

By Preston G. Sullivan  
NCAT Agriculture Specialist  
August 2004  
©NCAT 2004

**Abstract:** *Thistles compete with desirable forage and grain crops like clover and wheat and are a major pest in almost every state. This publication focuses on two of the more troublesome thistles (Canada and musk), with some coverage of other thistles such as plumeless, Italian, bull, and yellow star. Since thistles are a widespread problem, most Extension offices around the country have guidelines on thistle control and management. This publication focuses on the cultural, biological, organic, and least-toxic methods available for their control.*



## Biology

Common along the east coast, musk thistle occurs in 45 states.(Hoback et al., 2003) Musk thistle is a biennial – germinating in the summer and overwintering in the rosette stage, then bolting and flowering in the spring. It is adapted to a wide range of growing conditions and elevations.(Hoback et al., 2003) Musk thistle is also known as nodding thistle and is listed as a noxious weed in some states. A single musk thistle plant can produce up to 20,000 seeds, some of which can remain viable in the soil for seven years.(Hoback et al., 2003) The seed has no innate seed dormancy requirement.(McCarty et al., 1969) The seeds can germinate as soon as conditions are favorable. Eighty percent of the wind-dispersed seeds go only 130 feet from the parent plant, while almost none travel further than 322 feet.(Smith and Kok, 1984) Therefore, the key is to eradicate thistle plants before they produce seed. Seeds in the flower may mature even after the flower head has been cut, so try to control thistles before they bloom.

Canada thistle not only grows from seeds but also from roots, making it much more difficult to control. Young plants emerge from underground roots to make a denser patch. Even a half-inch piece of Canada thistle root can grow into a new plant.(Anderson, 2001) Researcher Rich Zollinger planted one 6-inch root piece that produced 644 feet of roots and 336 feet of above-ground shoots in 15 months.(Anon., 1996) Canada thistles arise as male and female plants, with only the females producing viable seed. To control Canada thistle, you must not only take out the top growth but deplete the root reserves to prevent regrowth. Besides Canada thistle, other perennials include the Platte and wavyleaf thistles. Besides musk, other biennial thistles include bull, field, Scotch, and tall. Yellow star and Italian thistles are annuals, while plumeless is an annual or biennial.

In pastures, thistles take advantage of bare spots to get established. Bare spots are prevented by not overgrazing and providing adequate fertility and lime to assure a dense stand of forage. The weakest link in the thistle life cycle is when the seeds are germinating and getting established. This is the most effective and least costly point of attack for a long-term solution. Spraying adult thistle with herbicides will kill the adult plants but will do nothing to stop new ones from growing from seeds already in the soil.

Although thistle seeds are wind-dispersed, it is important to avoid transporting them to new areas where they have not previously grown. Transportation is most common with contaminated hay, equipment that has thistle seeds on it, and flowing streams that have thistle seeds in the water. Clean the equipment when moving it from a thistle-infested field to a clean field, and avoid bringing contaminated hay on to land without thistle populations. To avoid their spread, remove or treat small thistle outbreaks on previously clean land as soon as they become apparent.

## Biological Control

Several beneficial insects have been used to reduce thistle populations. Some have become naturalized and continue to provide control without reintroduction. There are commercial sources of beneficial thistle-control insects.



Thistle head weevil  
*Rhinocyllus conicus*  
Photo by Noah Poritz, Bio-control.com

The adult thistle-head weevil, *Rhinocyllus conicus*, feeds and mates on musk, plumeless, and a few more thistles while they are in the rosette stage. Once the plants bolt, the females lay eggs on the flower heads and stems. When the larvae hatch, they bore into the seed heads to feed on developing seed. This weevil is the most widely distributed insect for thistle control in the U.S., being found in wild populations in most states from coast to coast where musk and plumeless thistle occur. (Poritz, 2002) These weevils can reduce thistle populations by 90 to 95% in 8 to 10 years. (Anon., 2002) Since they also feed on native thistles, they may decrease populations of rare thistle species too. Because of their wider-than-expected host range, USDA APHIS has prohibited interstate movement of the *Rhinocyllus* weevils. (Poritz, 2002) They can be moved within a state, however. These insects are not a quick fix. The best sites for these weevils to get established have heavy musk thistle infestation, are not currently being used for

