



Musk Thistle

Identification and Control

The musk thistle or nodding thistle (*Carduus nutans* L.) is usually a biennial or winter annual, but it occasionally occurs as a summer annual. As a biennial or winter annual, it produces a rosette the first year and develops flowers and seeds the second year. As a summer annual,

this thistle completes its life cycle from germination through seed production in the same growing season.

Seedlings may emerge anytime during the growing season, but the plants usually remain in the rosette stage for about 90 percent of their life cycle. The rosette, a cluster of tightly packed spreading or radiating basal leaves with

little or no stem elongation, may reach 3 to 5 feet in diameter by season's end.

Musk thistle plants vary in height from a few inches to over 6 feet depending upon soils and growing conditions. A large plant has a large fleshy taproot that is corky and hollow near the ground surface.



◀ Leaves

Leaves are coarsely lobed and dark green with a light green midrib. They may have a silver-gray leaf margin. Leaves have an alternate arrangement on the stem and are smooth and hairless on both sides. Each lobe has three to five points that end in a white or yellowish spine. The spiny musk thistle leaves extend onto a hairless stem, resulting in a winged appearance.

Seeds ▶

Seed dispersal begins seven to 10 days after a head begins to bloom. The yellowish brown or straw-colored seed is about $\frac{1}{8}$ inch long with one edge curved and the other edge almost straight. It is pointed at the tip and has a protrusion on its rounded base. The surface of the shiny seed is longitudinally grooved. Most of the seed of musk thistle germinates during the first year after production. However, some seed may remain viable for several years.

A Nebraska study on musk thistle found an average of 11,284 seeds produced per plant with 4,850 seeds capable of germination. About 1,000 seeds develop in the terminal head. Musk thistle seed are primarily dispersed by the wind, but research has shown that less than 1 percent of the seeds are blown more than 300 feet from the mother plant. Seed is also spread by surface water, people, livestock, wildlife, and machinery.

Flowers ▶

Musk thistle usually starts flowering in May and may bloom from seven to nine weeks. Musk thistle flower heads are "powder puff" in shape, in contrast to "shaving brush" flower heads of some other thistles. The colorful flowers are usually deep rose to violet or purple. White-flowered plants occur, but they are not common.



Heads ▶

A musk thistle plant may produce from one to over 100 heads depending upon soil and growing conditions. The upper one or two heads develop individually on long stems while lower branches may have from two to nine heads per branch. The large terminal head is 1½ inches or more in diameter, solitary, and is usually bent over slightly. Prebud, flower, and mature seed stages of development often occur simultaneously on the same plant.



Musk thistle was declared a noxious weed throughout Kansas in 1963. Kansas law requires that all persons and organizations prevent its spread and eradicate musk thistle on all lands they own or supervise. Further information on the noxious weed law is available from the county extension offices, county noxious weed directors, or from the Plant Protection and Weed Control Section, State Board of Agriculture, Topeka, Kansas 66612.

Musk thistle reduces forage production and utilization. Cattle will not graze forage plants in heavy infestations of this spiny thistle. Dense infestations of musk thistle compete strongly with grass or other desirable plants for water, light, and nutrients. Research in northeastern Kansas indicates one plant per square foot nearly decreases forage production in half (Figure 1). This results in lower income from grazing areas. Loss in income also results from lower quality hay due to contamination by this noxious weed.

Cultural Control

Remove scattered musk thistle plants in a field by hand. Dig below the crown of a musk thistle rosette to prevent further development of the plant. Dig, remove from the field, and burn musk thistle flowers that are in late bud or bloom stage. This method can prevent possible seed development and further infestation of adjacent areas. Nebraska research shows that mowing is most effective at full bloom but must be repeated as necessary for effective control. New stems can develop from the base of

Importance and Distribution

Musk thistle, a native of Asia, was found in the United States in New Jersey, New York, and Pennsylvania during 1853–1882. It was first reported in Kansas in 1932 in Washington County. Musk thistle is distributed throughout Kansas except in a few western counties. Heaviest infestations occur in the north central and northeast counties.

