifolia</i>	P
Ash <sup>3</sup>	<i>Fraxinus</i> spp.	P
Aspen	<i>Populus</i> spp.	P
Autumn olive	<i>Elaeagnus umbellata</i>	P
Bald cypress	<i>Taxodium distichum</i>	P
Bigleaf maple	<i>Acer macrophyllum</i>	P
Birch <sup>3</sup>	<i>Betula</i> spp.	P
Black gum <sup>4</sup>	<i>Nyssa sylvatica</i>	P
Black oak	<i>Quercus kelloggii</i>	P
Boxelder	<i>Acer negundo</i>	P
Ceanothis	<i>Ceanothis</i> spp.	P
Cherry <sup>3, 4</sup>	<i>Prunus</i> spp.	P

(continued)

## Terrestrial Weeds Controlled (continued)

Common Name	Scientific Name	Growth Habit <sup>2</sup>
<b>Brush Species <small>(continued)</small></b>		
<b>Apply 4 to 6 pts/A<sup>1</sup></b>		
Chinaberry	<i>Melia azedarach</i>	P
Chinquapin	<i>Castanopsis chrysophylla</i>	P
Cottonwood	<i>Populus trichocarpa</i>	
	<i>P. deltoides</i>	P
Cypress	<i>Taxodium</i> spp.	P
Dogwood <sup>3</sup>	<i>Cornus</i> spp.	P
Elm <sup>5</sup>	<i>Ulmus</i> spp.	P
Eucalyptus	<i>Eucalyptus</i> spp.	P
Hawthorn	<i>Crataegus</i> spp.	P
Hickory <sup>3</sup>	<i>Carya</i> spp.	P
Huckleberry	<i>Gaylussacia</i> spp.	P
Lyonia spp.		
including:		
Fetterbush	<i>Lyonia lucida</i>	
Staggerbush	<i>Lyonia mariana</i>	P
Madrone	<i>Arbutus menziesii</i>	P
Maple	<i>Acer</i> spp.	P
Melaleuca	<i>Melaleuca quinquenervia</i>	P
Mulberry <sup>3, 6</sup>	<i>Morus</i> spp.	P
Oak <sup>7</sup>	<i>Quercus</i> spp.	P
Persimmon <sup>4</sup>	<i>Diospyros virginiana</i>	P
Poison oak	<i>Rhus diversiloba</i>	P
Poplar	<i>Populus</i> spp.	P
Privet	<i>Ligustrum vulgare</i>	P
Red alder	<i>Alnus rubra</i>	P
Red maple	<i>Acer rubrum</i>	P
Saltcedar	<i>Tamarix pentandra</i>	P
Sassafras	<i>Sassafras albidum</i>	P
Sourwood <sup>4</sup>	<i>Oxydendrum arboreum</i>	P
Sweetgum	<i>Liquidambar styraciflua</i>	P
Sycamore	<i>Platanus occidentalis</i>	P
Tanoak <sup>3</sup>	<i>Lithocarpus densiflorus</i>	P
Titi <sup>8</sup>	<i>Cyrilla racemiflora</i>	P
Tree of heaven	<i>Ailanthus altissima</i>	P

Vaccinium spp.

including:

Blueberry	<i>Vaccinium</i> spp.	
Sparkleberry	<i>Vaccinium arboreum</i>	P
Water willow <sup>9</sup>	<i>Justicia americana</i>	P
Yellow poplar <sup>3</sup>	<i>Liriodendron tulipifera</i>	P

<sup>1</sup> Use higher rate where heavy or well-established infestations occur.

<sup>2</sup> Growth Habit: A = Annual, B = Biennial, P = Perennial

<sup>3</sup> Use higher labeled rates.

<sup>4</sup> Best control with applications before formation of fall leaf color

<sup>5</sup> Tank mix with glyphosate

<sup>6</sup> Degree of control may be species dependent.

<sup>7</sup> For water oak (*Quercus nigra*), laurel oak (*Q. laurifolia*), willow oak (*Q. phellos*), and live oak (*Q. virginiana*), use higher labeled rates.

<sup>8</sup> Suppression only

<sup>9</sup> Use not permitted in California unless otherwise directed by supplemental labeling.

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