grazing, and are where the thistles are not going to be disturbed. The weevils must complete their life cycle in the thistles in order for the insects to damage the plants and reproduce. These weevils typically leave areas where cattle are present, thus they may not be a useful management strategy for controlled grazing situations. (Hartzler, 1995) See [www.co.stevens.wa.us/weedboard/htm\\_bio/rhinocyllus%20conicus.htm](http://www.co.stevens.wa.us/weedboard/htm_bio/rhinocyllus%20conicus.htm) for more information on *Rhinocyllus* weevils.



Thistle rosette weevil  
*Trichosirocalus horridus*  
Photo by Noah Poritz, Bio-control.com

The thistle rosette weevil, *Trichosirocalus horridus*, feeds on musk thistle during the rosette stage, killing first-year rosettes and stopping the growth of older plants. (Hoback et al., 2003) The thistle defoliating beetle, *Cassida rubiginosa*, feeds on leaves of Canada, musk, and plumeless thistles. Adult beetles lay an average of 800 eggs per female, and both the adults



Thistle defoliating beetle  
*Cassida rubiginosa*  
Photo by Noah Poritz, Bio-control.com

and larvae feed on thistle foliage throughout the growing season. Read more on *Cassida rubiginosa* at [http://res2.agr.ca/lethbridge/weedbio/agents/acasrub\\_e.htm](http://res2.agr.ca/lethbridge/weedbio/agents/acasrub_e.htm).



Thistle-stem gall fly  
*Urophora cardui*  
Photo by Noah Poritz, Bio-control.com

The thistle-stem gall fly, *Urophora cardui*, attacks the Canada thistle stem, boring in and causing the plant to form a gall. The gall lowers normal plant function and reproduction, causing the plants not to flower in some cases. The severity of impact on Canada thistle depends on whether the galls are on the main shoots or lateral shoots, and whether the insects attack the thistle early or late in the season. Larger galls on young main stems reduce plant height by more than half. (Harris, 2003) To learn more about the stem gall fly, see [http://res2.agr.ca/lethbridge/weedbio/agents/aurocard\\_e.htm](http://res2.agr.ca/lethbridge/weedbio/agents/aurocard_e.htm).

A flower weevil, *Larinus planus*, also attacks Canada thistle and reduces seed production much as the musk thistle-head weevil does. These larvae feed on the flowers, and the adults consume foliage. Being an accidental introduction, *Larinus* weevils are no longer permitted for interstate transport by USDA APHIS, but occur in the wild on the eastern and western seaboard of the U.S. (Poritz, 2002) To learn more about *Larinus planus*, see [http://res2.agr.ca/lethbridge/weedbio/agents/alaripla\\_e.htm](http://res2.agr.ca/lethbridge/weedbio/agents/alaripla_e.htm).



Flower weevil  
*Larinus planus*  
Photo by Noah Poritz, Bio-control.com



Stem mining weevil  
*Ceutorhynchus litura*  
Photo by Noah Poritz, Bio-control.com

A stem-mining weevil, *Ceutorhynchus litura*, feeds on young Canada thistle plants. As the thistle plant bolts, the larvae continue to mine through the stem, eventually causing exit holes where they leave the stem near the ground. The larvae pupate in the soil, emerging in late summer to overwinter as adults. To learn more about *Ceutorhynchus litura*, see [http://res2.agr.ca/lethbridge/weedbio/agents/aceutlit\\_e.htm](http://res2.agr.ca/lethbridge/weedbio/agents/aceutlit_e.htm).

Starthistle is attacked by the yellow starthistle bud weevil, *Bangasternus orientalis*, and the yellow starthistle hairy weevil, *Eustenopus villosus*. Larvae and adult bud weevils feed on the flowers, thus reducing seed production. The hairy weevil adults feed on the outside of the flowers, while the larvae feed inside the flowers. As with the bud weevil, the hairy weevil also reduces seed production. More information on yellow starthistle is available from <http://wric.ucdavis.edu/yst/manage/management6.html#insects>.



