

# Field Guide for Managing Yellow Starthistle in the Southwest



## Cover Photos

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# Yellow starthistle (*Centaurea solstitialis* L.)

Sunflower family (Asteraceae)

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Yellow starthistle is an invasive plant that has been listed as a noxious weed in Arizona and New Mexico. This field guide serves as the U.S. Forest Service's recommendations for management of yellow starthistle in forests, woodlands, rangelands, and deserts associated with its Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also includes four national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

## Description

Yellow starthistle (synonyms: golden starthistle, St. Barnaby's thistle, yellow cockspur) is an early maturing winter annual. Native to Eurasia, it was introduced into North America as a seed contaminant in the mid-1850s and has persistently spread across the western United States. It is found in foothill regions of southwestern New Mexico and elsewhere in deserts, uplands, rangelands, and mountainous areas of the Southwest. Yellow starthistle is similar in appearance to two closely related species: *C. melitensis* (Malta starthistle) and *C. sulphurea* (Sicilian starthistle).

## Growth Characteristics

- Grey-green to blue-green, herbaceous plant covered in fine, white cottony hairs.
- Winter annual and occasional biennial; germinates fall to spring.
- Stout, rapidly growing, vigorous taproot; may grow deeper than 36 inches.
- Rosette in fall/winter; deeply lobed leaves appear ruffled; fine, cottony hairs.
- Bolts May to June; stiff, openly-branched stems; 6 to 60 inches tall; large stem wings.
- Leaves alternate, linear to oblanceolate; margins smooth, toothed, or wavy.

- Buds with spiny bracts form in June or July; each bract has a central spine up to 2 inches long with 2 to 3 pairs of lateral spines.
- Flowers May to December; yellow flowers borne at tips or in axils of winged stems.
- Reproduces solely via seed; two types of smooth seed—one type is lighter in color with a pappus of barbed bristles, the other is darker without a pappus.
- Leaves and stem become straw colored as seeds form; flower head becomes straw colored when seeds are mature; seeds are viable for up to 10 years.

## Ecology

### Impacts/threats

Yellow starthistle is highly competitive and often develops dense, impenetrable stands that lower the diversity of desirable flora and fauna species. The presence of sharp long spines on seed heads of yellow starthistle degrades livestock grazing, wildlife habitat, and recreational opportunities. When forced to graze mature yellow starthistle, livestock (especially horses) can be affected by an incurable neurological disorder known as "chewing disease." A neurotoxic sesquiterpene lactone in starthistles called repin is believed to be the underlying cause of the disorder. However, animals in general typically avoid the weed because of the sharp spines and hairs.

### Location

Yellow starthistle prefers well-drained soils, hot dry summers, and 10 to 60 inches of precipitation. It occurs in open woodlands, desert scrub, chaparral, rangeland, pastures, waste areas, cropland, and roadsides that generally lie below 7,500 feet in elevation. It is commonly found around residential subdivisions, agricultural land, and recreation areas throughout the Western States.

### Spread

When unassisted, yellow starthistle seed rarely moves far from the parent plant. However, seed easily attaches to fur,

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hair, or clothing; and it can be transported over far distances by adhering to tires and undercarriages of road vehicles and equipment. Yellow starthistle seed may also be introduced into new areas through transported hay that is not certified to be weed free.

### ***Invasive Features***

Yellow starthistle is a prolific seed producer and within dense stands can produce 50 to 100 million seeds per acre. It is highly adaptable to environmental variation and grows rapidly. This allows yellow starthistle to out-compete native plant species for sunlight, space, water, and nutrients. Other features that facilitate invasiveness include a deep taproot that accesses available soil moisture, winged stems that dissipate heat, and formidable spines at maturity that deter grazing by livestock or wildlife.

