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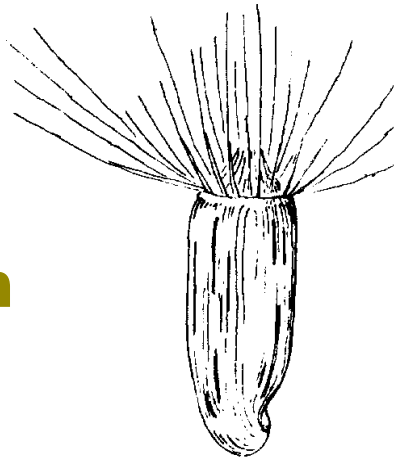
Managing Yellow Starthistle

in Southwestern Oregon



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In the heat of summer in the Rogue Valley, yellow starthistle *(Centaurea solstitialis)* raises heads of brilliant yellow flowers rigidly defended by sharp spines. Although bees reap double benefits of nectar and pollen during a season when most native plants no longer are flowering, this nonnative weed is a threat to rangelands and grasslands.

Yellow starthistle began to spread in the foothills surrounding southwest Oregon's interior valleys in the 1920s, when human activities already had changed the mosaic of natural grasslands, oak woodlands, and chaparral. Grazing, logging, fire control, clearing, and road building created openings for weeds by disturbing soils and vegetation. Since then, the pace of development has increased, and winter annuals from the Mediterranean region have replaced many nonwoody native plants at lower elevations.

These invaders cause many problems.

- With their short life span and often shallow roots, they provide less soil cover than perennials, and they change water cycles. Thus, they aggravate flooding by increasing surface runoff, soil erosion, and downstream sedimentation.
- Their early maturity creates extreme fire hazards of flashy fuel.
- In summer, they scratch people with awns, spines, burrs, and bristles; they stick to socks, puncture bicycle tires, and injure pets.
- Rare plants and colorful native wildflowers decline when exotic weeds dominate the landscape.

In southwest Oregon, annual forage production fluctuates widely with rainfall, and the window for grazing is condensed into a short period in the spring and early summer. The timing and quantity of rain in a given year determines which annual weeds will be most problematic.

By the time yellow starthistle is blooming, it is too late for large-scale control. Except for early detection and removal of scattered plants, control methods are not effective when yellow starthistle is in full flower. Instead, you should plan for long-term management.

Why is yellow starthistle a problem here?

Yellow starthistle is perfectly adapted to Mediterranean climatic conditions and thrives in the Mediterranean/maritime climate of the Rogue and Umpqua valleys, with their hot, dry summers and mild, wet winters. Yellow starthistle invades and dominates annual grasslands by using the deep soil moisture that remains after shallow-rooted annual grasses die in early summer. Foothills in southwestern Oregon are extremely susceptible to yellow starthistle invasion, particularly southeast- to southwest-facing slopes, as well as land where the soil and vegetation have been disturbed.

Although yellow starthistle invades and dominates south slopes and disturbed sites more quickly, it is not restricted to them. In the absence of competitive perennial vegetation, yellow starthistle forms

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dense stands on valley floors and invades openings in the conifer transition zone above oak woodlands.

Life cycle

Plumed yellow starthistle seeds fall to the ground in August and September. In the fall, as the days become cooler and rains refresh the parched soil, germination begins. The spiny bracts that ringed the flower heads drop off, leaving rigid skeletons of weathered, gray stems tipped with little balls of white fuzz (Figure 1). Plumeless seeds, which were held in the heads by the bracts, are released gradually through the winter, an insurance policy to protect the population if the first crop of seedlings dies.

During the winter, yellow starthistle seedlings form ground-hugging rosettes that take advantage of abundant soil moisture to grow deep taproots (Figures 2 and 3). Sunlight at the soil surface is critical, providing the energy for photosynthesis and creating a warmer microclimate for leaves lying near the ground. By the end of winter, yellow starthistle roots may extend more than 3 feet into the soil, penetrating cracks in the rock under shallow soils. Seedlings emerge from old plant debris (Figure 4).