Yellow starthistle bud weevil  
*Bangasternus orientalis*  
Photo by Noah Poritz, Bio-control.com



Yellow starthistle hairy weevil  
*Eustenopus villosus*  
Photo by Noah Poritz, Bio-control.com

Even though research has shown these beneficial thistle insects to be effective in reducing a stand of thistle, they are often slow to get established and would not be of much help in freeing fields of thistle in the first year. On the other hand, once they are established, and if they are not killed off by pesticides, they can provide long-term biological control of thistle. In general it seems apparent that some thistle plants will have to remain in order for these beneficial insects to retain their populations. In situations where all the thistles in an area are being hand cut or spot sprayed, and thus not allowed to complete their life cycle, most of the above mentioned biocontrol insects would not sustain themselves. These biocontrol insects seem most appropriate in remote inaccessible pastures and on range land where mowing or treating with herbicides is not practical. A combination of competitive



forages, wise grazing management, and biocontrol provided by these insects can virtually eliminate thistle by suppressing and stressing the thistle plants out of existence. Biological Control of Weeds, Inc. (see **References**), a Montana-based distributor of beneficial insects, sells several of the beneficial insects mentioned above that attack musk thistle, Canada thistle, and yellow starthistle.

High-intensity, short-duration rotational grazing reduces thistle populations by promoting a dense, competitive stand of forages. A dense stand of grass minimizes thistle's ability to get established from seed. The young seedlings have great difficulty emerging from below a thick cover of grass or a dense mat of dead grass on the ground. Additionally, sheep and cows will nibble at thistles in the rosette stage. Goats eat thistles more frequently, especially the flowers, which eliminates seed production. Goats can be run with cattle to generate additional income and control weeds. Horses, donkeys, and llamas will also eat Canada thistle flowers.(Anderson, 2001)

## Mechanical Control

Musk and other annual or biennial thistles reproduce only by seed. Tilling, hoeing, or hand pulling should be done before flowering. Cut the plant below the ground or as close to the ground as possible to prevent regrowth. Cutting or mowing is more effective later in the season when the stem core is hollow, but before flowering. At that time, the plant is least likely to regrow. If cut in the rosette stage, they will regrow easily. Mowing can wait until two days before blooming to prevent seed production.(Anderson, 2001) Mowing or hand cutting only four days after flowering will allow some seeds to mature. Plants cut after the flowers open should have the flowers removed. Put the flowers in a tight container and bury or otherwise destroy them. Timing a mow can be difficult since thistles don't all bloom at the same time. It's important to reestablish desirable forage or crop plants with adequate fertility soon after thistle is controlled, to provide competition to future thistle plants. Appropriate grazing management that eliminates bare ground and produces a dense stand of forage goes a long way toward good thistle control.

Canada thistle, being a perennial, requires repeated removal of the top growth to weaken or kill the plants. Farmer recommendations for controlling Canada thistle include repeated mowing and various tillage operations. North Dakota farmer Terry Jacobson (Bowman, 1997) recommends using a "Noble" wide-blade sweep plow set with three 7-inch sweeps when thistle plants are in the purple-bud stage. This plow undercuts surface weeds. A coulter runs in front of each sweep to prevent clogging. Continue to till every 21 days until frost. Reportedly, this produces about 95% eradication of Canada thistle. In integrated methods, spot treatment with a systemic herbicide for these perennials could be an option.

## Integrated Methods

California researchers (Thomsen et al., 1996) tested mowing in combination with controlled sheep grazing and subterranean clover plantings for starthistle control. The researchers theorized that the subclover would help fill the niche vacated by the yellow starthistle populations. They chose an undeveloped pasture dominated by starthistle and annual grasses. They compared subclover seeding + grazing + two mowings, grazing + mowing without subclover, and an untreated area without grazing, subclover, or mowing. Thistle seed production was 130 times higher where only one mowing was done, and 1,720 times higher where nothing was done, as compared to the area that had been grazed and mowed twice. Thistle flower-head density was 0.2 per square meter for mowing+grazing, 43 per square meter for one mowing, and 420 per square meter for no treatment. This study shows that excellent yellow starthistle control can be achieved with competition from desirable plants, such as subclover, combined with mowing and rotational grazing.

