



# Integrated Management of Invasive Thistles in Oklahoma

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Invasive thistles of immediate concern in Oklahoma include bull thistle (*Cirsium vulgare*), musk thistle (*Carduus nutans*), Scotch thistle (*Onopordium acanthium*), distaff thistle (*Carthamus lanatus*), and Canada thistle (*Cirsium arvense*). These five thistles were introduced from Europe and Eurasia, where diseases and insects not present in the United States kept their populations at tolerable levels. The current Oklahoma Thistle Law declares musk, Scotch, and Canada thistle to be noxious weeds and public nuisances in all counties of the state and requires a "Plan of Action" for control by all landowners whose land is infested. Since other, native thistle species exist in Oklahoma, it is important to properly identify and control the five introduced, invasive thistle species.

## Short Introduction on History, Distribution and Identification

For more details see, "Thistles in Oklahoma and Their Identification," Fact Sheet 2776, and "Musk Thistle Management Action List," L-308.

**Bull thistle** (*Cirsium vulgare*) (Figure 1) has existed in Oklahoma for more than 40 years and is currently distributed statewide. Rarely does it reach infestation levels to justify treatment. This is likely due to insects that commonly feed on native thistles (*Cirsium* spp.) also feeding on bull thistle.

**Muskthistle** (*Carduus nutans*) (Figure 2) was first documented in Payne County, Oklahoma, in 1944. Musk thistle has now been documented in almost every county in the state (Figure 3) and, in 1994, was declared a noxious weed in the state of Oklahoma. Integrated control using herbicides and musk thistle weevils can provide satisfactory control.

**Scotch thistle** (*Onopordium acanthium*) (Figure 4) invaded Oklahoma from the west and is known to exist in several Oklahoma counties, including Roger Mills, Custer, Love, Texas, Harper, and Woodward (Figure 5). It is more difficult

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**Figure 1.** The leaf margins of a flowering bull thistle plant (a) are tipped with spines, and the stems have spiny wings. The flower heads of bull thistle are top-shaped and can be white to purple in color. Bull thistle generally behaves as a biennial in Oklahoma, remaining in the rosette stage for most of its life.

to control with herbicides. No biological control options are available for Scotch thistle.

**Distaff thistle** (*Carthamus lanatus*) (Figure 6) infestations were reported in McClain and Grady counties about 25 years ago. However, those infestations were not allowed to flower, and no other infestations have been reported.

**Canada thistle** (*Cirsium arvense*) (Figure 7) is a perennial thistle widely distributed in northern states. Some plants were collected in the Oklahoma Panhandle counties over 50 years ago, but currently no infestations are known to exist in the state. In 1998, a Canada thistle infestation was reported in Meade County, Kansas, the only infestation in the 14 Kansas counties adjoining Oklahoma.

## Thistle Growth and Development

Bull, musk, and Scotch thistle are generally classified as biennials in the northern states where plants emerge in the spring, grow as a rosette (i.e. a vegetative stage) the first growing season, overwinter as rosettes, then the second spring they bolt and produce seed (Figure 8). However, in Oklahoma



Figure 2. Musk thistle seedlings (a) can emerge in the fall and behave as an annual weed or in the spring and behave as a biennial weed. The rosette leaves of annual musk thistle plants (b) (i.e. emerging in the fall) are not as deeply lobed or spiny as the leaves of the biennial plants. Biennial musk thistle plants (c) can produce over 10,000 seeds per plant. The flower heads of musk thistle (d) are deep rose to purple and powder-puff shaped.