By May, rosettes "bolt," sending up vertical stems that develop buds at the tips (Figure 5). As flower heads develop, the entire plant becomes more drought resistant. Basal rosette leaves wither, and upper leaves form narrow wings along the stems, reducing leaf area. The entire plant looks gray-green as a result of light-reflecting white hairs that cover stem and leaf surfaces. Leaves are oriented to a nearly vertical position. These adaptations to minimize water loss and a taproot that accesses water deep in the soil enable the plant to flower and produce seed during the summer drought.

About 3 weeks after the flowers open and are pollinated, the dry heads open again to release plumed seeds. Although yellow starthistle reproduces only by seeds, it is a superachiever in this arena; estimates of annual production range from 500 to 4,000 seeds per square foot.

Although yellow starthistle plants that emerge early in the fall are most competitive, spring seedlings can flower and produce seed the same growing season. If buried, a small percentage of plumeless seeds may persist in the soil seed bank for 10 or more years.

How can starthistle be controlled?

The following sections describe control options and how they can be integrated into an overall program. Timing is a critical element for almost every control technique.

Yellow starthistle is a tremendously successful weed, but we now know how to reduce its competitiveness. For seed production during the summer drought, yellow starthistle needs sunlight at the soil surface from fall through spring to grow roots that can tap water stored deep in the soil.

Establishing competitive perennials

The most promising solution that minimizes long-term control costs is to replace yellow starthistle and associated weedy annuals with competitive perennials, particularly grasses. Perennials that shade the soil surface weaken starthistle seedlings by limiting their access to sunlight energy and to the deep soil moisture they need for midsummer growth and seed production.

In local tests of native and introduced grasses, two cultivars were particularly effective in the foothills of southwestern Oregon: Covar sheep fescue and Palestine orchardgrass. Palestine orchard-grass performed well on all sites above 2,500 feet elevation and on loamy soils below 2,500 feet. Covar sheep fescue effectively limited starthistle reinvasion on most sites, but performed poorly on soils with perched water tables and expanding clay.

Among native species, Idaho fescue was the most competitive, growing rapidly during early-season cool weather and maturing seed before the summer drought. Berber orchardgrass, intermediate wheatgrass, and tall wheatgrass are suitable for pastures. At higher elevations (in the conifer zone), Durar hard fescue replaces sheep fescue for weed and erosion control along roadsides. For special management purposes, such as irrigated pastures and orchards, Fawn tall fescue or Potomac orchardgrass can be managed to exclude yellow starthistle.

The first step is to determine objectives for the site, considering what land uses are desired and

Figure 1.—Where yellow starthistle invades grasslands and open oak woodlands, hillsides appear golden in the summer, but by winter they become an expanse of weathered, gray stems topped with white fuzz.

Figure 2.—In full sunlight, yellow starthistle rosettes grow flat against the soil surface; the blue-green leaves are deeply lobed along the sides and have a large, triangular lobe at the tip.

Figure 3.—Seedlings germinate in the fall and grow deep taproots during the winter. Each bandon stick is 4 inches.

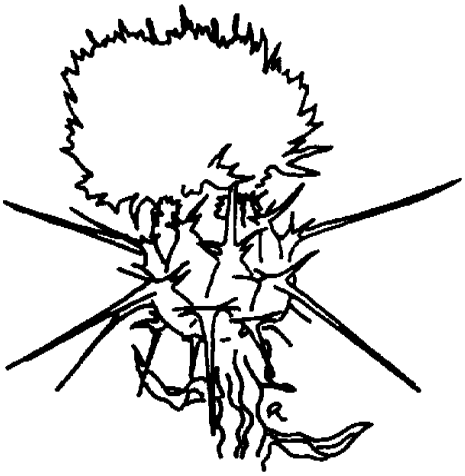
which plant cover fulfills the objectives. Depending on the site potential and your objectives, you can combine various techniques in a long-term plan. This requires systematic and persistent efforts over a period of years. Results of research in southwest Oregon indicate that some range seedings may take up to 5 years to establish.

You can modify this long-term plan according to weather patterns and vegetation responses to control measures. Start small, and if the first attempt doesn't work, try something else; if it does work, try it over a larger area.

Although the plant cover that works for you may range from a single cultivated grass species to a mixture of native plants, the process of planning and implementing a seeding program is similar in all cases.