Researchers at South Dakota State University (Tonneson, 1988) tested 56 combinations of crops, cultivations, and sprayings for their ability to control Canada thistle. Six of them gave 75 to 90% control. They are 1) cultivate every three weeks during good growing periods such as June or July, using a field cultivator or a blade implement or a one-way disc; 2) spray grain crops in the five-leaf stage with 2,4-D Amine at  $\frac{3}{4}$  pound per acre to reduce stands by 30%, then cultivate three or four times after harvest; 3) follow small grain harvest by plowing, then spray thistles that emerge before frost; 4) spray thistles after small-grain harvest and plow the field in October – this plan has the hazard of leaving the soil bare over the winter; 5) prepare the soil with a sweep cultivator or blade before drilling soybeans, forage sorghum, buckwheat, sudangrass, or millet during late June. Following harvest, plow and cultivate once or twice; 6) cultivate with a blade or sweep cultivator every three weeks from June 1 to August 15, then seed alfalfa or a perennial grass mixed with alfalfa.

In a two-year Virginia study (Kok et al., 1986) researchers investigated the effect of tall fescue in combination with two thistle weevil species (*Trichosirocalus horridus* and *Rhonocyllus conicus*). They found that fescue competition had a higher impact on thistle than either of the weevil species. Musk thistle seeds had low germination rates when planted in a one-year old stand of tall fescue. Seeds that did manage to germinate in the fescue stand grew poorly and never reached their reproductive stage.

## Least-toxic Herbicide Control

Several herbicides are labeled for thistle control. Information on these and their rates should be available through your local Extension office. Using a low-toxicity herbicide for spot spraying should suffice as a sustainable practice in situations where thistle density is low.

U.S. Department of Agriculture Researchers in Maryland tested various strengths of vinegar on Canada thistle. (Daniels, 2003) They found that either a 5% or 10% solution of vinegar burned off the top growth of Canada thistle. The plants, however regrew from the roots. Acetic acid in vinegar kills plant tissue by dissolving the cell membrane, which causes the plant to dry out. Vinegar works best when used in the sun. A word of caution, however: vinegar in concentrations greater than 5% acetic acid may be hazardous – burning the skin or damaging the eyes – and should be handled with care. Additionally, vinegar is not registered with EPA for use as herbicide. (Byczynski, 2003)

Several vinegar-based herbicides have been developed, including St. Gabriel Labs' BurnOut Weed and Grass Killer concentrate and Nature's Glory Weed and Grass Killer concentrate. These two come as 25% concentrates with instructions to dilute them to 6.25% and use on non-crop, right-of-ways, and industrial lands. (Byczynski, 2003) More dilute products that come ready-to-use include Fast-Acting BurnOut RTU, Nature's Glory Weed and Grass Killer RTU, and Greenergy's Blackberry and Brush Block, with acetic acid concentrations from 6.25% to 7%. The Greenergy product lists acetic acid as an inert ingredient and citric acid (at 7% concentration) as the active ingredient. SummerSet Products sells a vinegar-based herbicide called Alldown Green Chemistry Herbicide that has been approved for use in organic farming by the Organic Materials Review Institute (OMRI). Alldown contains vinegar, garlic, and citric acid.

Nature's Glory Weed and Grass Killer RTU and Fast Acting Burn Out RTU are registered with EPA. Greenergy's Blackberry and Brush Block and Alldown Green Chemistry herbicide have a 25(b), "minimum risk pesticide," exempt status with EPA, and so do not have EPA registration numbers. The Greenergy product lists acetic acid as an inert ingredient and citric acid (at 7% concentration) as the active ingredient. If an herbicide has an EPA registration number, it has been approved for sale "at the Federal level." However, companies must still register their products with the individual states to sell them there.

