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Yellow Starthistle

Ecology and Management on Pacific Northwest Rangelands

L. Larson, R. Sheley, M. McInnis, and G. Kiemnec

Yellow starthistle *(Centaurea solstitialis* L.) is a member of the knapweed *(Centaurea* L.) complex. It is poor forage for all livestock and causes "chewing disease," a nervous disorder, in horses. Yellow starthistle infests millions of acres in California and the Pacific Northwest. Infestations range from scattered plants to dense stands associated with annual grasses.

Yellow starthistle is native to the Mediterranean region of Europe and north Africa. By the early 1800s, it had arrived in California, probably in contaminated alfalfa seed. Yellow starthistle was first reported at Walla Walla, WA around the turn of the century and began spreading into perennial and annual grasslands throughout the Pacific Northwest in the 1920s.

Infestations currently are estimated to be about 8 million acres in California, 280,000 acres in Idaho, 135,000 acres in Oregon, and 148,000 acres in Washington. Yellow starthistle seems to have reached the northern and southern limits of its range but it continues to invade rangeland at rates ranging from 7,000 to 20,000 acres per year within these boundaries.

The purpose of this publication is to provide basic information regarding yellow starthistle ecology and management. It is based on research conducted by the authors in northeastern Oregon and southeastern Washington. Information sources are listed at the end of this publication. Life cycle numbers represent observed research data and are included to illustrate population dynamics. These numbers are not constant and will vary with environmental conditions.

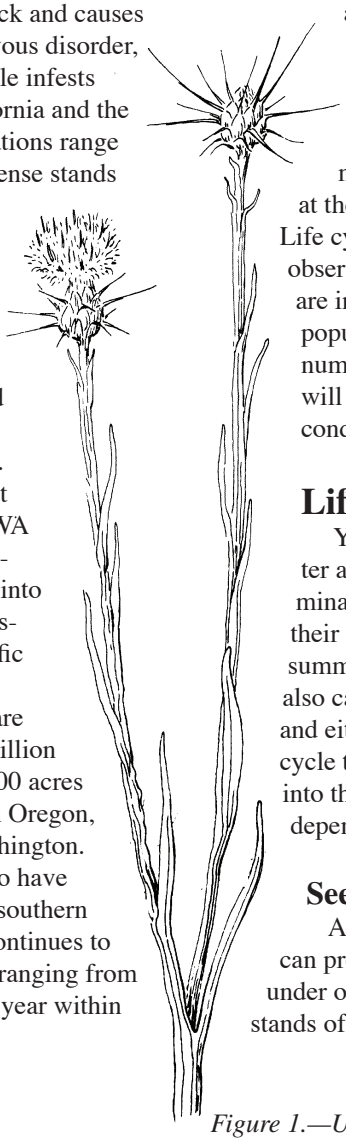

Figure 1.—Upper branches of yellow starthistle plant (*one-third actual size).*

Life Cycle

Yellow starthistle is a winter annual. Most seedlings germinate in the fall and complete their life cycle the following summer. However, seedlings also can emerge in the spring and either complete their life cycle the same year or continue into the next growing season, depending on conditions.

Seed production

A yellow starthistle plant can produce up to 150,000 seeds under optimum conditions. Dense stands of this species have been observed to produce 20 to 120 seeds per plant. This variation largely depends on plant density, the amount of spring precipitation, and soil nutrient status.

Seed dispersal

Yellow starthistle plants produce two types of seed: those with parachutelike plumes and those without plumes. Most seeds have plumes and are dispersed at maturity (July through September). Plumeless seeds are dispersed between November and February.

More than 90 percent of the seeds that reach the soil fall within 2 feet of the parent plant. This dispersal pattern tends to form a slow invasion front.

Birds such as ring-necked pheasants, California quail, house finches, and American finches feed on yellow starthistle seed and contribute to both long- and short-distance dispersal. Finches tend to shell seeds, leaving most of the consumed seed nonviable. Quail and pheasants consume whole seeds, which occasionally may be passed in viable form. Animals (including humans), whirlwinds, and vehicles also contribute to the transport of yellow starthistle seed.

About 60 percent of the seeds produced by a starthistle population survive dispersal and are available for germination in the fall.

Larry Larson, professor of rangeland resources, Oregon State University; Roger Sheley, assistant professor of plant, soil, and environmental sciences, Montana State University; Michael L. McInnis, professor of rangeland resources, and Gary L. Kiemnec, associate professor of crop science, Oregon State University.

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Germination and viability

Yellow starthistle seeds can germinate rapidly. Under optimum conditions (near 68°F with adequate moisture), plumed seed begins to germinate within 16 hours and can reach 75 percent germination within 48 hours. In dry or saline soil, yellow starthistle germination is reduced, but it still is relatively high. Rapid germination allows yellow starthistle to capture resources before neighboring species begin growth.