## **Management**

In many cases, 3 or more years of intensive management may be necessary to significantly reduce a yellow starthistle population. Early detection and eradication soon after discovery will increase the possibility for control of a starthistle population. A high priority should be treatment of small or sporadic infestations on otherwise healthy sites, which can then be shifted to larger infestations. The following actions should be considered when planning a management approach to control starthistle:

- Maintain healthy plant communities to suppress or limit the impact of a starthistle infestation.
- Incorporate sound grazing management with any control strategy.
- Map known infestations and keep annual records of reported infestations.
- Combine mechanical, cultural, biological, and chemical methods to control yellow starthistle populations whenever possible.
- Include monitoring and a followup treatment plan for missed plants and seedlings.

Table 1 summarizes management options for controlling yellow starthistle under various situations. Choice of individual control method(s) for starthistle depends on many local factors including degree of infestation, current land use, and site conditions (terrain, accessibility for treatment, microclimate, nontarget flora and fauna present, etc.). Other important considerations include treatment effectiveness, overall cost, and the number of years needed to achieve control. Typically, more than one control method may be needed for a particular site.

### **Physical Control**

Yellow starthistle reproduces solely by seed, so physical methods should focus on reducing seed production and preventing seed germination. These methods usually have to be repeated and must be timed properly to be most effective.

#### ***Manual Methods***

Hand pulling or hoeing are most effective in a maintenance program for an area where yellow starthistle is relatively sparse. Take care to remove as much of the taproot as possible. Anticipate that hand removal will need to be repeated in about 2 weeks to remove missed plants or those maturing at a later time. Care should be taken to minimize soil disturbance and to properly dispose of plant debris by bagging and/or burning.

#### ***Mechanical Methods***

In suitable terrain, tillage in early summer with a plow or disc that is repeated at a later time (about 4 to 6 weeks) can effectively bury yellow starthistle plant parts. A harrow, knife, or drag pulled behind a tractor can be used to cut and separate shoots from roots of larger mature plants. These methods are most commonly used in agronomic or roadside settings and should only be used when the soil surface is dry since fragmented plant segments in moist soils will regrow and possibly magnify the problem.

Mowing is a commonly used control technique for yellow starthistle along roadsides and in recreational areas. Although it can be a cost-effective method for starthistle control, mowing is not feasible in many locations due to

**Table 1. Management Options\***

Site	Physical Methods	Cultural Methods	Biological Methods	Chemical Methods
Roadsides	Use repeated, shallow cultivation and/or mowing throughout germination and growing periods.	Educate road crews to identify and report infestations along roads; implement requirements for vehicle operations in infested areas.  Gravel and other road materials transported into uninfested areas should be weed free.	Consider using weevils or rust fungus as biological control agents (see table 2). Effectiveness of agents may be limited due to possible disturbances in agent life cycles from roadside operations.	Use truck spraying equipment to apply herbicide during early growth. Clean equipment to prevent spread.
Rangelands	Use repeated, shallow cultivation and/or mowing throughout germination and growing periods.  If feasible, combine prescribed fire with herbicide spraying.	Use certified weed-free hay and seed.  After passing through infested areas inspect and remove any seed from animals, clothing, and vehicles before entering treated or uninfested areas.	Use prescribed grazing during spring with an intense, short-duration approach in combination with other control methods. Closely manage grazing to prevent overuse.  Consider using weevils or rust fungus as biological control agents (see table 2).	For extensive and dense infestations, use ground or aerial broadcast spraying.  For less dense infestations, consider ATV or backpack spraying. Clean ground equipment to prevent spread.
Wilderness and other natural areas	Hand methods can be used by starting at the edges of an infestation and working toward the center. Pull before plant reaches full bloom.	Use certified weed-free hay and seed.  After passing through infested areas inspect and remove any seed from animals, clothing, and vehicles before entering treated or uninfested areas.  Post signs warning visitors to inspect for and remove seeds.	Same as above.	Use backpack or hand-held sprayers. Broadcast spraying by aerial or ground methods may be used on thicker stands, if allowed. Clean ground equipment to prevent spread.