Figure 4.—By late winter, seedlings emerge from beneath the skeletons of the previous year's yellow starthistle plants.

Figure 5.—When yellow starthistle is bolting (developing an upright stem), plants are more easily pulled or damaged by grazing animals.



Seeding

After you decide which species or mixture of species to use, there is the difficult step of establishing the grass from seed. Perennial grass seedlings are delicate in comparison with the robust seedlings of annuals. Competition from weeds causes most failures in grass seeding. Do everything practical to favor the seeded grass, starting with seedbed preparation that provides good seed-to-soil contact and reduces the weed seed bank.

Cultivation and drilling of the seed is recommended where practical. However, try to avoid a bare soil surface going into the winter. Small areas can be mulched with straw or similar material to prevent soil erosion and protect the seedlings from frost heaving. Where this is not practical, include a quick-establishing "nurse crop," such as annual or perennial ryegrass, to provide rapid soil cover.

Seeding should be done in the fall, after rains give reliable soil moisture but before temperatures get too cold for grass growth, usually between September 1 and mid-October. Spring seedings usually do not develop adequate roots to survive the first summer, so don't try seeding in spring unless irrigation is available. Seeding rates range from 8 to 10 lb/a.

If the site cannot be cultivated, do everything possible to position the seed in the surface soil and reduce weed competition. Drilling, which covers the seed up to ¾-inch deep, is most effective; you can use a rangeland drill on sites that cannot be cultivated. If drilling is not an option, seed can be broadcast and "raked in" with a spike-tooth harrow. Seeds also can be incorporated into the soil by the hoof action of sheep or cattle, but do not try this method when the soil is wet because soil compaction causes long-term damage.

Broadcasting seed without soil cover is more likely to fail. Increasing the seeding rate to 12 to 15 lb/a and controlling weeds are ways to improve the chances of success.

Herbicides effectively reduce weed competition. A nonselective application after fall weed germination but before seeding also helps deplete the weed seed bank. Additional, more selective treatments may be needed to control weeds in the spring. See "Herbicides," page 6, for details.

First-year seedlings

Look for grass seedlings the next spring. Fescue seedlings look like fine, green hairs; orchardgrass has bluish-green leaves that are folded flat as they emerge. Covar sheep fescue usually takes longer to establish than orchard-grass; sometimes the clumps are not readily apparent until the third year.

Control of weed seedlings the first year must avoid damaging the grass seedlings. Options include mowing, carefully controlled grazing, and use of selective herbicides.

Mow when weeds overtop the grass seedlings and while there still is sufficient soil moisture for seeded species to continue growth. Set the mower high enough to avoid cutting the seedlings.

Grazing may be used in place of mowing, but it must be managed very carefully to avoid soil compaction and damage to grass seedlings. Excessive grazing is detrimental to seedling vigor and establishment. Use grazing techniques that allow for reduction of weedy competition and continued growth of seeded species. Continue careful management so your perennials can become dominant within the plant community.

You also may use a nonselective herbicide to control annual grasses and other weeds competing with the new seedlings if you can apply it to the weeds without contacting the seeded grass.

Fire

In California trials, 3 consecutive years of burning at early flowering stage controlled yellow starthistle and depleted its soil seed bank by 99 percent, while restoring native perennials. Enough fine fuel, such as dry grass, must be available to carry the fire. Hot fires are not necessary; merely scorching starthistle stops seed production.

Burning after annual grasses have cured and before yellow starthistle flowers (late June, early July) generally has a high risk of

causing expensive wildfires. Burning in the fall or spring to reduce the risk of fire does not control yellow starthistle. In fact, it is likely to benefit it because removal of plant residue at those times provides more sunlight and a flush of nutrients to starthistle rosettes, boosting plant density and seed production the following year. The potential of fall burning to reduce weed competition for fall seedings is under investigation.

It's possible to reduce risks with fire in the spring by using a "brown and burn" technique. A nonselective herbicide such as glyphosate (e.g., Roundup) is applied, and the vegetation is allowed to cure before burning. The fire is contained more easily because surrounding vegetation still is green.

