**Centaurea solstitialis**

**System:** Terrestrial

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<th>Kingdom</th>
<th>Phylum</th>
<th>Class</th>
<th>Order</th>
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<td>Magnoliophyta</td>
<td>Magnoliopsida</td>
<td>Asterales</td>
<td>Asteraceae</td>
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**Common name**
- geeldissel (English), golden star thistle (English), St. Barnaby’s thistle (English), yellow centaury (English), yellow cockspur (English), yellow star thistle (English), sonnwend-Flockenblume (German)

**Synonym**
- *Leucantha solstitialis*, (L.) A. & D. L?

**Similar species**
- *Centaurea melitensis*

**Summary**
Centaurea solstitialis is a winter annual that can form dense impenetrable stands that displace desirable vegetation in natural areas, rangelands, and other places. It is best adapted to open grasslands with deep, well-drained soils and an annual precipitation range of 25 to 150cm per year. It is intolerant of shade. Although populations can occur at elevations as high as 2,400 m, most large infestations are found below 1,500 m. Human activities are the primary mechanisms for the long distance movement of *C. solstitialis* seed. The short, stiff, pappus bristles are covered with barbs that readily adhere to clothing, hair, and fur. The movement of contaminated hay and uncertified seed are also important long distance transportation mechanisms. Wind disperses seeds over short distances.

[view this species on IUCN Red List](http://www.iucngisd.org/gisd/species.php?sc=263)
Species Description
DiTomaso (2001) reports that Centaurea solstitialis is an erect winter annual (sometimes biennial), which grows mostly to 1m tall (occasionally to 2m tall) with spiny yellow-flowered heads. The first few leaves are typically oblanceolate (shaped like a lance-point reversed, with the tapering point attached to the leafstalk). Subsequent rosette leaves are oblanceolate or entire to pinnate-lobed. Later rosette leaves are 15cm long, typically deeply lobed to midrib. Lobes are mostly acute, with toothed to wavy margins. Stems are stiff, openly branched from near or above the base or sometimes not branched in very small plants. Leaf bases extend down the stems (decurrent) and give stems a winged appearance. Largest stem wings are typically 3mm wide. Foliage is grayish to bluish green, densely covered with fine, white, cottony hairs that hide thick, stiff hairs and glands. Taproots grow vigorously early in the season to soil depths of 1m or more, giving plants access to deep soil moisture during the dry summer and early fall months. Flowerheads are ovoid, spiny, solitary on stem tips, and consist of numerous, yellow disk flowers. Vigorous individuals of C. solstitialis may develop flower heads in branch axils. The involucre (phyllaries as a unit) is approximately 12-18mm long. Phyllaries are palmately spined, with one, long central spine and 2 or more pairs of short lateral spines. Phyllaries are more or less densely to sparsely covered with cottony hairs or with patches at the spine bases. The central spines of the main phyllaries are 10-25mm long, stout, and yellowish to straw-coloured throughout. Lateral spines occur typically in 2-3 pairs at the base of the central spine. The corollas are yellow, and mostly 13-20mm long. Flowerheads produce two types of achenes (seeds), both glabrous, approximately 2-3mm long, and with broad bases. Achenes are barrel-shaped, compressed, and laterally notched at the base. Flowers at the periphery of the flowerheads produce dull, dark brown (often speckled with tan) achenes that are darker and have no pappus (the bristly, feathery, or fluffy perianth whorl crowning the ovary). This seed type represents between 10 and 25% of the total seed and often remains in the seedheads until late fall or winter. The central flowers produce glossy, gray, or tan to mottled cream-coloured and tan seeds with a short, stiff, unequal, white pappus (2-5mm long). This represents the majority of seed produced (75-90%).

Lifecycle Stages
Over 90% of Centaurea solstitialis seeds are germinable one week after seed dispersal (Benefield et al. 2001, Joley et al. 1997, Roché et al. 1997, Sheley et al. 1983, 1993, in DiTomaso, 2001). Maximum germination of seeds (nearly 100%) occurs when seeds are exposed to moisture, light and temperatures of 10, 15, or 20 Celsius (Joley et al. 1997, Roché et al. 1997, in DiTomaso, 2001). At temperatures above 30 Celsius, germination is dramatically reduced (Joley et al. 1997, Roché et al. 1997, in DiTomaso, 2001). When exposed to light and moisture, germination occurs rapidly (typically by 24 hours) with nearly all seed germinating within 96 hours (Sheley et al. 1983, 1993, in DiTomaso, 2001). DiTomaso (2001) reports that seeds may be relatively short-lived under normal field conditions where seeds are predominantly dispersed on the soil surface. Furthermore, microbial degradation and invertebrate predation of C. solstitialis seeds contribute significantly to the rapid depletion of the soil seedbank.

