

Ecology and Management of Yellow Starthistle (*Centaurea solstitialis* L.)

By

Jim Jacobs, Plant Materials Specialist, NRCS, Bozeman, MT
Jane Mangold, Extension Invasive Plant Specialist, Montana State University, Bozeman, MT
Hilary Parkinson, Research Associate, Montana State University, Bozeman, MT
Melissa Graves, Extension Weeds Integrated Pest Management Specialist,
Montana State University, Bozeman, MT



Figure 1. Yellow starthistle growing along Interstate 90 in Gallatin County, Montana. Photo by Mike Jones, Gallatin County Weed District.

Abstract

Yellow starthistle is one of the more invasive weeds of the Pacific Northwest. A report from 2003 estimated that yellow starthistle infested nearly 15 million acres in 17 western states, with the majority of acres (12 million) being in California. In Montana it is currently the only Priority 1A listed noxious weed, meaning established populations are not in the state, and management criteria include education, prevention, and eradication when populations are found. Since 1958, 18 populations have been reported and controlled in Montana.

Native to the Mediterranean region of Europe, yellow starthistle is a winter annual in the Asteraceae family. Seeds germinate in the fall and plants overwinter as seedlings. Seedlings transition into rosettes in early spring. Plants bolt and form spiny flowers (see Figure 1) in summer and may continue flowering until frost. Seeds set and disperse in late summer and early fall. Populations of yellow starthistle form dense stands on rangelands, pastures, roadsides, and wastelands where they displace plant native communities affecting critical wildlife habitat, accelerate soil erosion, and

reduce forage for livestock and wildlife. Yellow starthistle causes chewing disease in horses which is typically fatal.

Prevention, early detection and rapid response to eradicate new populations are the management priorities for Montana. New populations should be reported to county Extension agents or weed coordinators. Control options will include hand pulling to remove plants with seeds and herbicide applications. Consult your county Extension agent or weed coordinator for the best herbicide options for your area.



Figure 2. A yellow starthistle plant showing the lobed rosette leaves and winged stem. Photo by Jane Mangold, Montana State University, Bozeman, Montana.

PLANT BIOLOGY

Identification

The rosette of yellow starthistle (see Figure 2) lies close to the ground and produces six to 28 deeply lobed leaves that range from one to eight inches long (2.5 to 20 centimeters) and are generally less than two inches wide (5 centimeters). The rigidly branched, winged flowering stems (see Figure 2) average about two feet (60 centimeters) tall but range from four inches (10 centimeters) to five feet (1.5 meters), depending on environmental conditions. The stem leaves are entire without lobes, linear in shape, and are vested with woolly hairs that persist through the growing season. Flowerheads are single on the ends of short stems and have many bright yellow flowers. The bracts of the flowerheads are armed with stout, straw-colored spines one to two inches long (2.5 to 5 centimeters) that radiate from the flowerhead in a star shape (see Figure 3).



Figure 3. A yellow starthistle flower. Photo by Brother Alfred Brousseau at USDA, NRCS, PLANTS Database.

Life History

Yellow starthistle is a winter annual dependent on seed production for population growth and spread. Plants normally produce 20 to 120 seeds each, but under ideal conditions production may exceed 100,000 seeds per plant. Up to 90% of the seeds have a short plume (pappus). These seeds disperse at maturity and readily germinate when moisture is available in the fall. The other 10 percent lack a plume, disperse over winter, and can remain dormant in the soil for up to 10 years. One-quarter to one-half inch (0.6 to 1.3 centimeters) of rain in the fall is sufficient to stimulate germination and seedling emergence. Seedling densities in Washington have been reported as high as 2,500 per square foot. Populations overwinter as seedlings or rosettes. Seedlings can also germinate in the spring.

Beginning in March and continuing through May, seedlings transition into rosettes. Normally, between 60% and 75% of the rosettes die from self-thinning and moisture stress. Surviving rosettes produce a tap root capable of penetrating deeply into the soil to access deep soil moisture. A flower stalk grows from surviving rosettes and blooms in mid-summer. Flowers are primarily pollinated by honeybees (*Apis* spp.) and bumblebees (*Bombus* spp.), and germinable seed is produced eight days after flower initiation. Spring emerging seedlings are capable of blooming in the year of emergence or overwintering to bloom in the following year.