\* Choice of a particular management option must be in compliance with existing regulations for land resource.

rocks and steep terrain. Some vegetation experts do not recommend mowing since plants not cut close to the surface often produce side branches that can form additional flowers, even with repeated mowing and proper timing. Despite its limitations, mowing over a 3-year period has been reported to provide over 90 percent control when two timely, repeated mowings are made per year. Since timing is critical, best results occur when mowing is completed in the early flowering stage before viable seed production; i.e., when no more than 2 to 5 percent of the spiny heads are in bloom. After mowing, no leaves should be left below the level of the cut.

### **Prescribed Fire**

Burning from January to May can eliminate yellow starthistle in the seedling, rosette, and early bolting stages. However, burning during this time is often limited since there generally is insufficient fine, dry fuel available to carry the intense, uniform fire required for starthistle control. Yellow starthistle may also be burned in early to mid-summer (late May to early July) during the early flower stage. Despite its effectiveness in selected situations, there are risks associated with prescribed burning which should be assessed in a management plan using prescribed burning. Research currently underway is investigating fire in combination with herbicide control, but results are not available at this time.



## Cultural Control

Educational programs focused on the biology and identification of nonnative weed species should be encouraged with local land managers and others to help find, report, and monitor suspected infestations. Vehicles, humans, and livestock should be discouraged from traveling through infested areas; and a program to check and remove seed from vehicles and livestock should be implemented to help stop dispersal. Hay, straw mulch, planting seeds, and other similar materials should be certified to be weed free before use in unaffected areas or areas previously treated for starthistle. Gravel and other road materials transported into uninfested areas should also be weed free.

## Biological Control

### Grazing

In California, properly timed spring grazing with cattle, goats, or sheep has been shown to reduce yellow starthistle's growth, canopy cover, survivability, and reproductive capacity. This approach is based on intensive livestock grazing of yellow starthistle after stems on rosettes have begun to bolt but before spiny seed heads develop. Cattle and sheep tend to avoid starthistle once the buds produce spines, whereas goats continue to browse plants even during the flowering stage. For this reason, goats have become more popular for controlling yellow starthistle in relatively small infestations. Although grazing can reduce the presence of starthistle, owners of horses and other livestock should

ensure that suitable alternative forage is available. Owners should also look for signs of toxicity or so-called "chewing disease" in starthistle stands that have flowering heads.

Prescribed grazing with an intensive, short-duration approach can be part of an effective control strategy to manage yellow starthistle, especially when combined with other control methods (see the "Control Strategies" section for more information). A system using short periods of intense livestock grazing has been widely adopted in other countries for starthistle control. In this system, infested pastures are intensively grazed for 3 to 5 days, often with the use of electric fencing. After livestock have been moved to another part of the pasture, the grazed area is allowed to recover for at least a month before grazing is repeated. The system typically results in more uniform and complete forage utilization. In addition, desirable forage is not completely grazed and recovers rapidly. Ultimately, this can increase forage production and stocking capacity on a seasonal basis.

### Classical Biological Control

Several classical biological control agents have been released in California for control of yellow starthistle, but experience with these agents in New Mexico and Arizona is limited. Candidate biological agents listed in table 2 have been found to establish well in the western United States and contribute significantly to reduced seed production.

**Table 2. Classical biological control agents**

Species	Type of Agent	Site of Attack	Impact on Host	Use/Considerations for Release
<i>Chaetorellia succinea</i>	beetle/weevil	Larvae develop within the flower head and feed on seed.	When used in combination, these two biocontrol agents can reduce seed by 43–76 percent.	Accidental release.
<i>Eustenopus villosa</i>	beetle/weevil	Same as above		Introduced in 1990; established in California, Oregon, Washington, Idaho.
<i>Puccinia juncea</i> var. <i>solstitialis</i>	rust fungus	leaves and stem	Stress caused by agent reduces production of flower heads and seed.	Released in 2003

For further information on biological control of yellow starthistle, see Wilson et al. (2003) in the “References and Further Information” section of this field guide.