Approximately 95 percent of yellow starthistle seed is viable, and seed can remain dormant for more than 10 years. In heavily infested areas, up to 13 percent of total seed production can remain in the soil. These dormant seeds create a difficult problem for land managers because they allow yellow starthistle to reestablish following most initial control efforts.

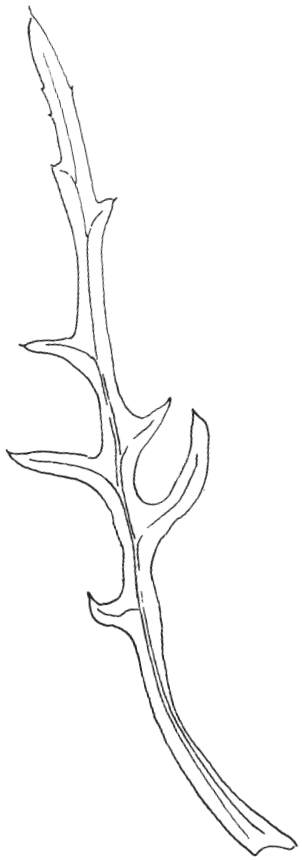

Figure 2.—Yellow starthistle lower leaf (two-thirds actual size).

Seedlings

Yellow starthistle typically begins growing in the fall following a rainfall of 0.25 to 0.5 inch. The number of seedlings increases until soil moisture and/or soil temperature become limiting. By January, yellow starthistle populations can reach 2,500 seedlings per square foot. Subsequent frost heaving can reduce populations by as much as 40 percent.

Rosettes

If seedlings survive the frost heaving period, they become rosettes. This transition begins in March and continues into May. Starthistle rosettes form when leaves emerge from the base of the plant. Rosettes generally have 6 to 15 (up to 28) leaves that range from 1 to 8 inches in length.

The rosette stage is a difficult time for yellow starthistle. In most years, 60 to 75 percent of rosettes die by July from either moisture stress or self-thinning.

Adults

As yellow starthistle matures, a flower stalk grows from the center of the rosette. The stalk ranges in height from 2 inches (dry conditions) to 5 feet (moist, nonstressed environments). Flowering can occur as early as June and can continue into September. Flowers are bright yellow with a base of yellow-green spines 0.25 to 2 inches long.

Adult mortality can occur in stressful environments, but most adult yellow starthistle plants complete their life cycle. In early fall, adult yellow starthistle plants lose their leaves and dry to a silvery-gray skeleton, with cottony white terminal seed heads. With the arrival of fall rains, seeds on or in the soil germinate, and the cycle is repeated.

Yellow Starthistle Invasion

Yellow starthistle can invade rangelands throughout the western United States. In the Pacific Northwest, the most susceptible rangelands are those with deep loamy soils, south-facing slopes, and 12 to 25 inches (winter/ spring peak) of annual precipitation.

Yellow starthistle favors sites originally dominated by perennial grasses, especially bluebunch wheatgrass, Idaho fescue, and Sandberg's bluegrass. It does not appear to compete well with sagebrush but readily invades areas of disturbance within sagebrush communities.

Yellow starthistle tends to invade along a slowly advancing front as large numbers of seeds are dispersed a short distance from parent plants. The competitive success of yellow starthistle is directly related to its rapid growth and resource capture. In general, yellow starthistle seedlings grow more rapidly than most perennial grass seedlings. Therefore, it is difficult for grass seedings to become established if they are infested with yellow starthistle. Once established, vigorous stands of perennial grass limit reinvasion by yellow starthistle.

The rapidly growing and deeply penetrating roots of yellow starthistle tend to avoid direct competition with shallow-rooted annual and/or perennial grasses on deep soil. Yellow starthistle root and shoot growth rates can be twice as fast as those of downy brome. As a result, starthistle roots tend to penetrate deeper into the soil profile, allowing continued growth late in the growing season and increased seed production. In such circumstances, yellow starthistle can dominate deep-soil sites.

Use herbicides safely!

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

Despite its overall vigor, yellow starthistle seedlings and rosettes are sensitive to resource stress (competition for light, water, nutrients, and space) and are subject to high mortality when stress conditions prevail. The growth rate of yellow starthistle declines with increasing plant density and/or shallow soils. Under these conditions, yellow starthistle tends to be a secondary or codominant species.