## Soil Conditions and Pasture Management

Some farmers report that thistles grow where soil calcium levels are low, iron is high, and phosphorus is low or complexed.(Anderson, 2001) Thistles seem to prefer soils high in anaerobic bacteria, where residue decay is poor, or the soil is compacted. Virginia farmer, writer, and speaker Joel Salatin offers his experiences with thistles in his book *Salad Bar Beef*. He discusses the poor soil quality on his farm when the family first moved onto the place in 1961. The pastures were nothing but dewberries, briars, other weeds, and broomsedge. The farm grew so many thistles that it looked like a snowstorm when they baled hay. After several years of controlled grazing and applying compost, Salatin's pasture is lush with red clover, white clover, thick grasses, and a healthy smattering of forbs. Fewer than a dozen thistle plants can be found on the whole farm.(Salatin, 1995) Salatin speaks highly about the power of natural succession, using animals and plants to progress to the next higher level of plant community – in this case, one with few thistles. He moves cattle to new pasture paddocks every 24 hours, allocating the correct amount of forage they will need each day in a given paddock. Read more about rotational grazing in the ATTRA publications *Rotational Grazing*, *Matching Livestock and Forage Resources in Controlled Grazing*, and *Sustainable Pasture Management*.

## References

Anderson, Lee. 2001. Keeping thistles at bay. ACRES USA. February. p. 26.

Anon. 2002. Understanding life cycle in helpful in managing musk thistle. High Plains Journal. September 9. p. 7-B.

Anon. 1996. Why Canada thistle's so tough to kill. Soybean Digest. April. p. 16.

Biological Control of Weeds, Inc.  
1418 Maple Drive  
Bozeman, MT 59715  
800-334-9363 (toll-free)  
406-586-5111  
406-586-1679 FAX  
bugs@bio-control.com  
www.bio-control.com

Bowman, Greg (ed.). 1997. Steel in the Field; a farmer's guide to weed management tools. Sustainable Agriculture Network Handbook Series, Book 2. National Agricultural Library, Beltsville, MD. 128 p.

Bycznki, Lynn. 2003. The vinegar brouhaha. IPM Practitioner. September/October. p. 7-8.

Daniels, C.H. 2003. What's cooking with vinegar recommendations. Acetic Acid as Herbicide. North Dakota Pesticide Quarterly. Vol. 21, No. 1. January. 8 p.

Greenergy Inc. (maker of Blackberry and Brush Block)  
P.O. Box 6669  
Brookings, OR 97415  
Greenergy@Earthlink.net  
www.greenergyinc.com/

Harris, P. 2003. Classical biological control of weeds established biocontrol agent, *Urphora cardui* (L.). Stem-gall fly. Agriculture and Agri-Food, Canada. 5 p. Available at [http://res2.agr.ca/lethbridge/weedbio/agents/aurocard\\_e.htm](http://res2.agr.ca/lethbridge/weedbio/agents/aurocard_e.htm).

Hartzler, Robert G. 1995. Evaluation of a biological control agent for musk thistle. Leopold Center Progress Report. Vol. 4. p. 77-80

Hoback, W. Wyatt, Kerri M. Skinner, and Leon G. Higley. 2003. Exotic Species Curriculum for Agricultural Problem-solving Education. Kearney, NE: University of Nebraska. [www.unk.edu/acad/biology/hoback/escape/muskthistle\\_facts.html](http://www.unk.edu/acad/biology/hoback/escape/muskthistle_facts.html)

Kok, Lok T., T.J. McAvoy, and W.T. Mays. 1986. Impact of tall fescue grass and *Carduus* thistle weevils on the growth and development of musk thistle. *Weed Science*. Vol. 34. p. 966-971.

McCarty, M.K. et al. 1969. Germination and Early Seedling Development of Musk and Plumeless Thistle. Nebraska Agricultural Experiment Station Resource Bulletin No. 229.

Nature's Glory Weed and Grass Killer  
866-298-2229  
[www.naturesglory.com/](http://www.naturesglory.com/)

Poritz, Noah. 2002. Personal communication.

Salatin, Joel. 1995. Salad Bar Beef. Polyface, Inc. Swoope, Virginia. 368 p.