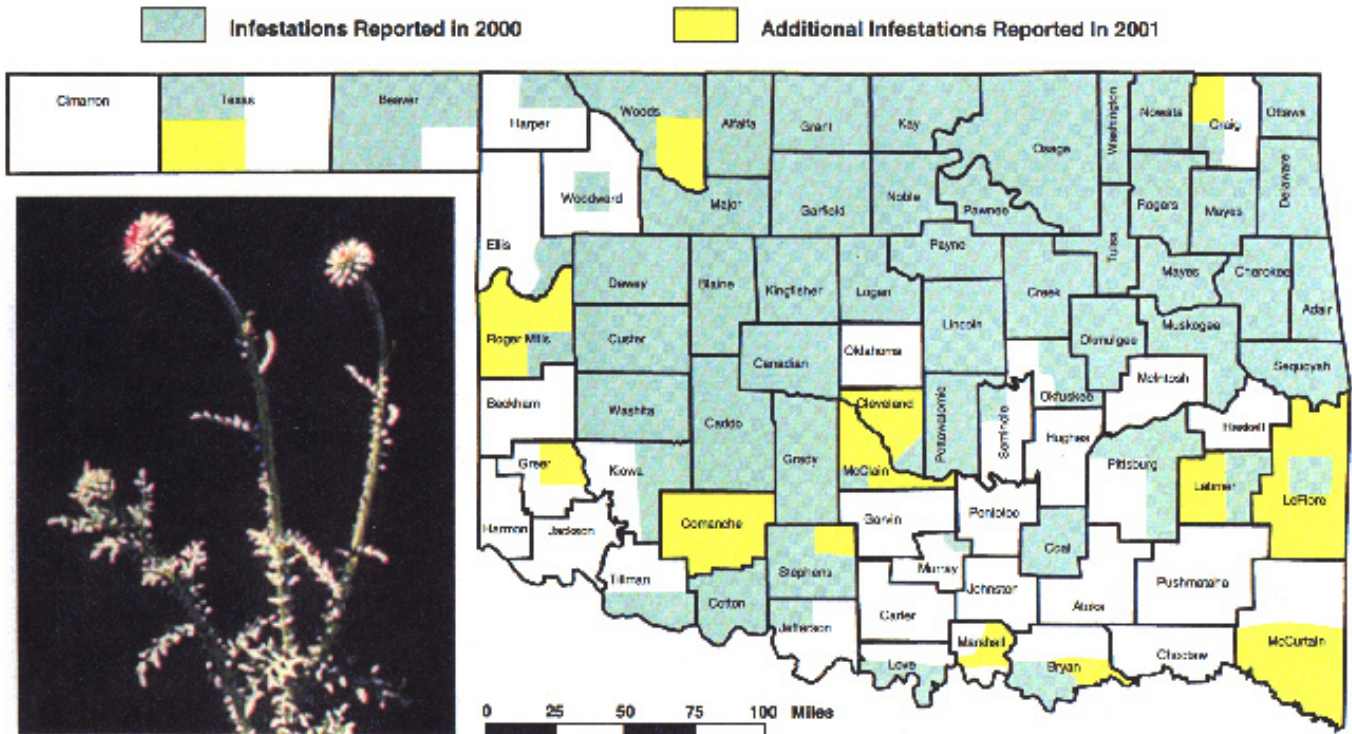


Figure 3. Infestation of Musk Thistle in Oklahoma, December 2001. (Information from 2000 and 2001 survey results provided by Oklahoma Department of Agriculture)





Figure 4. The leaves of seedling Scotch thistle (a) are densely covered with fine cotton-like hairs. During bolting (b) Scotch thistle leaves can grow to over twelve inches in width. The reddish-purple flower head (c) is globe-shaped.