Uses
Zouhar (2002) reports that Centaurea solstitialis is regarded as an important honey source plant in California and other western states. It is used in Turkish folk medicine for the treatment of ulcers. In a laboratory study, aqueous extracts of fresh or dried flowers of C. solstitialis given orally showed significant (p<0.01) antiulcerogenic activity in rats.
Habitat Description
DiTomaso (2001) states that *Centaurea solstitialis* is best adapted to open grasslands with an annual precipitation range of 25 to 150 cm per year. It is generally associated with deep, well-drained soils and infestations thrive in disturbed areas with high sunlight exposure. Although populations can occur at elevations as high as 2,400 m, most large infestations are found below 1,500 m. Zouhar (2002) reports that it is uncommon in deserts and moist coastal sites. It invades and dominates annual grasslands by using the deep soil moisture that remains after shallow-rooted annual grasses die in early summer. Seedlings are more likely to establish in soils with deep silt loam and loam with few coarse fragments (Larson and Sheley 1994, in DiTomaso, 2001).

Reproduction
Zouhar (2002) states that the plant is monoecious (male and female flowers on the same plant), pollinator-dependent, and facultatively xenogamous (can cross fertilise with other plants). Most of the plants are self-incompatible. Honeybees play an important role in the pollination of *C. solstitialis* and can account for 50% of seed set (Barthell et al. 2001, Maddox et al. 1996, in DiTomaso, 2001). Bumblebees are the second most important floral visitor to flowers, but several other insects also contribute to fertilisation of the ovules (Barthell et al. 2001, Harrod and Taylor 1995, in DiTomaso, 2001). Seed production per seedhead ranges from about 35 to over 80 seeds (Benefield et al. 2001, Maddox 1981, in DiTomaso, 2001), depending upon the site. DiTomaso (2001) states that large plants can produce over 100,000 seeds. *C. solstitialis* infestations can produce 50-100 million seeds per acre (DiTomaso et al. 1999a, Maddox 1981, in DiTomaso, 2001).

Nutrition
The nutritional component of yellow starthistle leaves is high during the growing season (Callihan et al. 1995). However, its nutrient value declines as the plants mature. Yellow starthistle in the pre-spiny stage contains between 8 to 14% protein (Thomsen et al. 1990). However, an analysis of the nutritional status of cattle manure in the fall indicated that yellow starthistle-infested pastures contain considerably less crude protein and total digestible nutrients compared to uninfested pastures (Barry 1995).
General Impacts
DiTomaso (2001) states that due to the spiny nature of the plant, livestock and wildlife avoid grazing in heavily infested areas. Thus, infestations can greatly increase the cost of managing livestock. In addition to rangeland, pastures and grasslands, *C. solstitialis* is also an important weed problem along roadsides and an occasional problem in dryland cereals, orchards, vineyards, cultivated crops, and wastelands (Maddox *et al.* 1985, in DiTomaso, 2001). It can also reduce land value and reduce access to recreational areas (DiTomaso *et al.* 1998, Roché and Roché 1988, in DiTomaso, 2001). In addition, *C. solstitialis* infestations can reduce wildlife habitat, displace native plants, and decrease native plant and animal diversity (Sheley and Larson 1994, in DiTomaso, 2001). Because of its high water usage, *C. solstitialis* threatens both human economic interests as well as native plant ecosystems (Dudley 2000, in DiTomaso, 2001). Although no economic assessments have been conducted for *C. solstitialis*, millions of dollars in losses probably occur from interference with livestock grazing and forage harvesting procedures, producing lower yield and forage quality of rangelands (Callihan *et al.* 1982, Roché and Roché 1988, in DiTomaso, 2001). DiTomaso (2001) states that when ingested by horses, it causes a neurological disorder of the brain called nigropallidal encephalomalacia or "chewing disease." Continued feeding results in brain lesions and ulcers in the mouth (Kingsbury 1964, in DiTomaso, 2001). In most cases, poisoning destroys the animal’s ability to chew and swallow and death occurs through starvation or dehydration (Panter 1991, in DiTomaso, 2001). DiTomaso (2001) states that only horses are affected by ingesting *C. solstitialis*. Other animals, including mules and burros, are not susceptible to the toxic effect of the weed.
Management Info
DiTomaso (2001) states that mechanical, cultural, biological, and chemical control options are available for management of *C. solstitialis*. Most often a single method is not effective in the sustainable control of *C. solstitialis* and other range weeds. A successful long-term management program should be designed to include combinations of mechanical, cultural, biological, and chemical control techniques.

