19 Bull Thistle (Spear Thistle)

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PEST STATUS OF WEED

Bull thistle, *Cirsium vulgare* (Savi) Tenore, is an invasive thistle from Eurasia, found throughout the United States and in Canada from Newfoundland to British Columbia. It is capable of invading fields, pastures, wastelands and along roadsides, but will not survive in cultivated fields.

Nature of Damage

Economic damage. Bull thistle occurs in overgrazed pastures, where heavy infestations can exclude livestock from infested areas. It also is common along roadside and vacant fields.

Ecological damage. Although bull thistle is a problem predominantly in disturbed areas, it also can be found in natural areas. The basal rosette may grow to nearly 1 m in diameter before bolting, and, once established, bull thistle outcompetes native plant species for space, water, and nutrients.

Geographical Distribution

Bull thistle was introduced into the eastern United States several times during the 19th century. It is now established in all 48 contiguous states as well as Alaska and Hawaii (USDA, NRCS, 1999). It has been designated as a noxious weed in Maryland, Pennsylvania, Minnesota, Iowa, Oregon, and Colorado.

BACKGROUND INFORMATION ON PEST PLANT

Taxonomy

Bull thistle differs from Canada thistle, *Cirsium avense* (L.) Scop., in that leaves are pubescent on both sides, while those of Canada thistle are not pubescent on top, and may or may not be so on the underside. Flower bracts of bull thistle have spines, in contrast to those of Canada thistle. Leaves are covered with coarse hairs on the upper surface of the leaf blade, and are woolly below. Long spines extend from the leaf blade at the midrib and at each lobe. The leaf bases extend downward on the stem forming long wings.

Biology

Bull thistle is a biennial species that reproduces by seed. The root system consists of several primary roots each with several smaller lateral roots. It does not reproduce by vegetative means. Bull thistle is erect and bushy in appearance, up to 2 m high, and has many spreading branches (Fig. 1). Stems are erect, stout, often branched, and hairy. Leaves are green on the upper side, with woolly gray hairs on the underside, and end in long, pointed, yellow spines. The compact large purple flower heads (2.5 to 5.0 cm in diameter) are borne singly at the tip of a stem (Fig. 2), each producing up to 250 light straw-colored seeds. Mature plants can produce up to 4,000 seeds

Figure 1. Bull thistle stand. (Photograph by L.-T. Kok.)

per plant. Bull thistle grows best on nitrogen-rich, neutral soils with moderate moisture (Klinkhamer and de Jong, 1993). It is not typically found on sand or on soils with high humus content and is absent from pure clay soils. Establishment is promoted by soil disturbance, which increases nutrient, water, and light availability to seedlings and reduces the vigor of competing vegetation (Randall, 1994). Bull thistle does not grow well in shade and drought. Phenolic acids inhibit competing plants through allelopathic effects or serve as a defense, coupled with spines, against herbivory (Klinkhamer and de Jong, 1993).

Figure 2. Bull thistle bloom, close up. (Photograph by L.-T. Kok.)

Analysis of Related Native Plants in the Eastern United States

Cirsium vulgare belongs to the tribe Cardueae (family Asteraceae), which is largely an Eastern Hemisphere group. The tribe is further divided into four subtribes (Echinopsidinae, Carlininae, Carduinae, and Centaureinae) including some 13 genera in North America (Bremer, 1994; USDA, NRCS, 1999). Only three of these 13 genera include species native to North America: (1) *Centaurea* (two species; subtribe Centaureinae), (2) *Saussurea* (seven species; assigned to the subtribe Carduinae, but the position of the genus in the tribe remains uncertain), and (3) *Cirsium* (subtribe Carduinae). The genus *Cirsium* includes about 100 native species, of which a few are threatened or endangered plants in the United States (*Cirsium fontinale* [Greene] Jepson var. *fontinale*, *Cirsium fontinale* [Greene] Jepson var. *obispoense* J. T. Howell, *Cirsium hydrophilum* [Greene] Jepson var. *hydrophilum*, *Cirsium pitcheri* [Torr. ex Eat.] Torr. and Gray, and *Cirsium vinaceum* Woot. and Standl.).