Fire can supplement other control methods. Burning to remove heavy annual plant debris improves herbicide efficacy by increasing contact with the target weeds. Killing one or more flushes of weed seedlings that germinate following a fire can deplete the seed bank more quickly than does simply preventing seed development for that year. You also can use fire to prepare a seedbed for competitive perennials and then broadcast seed in the ash.

Biological control

Biological control insects contribute to the stability of the perennial community by reducing yellow starthistle seed production. One of the most promising roles for biological control insects is in helping seeded grass stands resist reinvasion by yellow starthistle. Six insects—three weevils and three flies—have been established in southwestern Oregon for biological control of yellow starthistle:

- The bud weevil (*Bangasternus orientalis*) attacks the early bud stages.
- The hairy weevil (*Eustenopus villosus*) feeds on midstage buds and lays eggs in late-stage buds.
- The flower weevil (*Larinus curtus*) lays its eggs in open flowers.
- The gall-fly, also known as a seed fly (*Urophora sirunaseva*), forms galls in seed heads.
- Larvae of two peacock flies (*Chaetorellia australis* and *C. succinea*) feed in seed heads.

All of these insects feed in the seed heads. They have reduced seed production significantly in some areas, but have not yet demonstrated the ability to achieve acceptable control levels.

Biological control insects have advantages over other methods: they are not limited to accessible sites, they are self-sustaining once established, and they are host-specific. Host specificity ensures that they will not attack other plants if starthistle populations decline. However, since they are limited to one weed species, they may indirectly benefit other weeds by reducing yellow starthistle competition.

Mowing

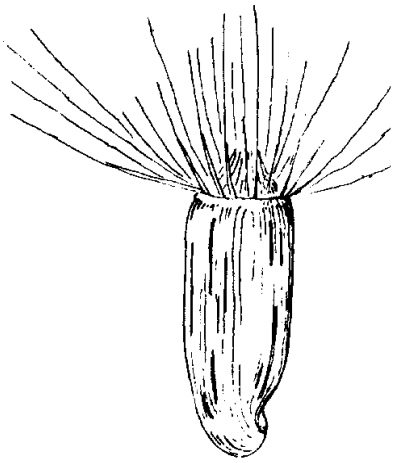
Research in California found that mowing when yellow starthistle began to flower (about 5 percent of the heads showing yellow) reduced canopy size, seed production, and plant density. However, if the soil still is moist at this time, yellow starthistle regrows and flowers later in the season. If the first mowing is high enough to allow a second mowing closer to the ground, fewer seeds are produced.

Repeated mowing for several years dramatically reduces the number of starthistle seeds in the seed bank and helps prepare the ground for seeding perennials. Mowing also helps control competition with grass seedlings (see "First-year seedlings," page 4).

Proper timing is essential; mowing too early in the season, before starthistle bolts, removes the grass cover and promotes more vigorous starthistle growth. Done too late, mowing scatters starthistle seed.

Grazing

Grazing at the wrong time increases the amount of yellow starthistle. If animals graze when starthistle is a rosette, they consume associated plants and release the starthistle from competition. As with mowing, delaying grazing maximizes competition by the associated vegetation for light and moisture. For this reason, and because defoliation is more damaging later in the season when temperatures are hotter and humidity is lower, the best time to graze is when starthistle is stemming up. Maximum benefit is obtained by returning to graze the yellow starthistle regrowth one to three times, depending on available soil moisture.



In California, yellow starthistle has been managed by intensively controlled grazing of annual grasslands that set seed and dry out while yellow starthistle still is green. Cattle, sheep, and goats routinely graze yellow starthistle before it becomes spiny and while it is nutritionally acceptable, with crude protein levels as high as 13 percent at the bolting stage.

Although sheep generally prefer "weeds" as compared to cattle, the timing of grazing is more important than the class of livestock. Thus, availability of animals and the size of the weed infestation should determine what type of livestock you use.

Never keep horses in pastures with yellow starthistle. If horses graze enough yellow starthistle (86 to 200 percent of their body weight), they develop permanent brain lesions. Chewing disease (equine nigropallidal encephalomalacia) affects only horses, but it is irreversible and can be fatal.