Smith, L.M., II, and L.T. Kok. 1984. Dispersal of musk thistle seeds. *Weed Science*. Vol. 32. p. 120-125.

St. Gabriel Labs - makes BurnOut herbicide  
800-801-0061 (toll free)  
[www.milkyspore.com/burnout.htm](http://www.milkyspore.com/burnout.htm)

SummerSet Products  
584 Kennebec Dr, Eagan, MN 55122  
651-452-0599  
651-452-4041 FAX  
[www.sumerset.com](http://www.sumerset.com)

Thomsen, Craig D., William A. Williams, William Olkowski, and Dave W. Pratt. 1996. Grazing, mowing and clover plantings control yellow starthistle. *The IPM Practitioner*. February. p. 1-4.

Tonneson, Lon. 1988. Fifty ways to win the war against thistles. *The Farmer*. January 2. p. 14.

## Web Resources

### **Exotic Species Curriculum for Agricultural Problem-solving Education**

By W. Wyatt Hoback, Kerri M. Skinner, and Leon G. Higley

University of Nebraska, Kearney, NE

[www.unk.edu/acad/biology/hoback/escape/muskthistle\\_facts.html](http://www.unk.edu/acad/biology/hoback/escape/muskthistle_facts.html)

*An educational tool about musk thistle.*

### **Managing Canada Thistle**

Colorado State University Extension Service

[www.colostate.edu/Depts/CoopExt/Adams/weed/canada\\_thistle\\_mgt.html](http://www.colostate.edu/Depts/CoopExt/Adams/weed/canada_thistle_mgt.html)

### **Managing Musk and Scotch Thistle**

Colorado State University Extension Service

[www.colostate.edu/Depts/CoopExt/Adams/weed/msthistle\\_mgt.htm](http://www.colostate.edu/Depts/CoopExt/Adams/weed/msthistle_mgt.htm)

### **Canada Thistle**

<http://dnr.metrokc.gov/wlr/lands/weeds/thisc.htm>

### **Bull Thistle**

<http://dnr.metrokc.gov/wlr/LANDS/Weeds/thisb.htm>

### **Musk Thistle Identification and Control**

Kansas State University

[www.oznet.ksu.edu/library/crpsl2/sections/l231d.pdf](http://www.oznet.ksu.edu/library/crpsl2/sections/l231d.pdf)

### **Canada Thistle**

Montana Weed Control Association

[www.mtweed.org/Identification/Canada\\_Thistle/canada\\_thistle.html](http://www.mtweed.org/Identification/Canada_Thistle/canada_thistle.html)

### **Scotch Thistle**

<http://dnr.metrokc.gov/wlr/lands/Weeds/Scotthis.htm>

### **Yellow Starthistle**

IPM Practitioner's Association, Eugene, OR

<http://members.efn.org/~ipmpa/Noxystar.html>

### **Canada Thistle**

by K.G. Beck

[www.ext.colostate.edu/pubs/natres/03108.html](http://www.ext.colostate.edu/pubs/natres/03108.html)

*Fact Sheet 3.108.*

### **Integrated Management of Musk Thistle**

Oklahoma State University Extension Service

[www.ento.okstate.edu/ipm/weeds/muskthistle.html](http://www.ento.okstate.edu/ipm/weeds/muskthistle.html)



**Management of Canada Thistle**

[www.co.larimer.co.us/depts/pubwor/weeds/management/MgtCanadaThistle.htm](http://www.co.larimer.co.us/depts/pubwor/weeds/management/MgtCanadaThistle.htm)

**Thistle Control Alternatives**

**By Preston Sullivan**

**NCAT Agriculture Specialist**

**©NCAT 2004**

**Edited by Paul Williams**

**Formatted by Cynthia Arnold**

**CT156**

**Slot 199**

**081804**

The Electronic version of **Thistle Control Alternatives** is located at:

HTML:

<http://www.attra.ncat.org/attra-pub/thistlecontrol.html>

PDF

<http://www.attra.ncat.org/attra-pub/PDF/thistlecontrol.pdf>