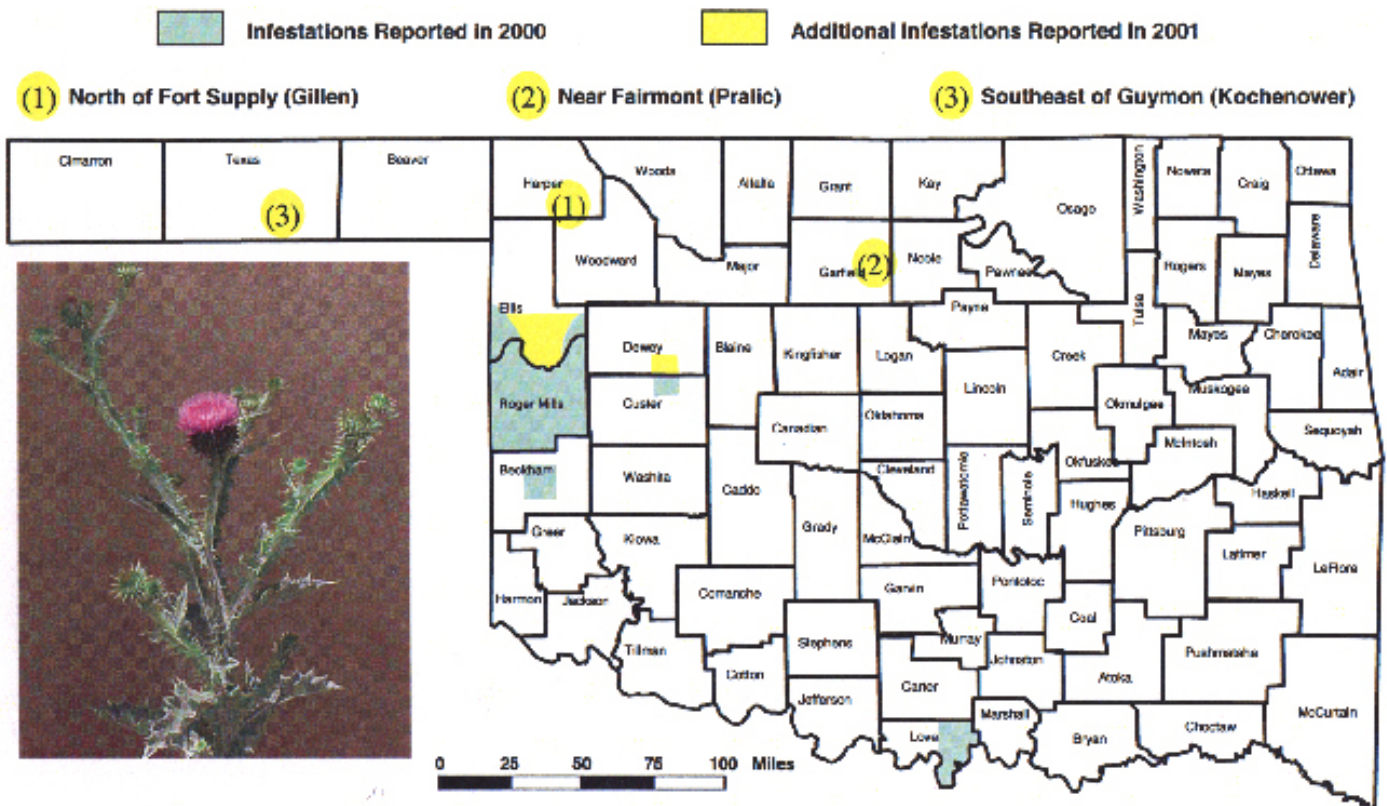


Figure 5. Infestation of Scotch Thistle in Oklahoma, December 2001. (Information from 2000 and 2001 survey results provided by Oklahoma Department of Agriculture)



Figure 6. Distaff thistle (a) is a robust, spiny annual thistle. It has yellow flowers (b) set in a whorl of spiny leaves.



Figure 7. A Canada thistle plant (a) may consist of several shoots located in the same area, but connected underground by rhizomes (b). The flower head of Canada thistle (c) is smaller than the other thistles and light pink, but will turn white after several days.

when these three thistles germinate in the fall, they behave as cool-season annuals (i.e., germinate in the fall, overwinter as a rosette, bolt and produce seed in the spring). Distaff thistle is classified as an annual, but Canada thistle is a perennial weed, capable of spreading by airborne seed and also by its root system.

## Integrated Management of Thistles

### Prevention

Annual and biennial thistles spread by the movement of seed-contaminated hay and wind or water dispersion into uninfested areas (Figure 9). Preventing the spread of thistles

requires cooperation among all landowners. If invasive thistles are not present, use of feed and hay from infested areas should be avoided. Do not allow any thistles to produce seed on or near your area. If plants do appear, immediately destroy them by cutting off their root system below ground or spraying them with herbicide before they produce seed. If an infestation is already present, an integrated control program should be initiated. Remember, one plant can produce up to 10,000 seeds, with some seeds continuing to germinate for as long as nine years.

### Mechanical Control

Mechanical control involves tillage and mowing of plants before they produce seed. Using a tillage implement, hoe,