These grazing recommendations for annual grasslands have been followed successfully in southwestern Oregon. They do not apply to irrigated pastures and orchards.

Herbicides

Several selective and nonselective herbicides are registered for control of yellow starthistle on noncrop areas, pasture, and rangeland. Herbicides used alone control yellow starthistle only temporarily, but this can make the difference between success and failure in establishing new vegetation.

The most effective uses of selective herbicides are to control yellow starthistle among perennial grasses and to protect uninfested areas by containing new yellow starthistle invasions. Selective broadleaf herbicides such as 2,4-D, dicamba, and clopyralid kill yellow starthistle without affecting grasses.

Herbicides may be applied at the seedling, rosette, or bolting stages of yellow starthistle, but higher rates are required to kill larger plants. Herbicides can be applied as late as bud stage to prevent seed formation. Applications during flowering have minimal benefit because they do not prevent seed production, and yellow starthistle plants die anyway after producing seed.

Clopyralid and picloram have residual soil activity, killing yellow starthistle seedlings that emerge later. Because additional starthistle seedlings emerge whenever there is enough soil moisture, nonresidual herbicides may have to be reapplied to achieve the same duration of control as residual herbicides.

You might prefer to use a nonselective herbicide if your long-term goal is to change the vegetative composition from annual weeds to desirable perennials. Glyphosate applied about 10 days prior to seeding controls green, actively growing annual grasses and broadleaf plants.

Herbicides control competition for new seedings and also serve important roles in prevention and containment programs. Check with your county office of the OSU Extension Service for specific recommendations; always follow label instructions.

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.

Prevention and containment

There are three key elements for preventing yellow starthistle invasion or return.

- Reduce the amount of yellow starthistle seed replenishing the seed bank.
- Use up deep soil moisture with perennials.
- Shade the soil surface.

There are several ways to achieve these objectives.

- Decrease seed movement from infested areas by pressure washing equipment and cleaning boots, pets, and anything else in which a seed might become lodged.
- Avoid driving ATVs or riding horses through yellow starthistle patches.
- Do not feed yellow starthistle-contaminated hay to livestock. Animals that might have ingested starthistle seed should be quarantined for 5 to 6 days.
- Establish populations of biological control insects to reduce seed production by scattered plants.
- Plan to invest strategically in routine maintenance by spot spraying, pulling, or digging a few plants each year—a worthwhile insurance policy to prevent isolated "hot spots" from becoming a serious problem.
- Maintain maximum vigor and soil cover in perennial grass stands.

Remember that any activity that increases sunlight at the soil surface benefits yellow starthistle. Late fall and early spring grazing, burning, or mowing remove soil cover, even if they do not damage the perennial bunchgrasses. Natural disturbances such as rodent activity favor yellow starthistle establishment.

Generally, it is not possible to eradicate yellow starthistle. A more realistic goal is to establish perennial grasses that limit the weed population to scattered individuals. This strategy requires minimal inputs of labor, herbicides, and money after establishment.

Key elements for managing existing infestations

- Shade yellow starthistle seedlings.
- Use up deep soil moisture with perennials.
- Reduce yellow starthistle seed production.

For further reading

OSU Extension publications

Yellow Starthistle: Ecology and Management on Pacific Northwest Rangelands, EM 8580, by L. Larson, R. Sheley, M. McInnis, and G. Kiemnec (Oregon State University, Corvallis, 1994). http://extension.oregonstate.edu/catalog/html/em/em8580/

OSU Extension Service has many other publications on weeds that may be viewed or downloaded from the Web. Visit the online Publications and Videos catalog at http://extension.oregonstate.edu
Copies of our publications and videos also are available from OSU Extension and Experiment Station Communications. For prices and ordering information, visit our online catalog or contact us by fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513).

Other publications

Biological Control in the Western United States: Accomplishments and Benefits of Regional Research Project W-84, 1964–1989, edited by J.R. Nechols, L.A. Andrews, J.W. Beardsley, R.D. Goeden, and C.G. Jackson (University of California Div. Agric. Nat. Res. Pub. 3361, Oakland, 1995). http://www.fao.org/agris/search/display.do?f=./1997/v2314/US9719880.xml;US9719880

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