Agents used for biological control in southwestern states should be adaptable to arid environments and local conditions. Public, tribal, and private land managers may obtain biological control agents for release directly from local offices of the USDA Animal and Plant Health Inspection Service (APHIS) when the agents are available. Other sources for biocontrol agents include private companies or locally developed insectaries. A permit must be obtained from APHIS before biological control agents can be transported across state boundaries. Regulations and permit applications (PPQ 526 permit forms) pertaining to interstate shipment of biological control agents can be found at <http://www.aphis.usda.gov/ppq/permits/>. Although biological control agents may be collected and released within a given state without a permit from APHIS, the state’s Department of Agriculture or Agricultural Extension

Service should be consulted for any regulations relating to movement of these agents inside the state.

## Chemical Control

The most effective time to spray yellow starthistle is usually late autumn to early spring during the seedling to rosette stage. Spraying is also effective later in spring when plants have 4 to 6 inches of growth and good growing conditions exist. Since yellow starthistle is an annual, starthistle should not be sprayed during or after flowering as these treatments will be ineffective. Yellow starthistle establishment is closely tied to rainfall events, which can complicate herbicide spraying. New plants can be produced throughout the year, and propagation from year to year can be highly variable. Therefore, infested areas should be checked closely for seedling abundance before deciding to spray.

Yellow starthistle is best controlled with a selective, postemergent broadleaf herbicide since these chemicals have little or no effect on grass species. The main herbicide

**Table 3. Herbicide recommendations**

Common Chemical Name (active ingredient)	Product Example <sup>1</sup>	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example <sup>2</sup>	Time of Application	Remarks
Clopyralid	Reclaim, Stinger, Transline	0.25–0.67 pints	1–3%	Fall to early spring during early rosette stage.	Selective broadleaf herbicide. Most perennial grasses are tolerant; residual.
Clopyralid + 2,4-D <sup>3</sup>	Curtail	0.25–1 pint	1–3%	After most rosettes have emerged, but before buds form.	Same as above.
Aminocyclopyrachlor + chlorsulfuron	Perspective	3–4.5 ounces	Consult label for spot applications.	Lower rate for rosette; higher rate at bolting. Fall or spring.	Selective herbicide used on noncrop sites; may cause temporary injury to some grass species.
Aminocyclopyrachlor + metsulfuron methyl	Streamline	4.75–9.5 ounces	Same as above.	Same as above.	Same as above.
Aminopyralid	Milestone	3–5 ounces	3–5%	Rosette through bolting stage.	Labeled for use in natural areas such as wildlife management areas. No grazing restrictions.

**Table 3. Herbicide recommendations (continued)**

<b>Common Chemical Name (active ingredient)</b>	<b>Product Example<sup>1</sup></b>	<b>Product Example Rate per Acre (broadcast)</b>	<b>Backpack Sprayer Treatment Using Product Example<sup>2</sup></b>	<b>Time of Application</b>	<b>Remarks</b>
Picloram <sup>4</sup>	Tordon 22K	1–1.5 pints	1–3%	Fall to early spring, at early rosette stage.	Selective broadleaf herbicide; may pose a risk to groundwater in permeable soils or in areas where the water table is near the surface.
Picloram <sup>4</sup> + 2,4-D <sup>3</sup>	Grazon P+D	2 quarts (1:4 mixture)	1–3%	Same as above.	Same as above.
Metsulfuron	Escort XP	1 ounce	NA	Same as above.	Selective broadleaf herbicide. Most perennial grasses are tolerant; residual.
Metsulfuron + 2,4-D + dicamba <sup>3</sup>	Cimarron Max	Rate III 1 ounce (Part A) + 4 pints (Part B)	NA	Same as above.	Same as above.
Dicamba + diflufenzopyr	Overdrive	4 ounces	1–3%	Same as above.	Selective broadleaf herbicide; not for use where surface water is present.
Triclopyr	Remedy	3 pints	1–1.5%	Best on seedlings to early rosette stage.	Selective broadleaf herbicide; little residual.
2,4-D <sup>3</sup>	several manufacturers	1 quart	5–10%	Rosette to early bud in the spring.	Nonpersistent; growth regulator; may be less effective alone.
Imazapyr	Arsenal	1 pint	1%	All stages.	Use only in areas where total plant control is desired such as roadsides. In addition to overspray, nontarget plants may also be killed or injured by root transfer of imazapyr between intertwined root systems.
Glyphosate	Rodeo, Round Up	Rodeo: 4.5–7.5 pints Round Up: 1.5–4 quarts	Rodeo: 0.75–2% Round Up: 1–2%	One week before reseeding.	Nonselective herbicide. Use only for site preparation in a reseeding program.