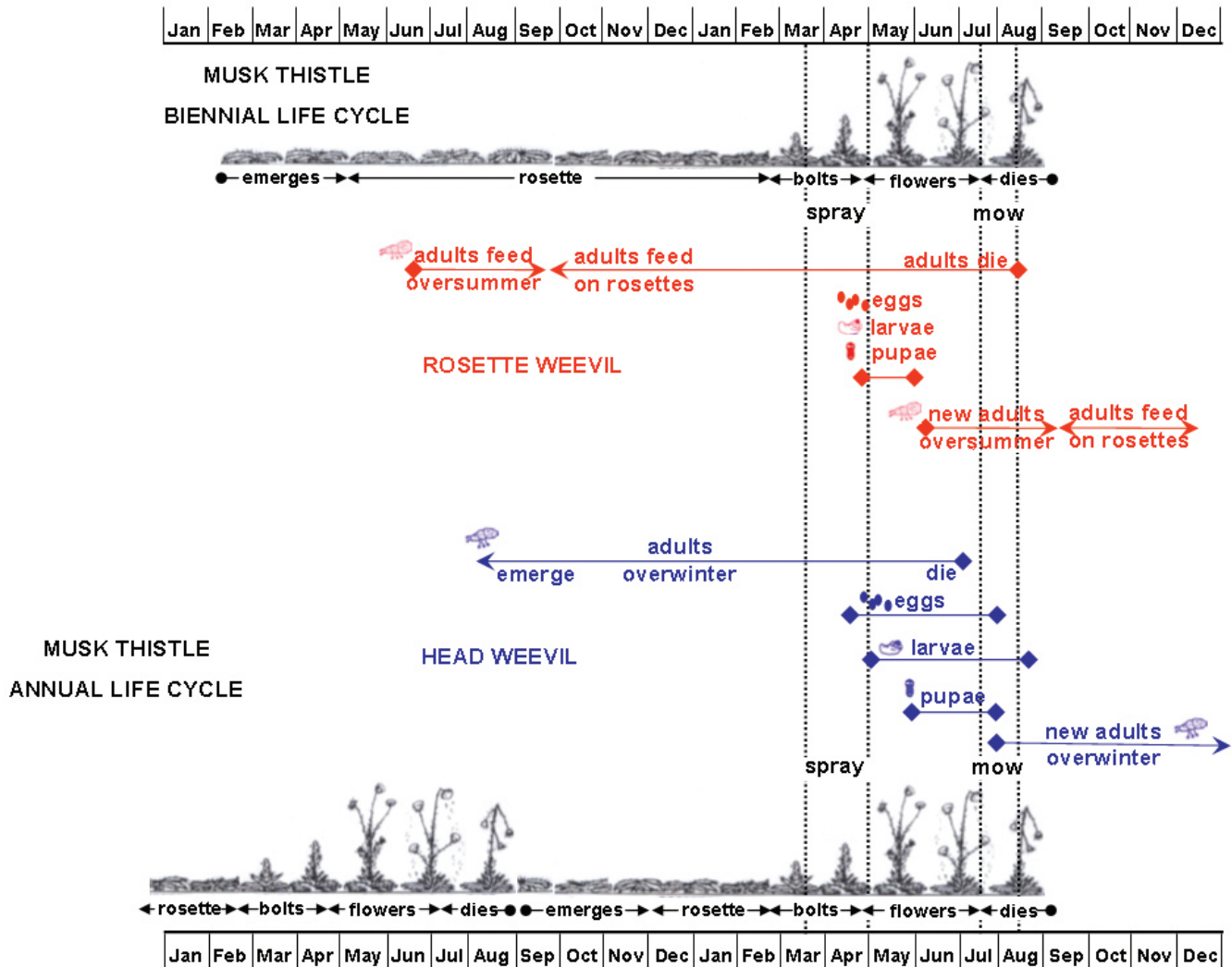


Figure 8. The life cycles of biennial and annual musk thistle and the rosette and head weevils.

or spade to cut the annual or biennial thistles off below the crown area is an effective way to kill individual plants. Mowing can prevent seed production, but should be done as close to the ground surface as possible when terminal heads start blooming. If the mowing height is too high, lower leaf axils may produce late-season blooms and seeds. If mowing is conducted after plants have begun blooming, some flowers may still produce viable seed.

### Chemical Control

The best chemical control of musk thistles in Oklahoma has been with spring applications to rosette plants in March (Table 1). If 2,4-D or Transline (1/3 to 2/3 pt./acre) is used in the spring, spray in March or early April before plants start bolting. Once plants begin bolting in April, they are more difficult to control; however, 90 to 100 percent control is possible with Grazon P+D (2 pt./acre), or Weedmaster (2 pt./acre), or Cimarron Max (Rate 1), applied in late April or early May. Cimarron (3/10 oz./acre) applied to bolted plants in late April or early May can reduce musk thistle seed production 98 to 100 percent, but some plants may re-sprout to produce new

flowers and seed. Therefore, tank mix 2,4-D (1 pt./acre) with the Cimarron to control the plants and prevent seed production. Grazon P+D, Weedmaster, Cimarron Max, or 2,4-D applied to pastures in late April or early May will also control most summer weeds like ragweeds, bitter sneezeweed, or common broomweed. All herbicide applications should be made to actively growing weeds, with adequate soil moisture, and when daytime air temperatures are above 60° F. Always read and follow the herbicide label.