**Physical**: Mowing can be used as a mechanical option for control provided it is well timed and used on plants with a high branching pattern. Cultural control options include grazing, prescribed burning, and re-vegetation with competitive species. Burning should be timed to coincide with the very early *C. solstitialis* flowering stage; at this time, it has yet to produce viable seed, whereas seeds of most desirable species have dispersed and grasses have dried to provide adequate fuel. Fire has little, if any, impact on seeds in the soil. In addition to controlling *C. solstitialis*, burning will reduce the thatch layer, expose the soil, and recycle nutrients held in the dried vegetation. Re-vegetation programs using perennial grasses or legumes can be effective for management of *C. solstitialis*, but establishment may be difficult in areas without summer rainfall.

**Chemical**: Clopyralid and picloram (not registered in California) are the most effective herbicides for full season control of the weed. Unlike most post-emergence herbicides, they provide both foliar and soil activity. The best timing for application is when *C. solstitialis* is in the early rosette stage. Clopyralid gives one season of control and is generally used at 110gm a.e./ha; 290gm product/ha. Picloram has longer soil residual activity than clopyralid (two to three years) and is applied at 0.28kg and 0.42kg a.e./ha. Glyphosate is a non-selective herbicide that is also effective on *C. solstitialis*. It will control bolted plants at 1.1kg a.e./ha; 9.4 liters product/ha or 1% solution and can be used as a late season spot treatment to small infestations or escaped plants.

**Biological**: Sheep, goats, or cattle are effective in reducing *C. solstitialis* seed production when grazed after plants have bolted but before spines form on the plant. Goats will eat the plant even in the spiny stage. Six biological control agents of *C. solstitialis* have been imported from Europe and are well established in the western United States. Of these, most effective are the hairy weevil (*Eustenopus villosus*) and the false peacock fly (*Chaetorellia succinea*). These insects attack the flower/seed head, and directly or indirectly reduce seed production by 43 to 76%. They do not, by themselves, provide sustainable management of *C. solstitialis* but can be an important component of an integrated approach. The most widely studied pathogen for *C. solstitialis* control is the Mediterranean rust fungus, *Puccinia jaceae*. It can attack the leaves and stem of *C. solstitialis*, causing enough stress to reduce flowerhead and seed production. The organism is currently under investigation and has not been released for use.

Pathway
Its introduction in North America probably occurred sometime after 1849 as a seed contaminant in Chilean-grown alfalfa seed (DiTomaso, 2001). The movement of contaminated hay and uncertified seed are also important long distance transportation mechanisms (DiTomaso, 2001). Seed is transported in large amounts on the undercarriage of vehicles (DiTomaso, 2001).

Principal source: Element Stewardship Abstract for *Centaurea solstitialis* L. (DiTomaso, 2001)
SPECIES: *Centaurea solstitialis* (Zouhar, 2002)
**GLOBAL INVASIVE SPECIES DATABASE**

**FULL ACCOUNT FOR: Centaurea solstitialis**

**Compiler:** National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

**Review:** Dr. Joseph M. DiTomaso, Weed Science Program, Department of Vegetable Crops, University of California, Davis, USA

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### ALIEN RANGE

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### BIBLIOGRAPHY

7 references found for Centaurea solstitialis

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**Abstract:** Studying germination in the native and non-native range of a species can provide unique insights into processes related to invasion. We explored differences in the germination strategy of *Centaurea solstitialis* (L.) L. (Asteraceae) in its native range and from two non-native regions with different climates. We found that seeds from all native populations, and those from the non-native region with summer rain, exhibited a largely unique germination strategy compared to the non-native region with summer drought. These results suggest that the germination strategy of *C. solstitialis* may be determined by the climatic conditions that follow germination for this annual ruderal plant. Specifically, germination was lower for native and non-native populations experiencing greater variation in winter precipitation among studied regions. These results suggest that rather than general climatic patterns, the degree of risk experienced at early developmental stages could exert an important control over the germination strategy of *C. solstitialis*. Further research is needed to understand how fitness trade-offs across different climates might influence the germination strategy of invasive species such as *C. solstitialis*.

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**DiTomaso J. (Undated) Element Stewardship Abstract for Centaurea solstitialis (Hawkweed).**

**DiTomaso J. (2001) Management information for Centaurea solstitialis.**

**Global Invasive Species Database (GDIS) 2015. Species profile Centaurea solstitialis.**