<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 yellow starthistle.

<sup>2</sup> Herbicide/water ratio - As an example, a gallon of spray water with a 3 percent mixture is made by adding a sufficient volume of water to 4 ounces of liquid herbicide until a volume of 1 gallon is reached (4 oz ÷ 128 oz/gal = 0.03 or 3 percent). For dry formulations, particulates should be added to sufficient water as specified by the label until the required concentration or volume of spray water is reached.

<sup>3</sup> 2,4-D is a restricted use pesticide in New Mexico only. A certified applicator's license is required for purchase and use.

<sup>4</sup> Restricted use pesticide - A certified applicator's license is required for purchase and use.



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entry into the plant is through the leaves with only minor entry through the roots. All herbicides shown in table 3 will effectively control yellow starthistle when properly applied. Of the compounds recommended, picloram and clopyralid are the most commonly used since they provide some residual activity in the soil and will control seedling emergence for a few months after spraying. The herbicides listed in table 3 may impact desirable broadleaf and woody species, so caution should be taken if nontarget species need to be protected. Each herbicide product has specific requirements and restrictions; therefore, it is important to read the label carefully and follow all instructions when mixing and spraying. Herbicides may be applied by backpack, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. Aerial application via fixed-wing airplane or helicopter may be warranted for large, monotypic infestations.

## Control Strategies

Any strategy adopted to control yellow starthistle must involve careful planning and a long-term commitment to using treatment actions. Yellow starthistle is a prolific seed producer so the initial treatment should attempt to eliminate live plants and disrupt flower production as much as possible. Treated areas should be monitored, and secondary treatment taken (such as spot spraying with a backpack) to control missed plants.

The following strategies are examples of combined methods that can be used to manage yellow starthistle invasion:

- **Herbicide–prescribed fire strategy** – As an initial treatment, use herbicide in a broadcast spray for seedlings and young plants in the rosette stage during fall or early spring. This treatment will eliminate the majority of the yellow starthistle population and allow grasses to become established. The herbicide treatment can then be followed the next year (or possibly 2 years) with burning, which may require a burn authorization from local air quality authorities. Burning is best performed when nontarget grasses

have dried but before yellow starthistle produces seed which is likely in late May or June for New Mexico and Arizona. This treatment sequence can benefit the range plant community by increasing species diversity and enhancing the quality and quantity of forage. Consider introducing biological control agents after the last burn.

- **Herbicide–reseed–graze strategy** – While experience in New Mexico and Arizona is limited, an herbicide–reseed–graze strategy used in California has had some success in reducing yellow starthistle. In this strategy, a broadcast application of glyphosate is made to the infested site in late winter. The area is then reseeded 1 week later with a variety of site appropriate perennial grasses by using a no-till drill. Two weeks after seeding, a broadcast application of clopyralid is made to control preemergent and postemergent yellow starthistle plants. A regime of light fall grazing is recommended for several years after planting until perennial plants are well established. Treated areas should be closely monitored to determine if further herbicide application is necessary.

Regardless of the strategy employed, the key to successful yellow starthistle control is persistent, long-term management. Always encourage growth of perennial grasses and other desirable plant species that will compete with yellow starthistle for soil moisture, light, nutrients, and space.

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## **Suggested Web Sites**

Invasive Plant Atlas of the United States. Available at:

<http://www.invasive.org/weedus/index.html>.

Pesticide labels online:

<http://www.cdms.net/LabelsMsds/LMDefault.aspx>

USDA Plants Database. 2010. Available at:

<http://plants.usda.gov/index.html>.

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