Bull thistle infestations are generally kept in check by biological pests of the thistles native to Oklahoma. However, chemical control options are available for this weed if necessary (Table 1). Bull thistle can be controlled with 2,4-D (3 pt./acre) applied to rosettes in the fall. A spring application of Grazon P+D (2 pt./acre), Weedmaster (2 pt./acre), or Cimarron Max (Rate 1), to rosettes or bolted plants will control bull thistle as well as other summer annual weeds present. Always read and follow the herbicide label.

Currently, there are no biological options for controlling Scotch thistle. Scotch thistle still in the rosette stage can be controlled with Cimarron (3/10 oz./acre), Escort (1 oz./acre),



**Figure 9. The flowers of musk thistle (a) mature over several weeks each summer. Thistle seed (b) are easily spread by the wind due to the pappus that is attached to each seed.**

Grazon P+D (2 pt./acre), Weedmaster (2 pt./acre), Cimarron Max (Rate 1), or Vanquish (1 to 2 pt./acre) applied in early April (Table 1). Bolting Scotch thistle plants can be controlled with Grazon P+D, Cimarron Max (Rate 1), or Weedmaster (1 pt./acre) tank mixed with Cimarron (3/10 oz./acre). Always read and follow the herbicide label.

### Biological Weed Control

Biological weed control is the use of natural enemies (plant pathogens, insects, or herbivores) to reduce weed populations in an infested area. Advantages of biological control include: 1) low cost, 2) non-target organisms are unaffected, 3) adjoining infested areas will attract the control agent, 4) requires little effort once established, and 5) can be used with other methods. Two biological control agents introduced for control of musk thistle are the thistle head weevil [*Rhinocyllus conicus* (Froelich)] and the rosette weevil [*Trichosiromus horridus* (Panzer)].

The thistle head weevil can reduce musk thistle populations by 90 to 95 percent eight to ten years after establishment. The thistle weevil larvae feed in the receptacle of developing flowers, disrupting seed development and thus the spread and proliferation of musk thistle. The thistle head weevils (Figure 10) overwinter as adults until early spring, when they feed on rosettes and mate. Female adult weevils then lay approximately 100 eggs on the bracts of emerging flowers. The adult weevils then die. The eggs hatch in six to eight days, and the larvae feed on flower heads for 25 to 30 days before entering pupation. After three to four weeks, adult weevils emerge to seek overwintering sites, but these adults will not lay eggs until spring, when thistles bolt.

The rosette weevil can complement the work of the thistle head weevil by killing small musk thistles in the rosette growth stage. On larger plants, the rosette weevil disrupts apical dominance resulting in shorter, multiple-stemmed,

**Table 1. Herbicide recommendations for controlling invasive thistles in Oklahoma.**

Herbicides Labeled <sup>a</sup>	Rate	Expense Level <sup>b</sup>	Recommendations for Controlling Invasive Thistles <sup>c</sup>		
			Fall - rosette	Spring - rosette	Spring - bolted
<b>Pasture &amp; Range</b>					
2,4-D Amine	2 pt./acre	\$	M	M	—
2,4-D Amine	3 pt./acre	\$	M - B	M	—
Cimarron	3/10 oz./acre	\$	—	S	—
Grazon P+D	2 pt./acre	\$\$	M - B - S	M - B - S	M - B
Weedmaster	2 pt./acre	\$\$	M - B - S	M - B - S	M - B
Cimarron + 2,4-D Amine	3/10 oz. + 1 pt./acre	\$\$	M	M	M
Cimarron + Grazon P+D	3/10 oz. + 1 pt./acre	\$\$\$	M	M	M - S
Cimarron Max	Rate 1	\$\$\$\$	M	M	M - S
<b>Roadsides</b>					
Escort	1 oz./acre	\$\$\$\$	—	S	—
Transline	1/3 to 2/3 pt./acre	\$\$\$\$	—	M	—
Vanquish	1 to 2 pt./acre	\$\$\$\$	—	S	—

a 2,4-D, Cimarron, Grazon P+D, and Weedmaster are labeled for pastures and rangelands. Escort, Transline, and Vanquish are labeled for non-cropland. Grazon P+D is a restricted use pesticide. Read labels for specific information and guidelines prior to using the product.

b Check your dealer for updated prices.

c Control includes killing the actively growing plant and preventing it from producing seed. Best results are obtained with spring applications, so that fall and spring emerging seedlings are actively growing at the time of treatment. M = musk thistle, B = bull thistle, and S = Scotch thistle.