Spread

More than 90% of yellow starthistle the seeds fall within two feet of the parent plant. The pappus plumes present on 75-90% of the seeds are too short to catch wind and are believed instead to help orient the seed on the soil for germination and establishment. This results in populations with slow invasion fronts. Birds including finches, quail, and pheasants feed on yellow starthistle seeds and disperse them short and long distances. Other animals, people and vehicles may also transport seeds long distances. Pappus bristles are covered with stiff microscopic barbs that readily adhere to hair and clothing where they can be spread long distances by the movement of animals and people. The original seed source for North American invasion is believed to be from contaminated alfalfa seed.

Habitat

In its native range, yellow starthistle evolved under Mediterranean climatic conditions characterized by precipitation in the fall and spring, and dry conditions in the winter and summer. Similar climatic conditions are found in the North American steppe region where it is invasive on most rangelands. It prefers deep loamy soils with south facing slopes and 12 to 25 inches of annual rainfall with a bimodal distribution in the fall and spring. It favors perennial bunchgrass communities dominated by bluebunch wheatgrass, Idaho fescue, and Sandberg's bluegrass. Although it does not compete well with sagebrush, it readily invades sagebrush communities after disturbance. It is most common in disturbed areas in full sun, such as rangelands, along highways or roads, railroad tracks and other transportation or communication lines. In Montana small patches have occurred along road sides, in new alfalfa seedings (from contaminated seed) and other disturbed areas such as construction lots. Because patches were controlled before they could establish and spread, it is unknown if certain regions or plant community types in Montana are more vulnerable. In California it is prevalent in the Central Valley and surrounding foothills and continues into mountainous regions below 7,000 feet (2,100 meters). In southwestern Oregon it is common in grassland foothills. In Washington it is most common on south-facing grassland slopes, primarily in the southeastern part of the state. Research in central Idaho found rangelands with south to southwest aspects and 20-30% slopes were most vulnerable to yellow starthistle invasion.

Impacts

Yellow starthistle is problematic on rangelands, pastures, roadsides, and waste areas. Its rapid growth rate and aggressive resource acquisition make it competitive within native plant communities where it forms dense stands displacing native species and reducing diversity. Loss of native bunchgrasses reduces available forage for livestock and wildlife, and the long, stout spines on the flowers deter grazing. Consumption of yellow starthistle by horses causes chewing disease, a fatal nervous disorder. Rosettes can be grazed by cattle and sheep before the spinney flower heads form. Flowers provide nectar for honeybees.

MANAGEMENT

Prevention

Currently there are no known viable populations of yellow starthistle in Montana, and therefore prevention is critical. Over the last 10 years, two infestations were found in newly seeded alfalfa fields, suggesting the introductions were from contaminated seed. Two infestations were also reported from disturbed sites and believed to be introduced from seed carried on heavy equipment. An infestation was reported from a chain-up area along the interstate, suggesting vehicular transport. Most of these recent introductions were one or two plants that were removed before seeds were produced emphasizing the importance in early detection and rapid response. These occurrences are reminders to use certified weed-free seed and hay, to scout newly seeded hay ground and pasture, to survey construction sites and corridors of transport, and to report suspected populations to county weed coordinators or Extension agents.

Hand pulling

Hand pulling that removes the root crown is effective management for new, small introductions of yellow starthistle. To prevent seed dispersal, flowering plants should be destroyed in a hot fire or

bagged and disposed of in an appropriate landfill. Repeated monitoring should be planned for every two to four weeks during the growing season.

Herbicide

There are many herbicides effective for controlling yellow starthistle including glyphosate, 2,4-D, picloram, dicamba, clopyralid and others. Consult with your county Extension agent or weed coordinator for the herbicide treatment that works best in your area and always follow label instructions for the optimal control and minimal environmental risk. For optimal population regulation, herbicide should be applied at the transitional stage from rosettes to flowers and before the population has advanced beyond the 2% flower initiation stage.