Management of Yellow Starthistle

Management strategies for weeds typically include three approaches:

- **Prevention** seeks to keep weeds from invading productive rangelands by maximizing the competitive ability of existing vegetation.
- **Containment** seeks to limit weed infestations to sites where they exist.
- **Control** seeks to reduce densities of weeds through the use of chemical, mechanical, and/or biological treatments and to replace them with more desirable vegetation.

Several herbicides are available for use on yellow starthistle. However, since herbicide registrations change frequently, this publication doesn't make specific herbicide recommendations. For current recommendations, refer to the *Pacific Northwest Weed Management Handbook,* published and revised annually by the Extension Services of Oregon State University, Washington State University, and the University of Idaho. In addition, detailed instructions for herbicide use are provided on herbicide container labels and in other literature provided by herbicide manufacturers.

Prevention

Prevention is the least expensive and most effective method of limiting yellow starthistle invasion on productive rangelands. Proper grazing management is an essential part of this strategy. Such grazing will limit yellow starthistle germination and promote early mortality by maintaining healthy vegetation cover. An effective grazing system includes the following:

- Allowing moderate grazing (typically 30 to 50 percent use of annual production)
- Altering the season of grazing
- Rotating livestock to allow perennial plants to recover before being regrazed
- Promoting litter accumulation

Unfortunately, yellow starthistle prevention on rangelands cannot be achieved through grazing management and plant competition alone. Soil and plant disturbance is a natural part of all plant communities, and yellow starthistle is well adapted to take advantage of most grassland disturbances. Therefore, in addition to prevention, you should monitor rangelands to identify, flag, and treat isolated patches and plants of yellow starthistle. It is best to flag infestations at the time of treatment and then monitor the treated areas for several years.

Containment

Containment programs are used to keep yellow starthistle from spreading to neighboring rangeland. Containment programs should be viewed as a "stopgap" measure. Replace them with a control program as soon as possible.

An effective method of containment is to spray the borders of the infested area with an herbicide (at the rosette stage of growth) and limit seed dispersal by humans. This approach addresses the tendency of yellow starthistle to invade as a slowly advancing front.

As part of your containment program, also implement a monitoring program to locate and treat satellite populations of yellow starthistle within the interior of the rangeland area.

Chemical and mechanical control

Because of yellow starthistle's growth rates and high seed viability, successful control requires long-term commitment. This process has three key parts, which are described below.

1. Break the annual cycle of yellow starthistle invasion with initial control.
2. Begin a vegetation establishment program to prevent rapid reinvasion of yellow starthistle.
3. Follow these measures with a program of vegetation management, monitoring, and periodic chemical application to control localized infestations.

Yellow starthistle control begins with herbicide applications. Actively growing starthistle seedlings and rosettes are most susceptible to herbicide control. Therefore, herbicides are most effective when applied in the spring and early summer.

Following initial control, establish a perennial grass cover to prevent reinvasion. A healthy grass stand will compete with starthistle seedlings and rosettes, limiting their survival. Perennial grasses that begin growth in the fall, have periodic growth through the winter, and continue growth into midsummer have the most success competing with yellow starthistle. Grasses that successfully

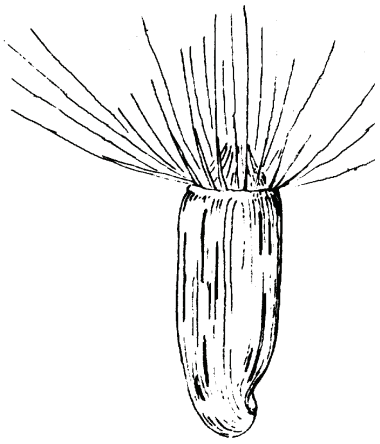

Figure 3.—Yellow starthistle fruit (magnified 8 times).

reduce the rate of starthistle reinvasion include Oahe intermediate wheatgrass, Tualatin tall oatgrass, Paiute orchardgrass, Covar sheep fescue, Critana thickspike wheatgrass, and Sherman big bluegrass.

The degree of success depends on the selection of a grass species that is suited to the site, the density of the established stand of grass, and the land manager's ability to maintain grass vigor. Do not fertilize new grass seedings that are infested with yellow starthistle because fertilizer can increase starthistle production.

After successfully establishing competitive grasses, monitor rangelands to identify, flag, and treat isolated patches and plants of yellow starthistle. It is best to flag isolated infestations and monitor treatment effectiveness for several years.

Biological control

Three weevil species *(Bangasternus orientalis, Eustenopus villosus,* and *Larinus curtis)* and two flies *(Urophora sirunaseva* and *Chaetorellia australis)* have been released in California and the Pacific Northwest for yellow starthistle control. These insects attack the flower head and reduce seed production. The effectiveness of insect control is currently under investigation, and it is too early to determine the long-term impact on yellow starthistle populations.

For More Information

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