**Figure 10.** The thistle head weevil (a) is larger than the rosette weevil (See Figure 11a). The head weevil (b) lays eggs on bracts of newly emerged flower heads. When the eggs hatch, the larvae make their way to the young seed of the head (c), where they feed on and destroy musk thistle seed.



**Figure 11.** The rosette weevil (a) is smaller than the head weevil (See Figure 10a). Feeding of the rosette weevil can lead to less competitive, multiple-stemmed plants that produce fewer seed, or even destruction of the musk thistle growing point (b).

and less competitive plants (Figure 11). The rosette weevil can overwinter in the adult, egg, or larval stages. Females begin laying eggs (1,200 to 2,000 per female) in late fall on the midribs of leaves, overwinter and resume laying eggs in the spring. Larvae hatch and feed in the center of a rosette, which can destroy the growing point. New adults emerge in early May, feed on plants, and rest underground during the summer, after which they emerge to mate and lay eggs in early autumn.

### Collecting and Releasing Musk Thistle Weevils

The Oklahoma Cooperative Extension Service and cooperating landowners began a program to release thistle head weevils in northeast Oklahoma in 1991. To date, more than 334,000 weevils have been collected in Missouri, Kansas, and Oklahoma and released on 670 sites in Oklahoma. Most of the early release sites now have populations high enough for use as collection sites.

Both head and rosette weevils should be collected after musk thistle plants have bolted one to two feet (about mid-May), on sunny days when weevils are active on the upper portions of the plant. Collect weevils by beating the upper portion of the plant with a dowel rod while holding a sweep-net beneath

the plant. Occasionally tap on the net to keep weevils from escaping. After collection, separate the weevils from debris, spiders, and other insects. Place 500 adult head weevils or 200 adult rosette weevils in cardboard containers with tight fitting lids, and place in an ice chest. Do not use plastic cartons because of moisture accumulation and resulting weevil mortality. Weevils need to be kept on ice or in a refrigerator until release. Weevils should be released as soon as possible (within 48 hours) to ensure that eggs are not deposited in storage containers. At least 500 head weevils and/or 200 rosette weevils should be released at each site. Simply sprinkle weevils over the plants at a rate of about ten per plant. When possible, place weevils in the upwind area of large pastures or fields. Adult weevils will move with prevailing winds through the entire thistle infestation. The head weevils will begin to lay eggs once deposited, but the rosette weevils will not lay their eggs until new musk thistle seedlings emerge in the fall.

Studies have shown that releases are most successful if the area is not mowed or sprayed during times in thistle growth critical to the weevil life cycle, such as head development. When possible, release in areas free from livestock. Remember, it takes five to seven years for weevil populations to reach a point where thistle control occurs. Contact your county Extension office for additional information concerning weevil roundups in the spring.



## Integrated Control of Musk Thistle

Once an area has a heavy infestation of musk thistles, the most economical approach is an integration of various control options. A good integrated management approach would be:

1. Release thistle weevils on thick stands of musk thistle along fence rows or on non-pasture areas. It is important to protect these areas, by fencing if necessary, to ensure maximum opportunity of a continued weevil population.
2. Minimize seed production on infested pastures and on adjacent areas. There are many musk thistle seed in the pasture soil that will continue to germinate for up to five years. Seed production can be stopped by selective mowing and spot treating with herbicides.
3. Integrate control methods. Researchers in Missouri found that the best approach was to spray rosettes in the fall and from mid-March to mid-April, let the head weevils disrupt seed development in May and June, and then mow in mid-July after the larvae have pupated.
4. Once the thistle population decreases, rely less on herbicides for controlling the thistles and more on the weevils. This will ensure the continuation of weevil populations for future thistle flushes. Thereafter, only spot spray to control problem areas.

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