Mowing

In parts of California where the plant is dense and widespread, timely mowing over a three-year period has reduced plant density. However, this is not an effective strategy in Montana where populations are small and eradication, not suppression, is the management goal. Mowing may reduce seed production, but it does not eliminate it, and may serve to spread seeds. When mowing is followed by rain, seed production may increase.

Tillage

Tillage is not a viable method of yellow starthistle control in Montana. However, for disturbed sites vulnerable to weed invasion, tillage should be considered as a seedbed preparation prior to revegetation. Quickly establishing competitive, desired vegetation following disturbance may decrease the chance for invasive weeds like yellow starthistle to become established (see revegetation below).

Burning

Prescribed fire has been effective in reducing populations in California. Burns conducted for three consecutive years in late June and early July after the dispersal of desirable grass seed but before yellow starthistle seed production, reduced the yellow starthistle seed bank, seedling density, and summer vegetative cover each by over 90%. However, in Montana burning is not an appropriate management strategy to eradicate newly established, small populations.

Biological

Because there are currently no known naturalized populations of yellow starthistle in Montana, biological control insects are not a practical control option in this state. Five insect species have been released in the western United States for the management of yellow starthistle. They feed on the flower buds and seedheads and can reduce seed production from 45% to 100%. There is also a rust fungus that reduces the vigor of yellow starthistle plants.

Revegetation

Because there are no large-scale yellow starthistle populations in Montana, revegetation is not a practical option for control. However, due to the fact that two recent introductions are associated with heavy equipment disturbance, restoring perennial vegetation after such disturbances is a priority. Competitive plants will reduce seedling survival; slow population spread, and makes

eradication more probable where yellow starthistle seeds are unintentionally introduced on disturbed sites. Also, where hay meadows and pastures are revegetated as part of a crop rotation or newly established field, scouting for new introductions is important for early detection in the event the crop seed was contaminated with yellow starthistle seed.

Integrated Pest Management (IPM)

The most important part of IPM for yellow starthistle in Montana is prevention and early detection followed by rapid response. This is facilitated by an educated and aware public, particularly people who work in the field that can identify and report introductions during the early phase of invasion. New populations should be reported to the county Extension agent, county weed coordinator, or Montana Department of Agriculture (406) 444-3140, so steps can be taken to prevent population spread. The most practical combination of controls is hand pulling to remove plants with seed and herbicide application to kill seedlings and rosettes. Scouting and surveys should be concentrated on newly seeded hay meadows and pastures and on sites of heavy equipment disturbances such as utility construction sites. Highways should be regularly surveyed to detect new populations established from seed transported on vehicles.

References

Benweffield, C.B., J.M. DiTomaso, and G.B. Kyser. 2001. Reproductive biology of yellow starthistle: maximizing late-season control. *Weed Science* 49:83-90.

DiTomaso, J.M. 2005. Yellow starthistle (*Centaurea solstitialis* L.). In: C.L. Duncan and J.K. Clark (eds), *Invasive plants of range and wildlands and their environmental, economic, and societal impacts*. Weed Science Society of America, Lawrence, KS. Pages 36-50.

DiTomaso, J.M., M.S. Hastings, and G.B. Kyser. 1999. Prescribed burning for control of yellow starthistle (*Centaurea solstitialis*) and enhanced native plant diversity. *Weed Science* 47:233-242.

Pitcairn, M.J., G.L. Piper, and E.M. Coombs. 2004. Yellow Starthistle. In: Coombs, E.M., Coombs, J.K. Clark, G.L. Piper, and A.F. Cofrancesco, Jr. (eds), *Biological control of invasive plants in the United States*. Oregon State University Press, Corvallis, OR. Pages 233-262.

Sheley, R.L. and L.L. Larson. 1997. Cheatgrass and yellow starthistle growth at 3 soil depths. *Journal of Range Management* 50: 146-150.

Sheley, R.L., L.L. Larson, and J.S. Jacobs. 1999. Yellow Starthistle. In: Sheley, R.L. and J.K. Petroff (eds), *Biology and Management of Noxious Rangeland Weeds*. Oregon State Press, Corvallis, OR. Pages 408-416.