Some 20 native *Cirsium* species occur in the eastern United States: *C. altissimum* (L.) Hill, *C. canescens* Nutt., *C. carolinianum* (Walt.) Fern and Schub., *C. discolor* (Muhl. ex Willd.) Spreng., *C. drummondii* Torr. and Gray, *C. engelmannii* Rydb., *C. flodmanii* (Rydb.) Arthur, *C. hilii* (Canby) Fern., *C. horridulum* Michx., *C. lecontei* Torr. and Gray, *C. muticum* Michx., *C. ochrocentrum* Gray, *C. nuttalii* DC., *C. pitcheri* (Torr. ex Eat.) Torr. and Gray, *C. pumilum* (Nutt.) Spreng., *C. repandum* Michx., *C. texanum* Buckl., *C. turneri* Warnock, *C. undulatum* (Nutt.) Spreng., and *C. virginianum* (L.) Michx. (USDA, NRCS, 1999). Of these, *C. pitcheri* is listed as threatened under the Endangered Species Act. It occurs in sand dunes along the shores of the Great Lakes in Illinois, Indiana, Michigan, and Wisconsin.

HISTORY OF BIOLOGICAL CONTROL EFFORTS IN THE EASTERN UNITED STATES

Area of Origin of Weed

Cirsium vulgare is a native of Europe, western Asia, and North Africa.

Areas Surveyed for Natural Enemies

Bull thistle was not considered a priority species when the thistle biological control program started in the early 1960s. However, it was included in the extensive surveys of natural enemies of Canada and musk thistle started in Europe in 1961 by the Commonwealth Institute of Biological Control (now CABI Bioscience), funded by Canada Department of Agriculture. Surveyed areas included southern England, France, Austria, Germany, northern Italy, and the northern part of the former Yugoslavia (Zwölfer, 1965).

Natural Enemies Found

More than 40 species have been recorded on bull thistle by Zwölfer (1965), of which 15 were reportedly broadly oligophagous on plants in the subtribe Carduinae (see Table 1 in the chapter on musk thistle). Only the seed-feeding fly, *Urophora stylata* Fabricius,

has been selected and released for biological control of bull thistle. With the exception of *T. horridus*, none of the insect species released against *Cirsium arvense* or those used against *Carduus* species have been used for bull thistle.

Host Range Tests and Results

Oviposition and larval development of *U. stylata* were observed on the target host plant and on *Onopordum acanthium* L. in experimental host range studies carried out in the early 1970s. Oviposition, but no larval development was recorded on *Arctium tomentosum* Miller and *Carduus acanthoides* L. European field records include *Carduus acanthoides*, *Cirsium arvense*, *Cirsium pannonicum* (L.f.) Link, and *Cirsium canum* (L.) All. (Zwölfer, 1972).

Releases Made (from Julien and Griffiths, 1999)

Urophora stylata was released in Maryland and Washington in 1983, and was followed by releases in Colorado, Oregon, Montana, and California.

BIOLOGY AND ECOLOGY OF KEY NATURAL ENEMIES

Urophora stylata (Diptera: Tephritidae)

The adult fly (Fig. 3) lays eggs in the closed flower buds. Gall tissue is formed around each larva separately (Zwölfer, 1972). The gall starts to form around the immature achene and the adjacent region of the receptacle begins to swell. Mature larvae (Fig. 4) overwinter within the flowerheads of bull thistle. Pupation occurs in May and adults emerge in June.

Figure 3. *Urophora stylata* adult. (Photograph by Peter Harris.)

Figure 4. *Urophora stylata* larva. (Photograph by Peter Harris.)

EVALUATION OF PROJECT OUTCOMES

Establishment of *U. stylata* in Maryland has not been confirmed, but this species is established in the western United States, with 60 to 90% of seed heads infested in some areas (Julien and Griffiths, 1999).

Trichosirocalus horridus has been released on bull thistle in Wyoming, but the establishment of the weevil has not been confirmed. Following initial releases on *Carduus acanthoides* in Virginia, some 20% of the bull thistle plants within the release areas also were exploited by this rosette weevil (McAvoy *et al.*, 1987).

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