Musk thistles are found primarily in pastures, rangeland, hay meadows, alfalfa, roadsides, and waste areas. Musk thistle generally is not a problem in cultivated cropland, but may germinate and develop in fallow fields or after winter wheat is planted in the fall.



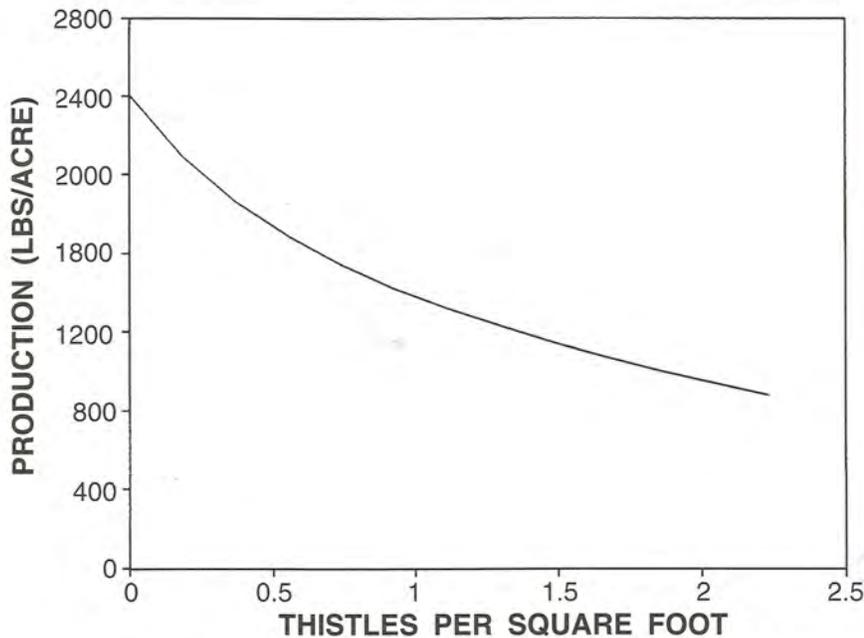


Figure 1. Musk thistle density affects on 1994 forage production in Pottawatomie County, KS.

mowed thistles, and these stems can produce flowers and seeds for future infestation.

Biological Control

The first line of defense against musk thistle should be proper grazing management. Musk thistle invasion is retarded on grasslands properly stocked to maintain a good cover of vigorous competing vegetation. Fertilization of cool-season forages is also an important practice in reducing weed invasion. Prescribed burning does not directly control musk thistle but makes control more effective in those pastures that have the weed. Burn at the proper time, wait 10 to 14 days after burning, and then spray.

The insect *Rhinocyllus conicus*, commonly known as the musk thistle head weevil, can provide biological control of musk thistle. The head weevil works best in isolated areas where disturbance by people or animals is restricted and use of

herbicides or cultural control methods is limited. Musk thistle weevils overwinter as adults. The weevils lay eggs on the bracts of the developing musk thistle flowers. Larvae tunnel into the swollen base (receptacle) of the flower to feed. Adults generally emerge in July.

The rosette weevil, *Trichosirocalus horridus*, was also introduced into Kansas to provide biological control of musk thistle. This weevil can destroy apical dominance resulting in multistemmed plants that are generally shorter and produce less seed. Rosette weevils alone seldom kill musk thistle. Use rosette and head weevils together or integrate with herbicides or mowing to eliminate seed production.

Integrated control of musk thistle using head weevils and herbicides is possible if spraying occurs in the fall or early spring while the thistles are still in the rosette stage. Mowing should be done after the

Reasons for Poor Control

- 1. Heavy infestation:** Small rosettes may be under leaf cover of other thistles.
- 2. Heavy plant growth:** Thick weeds or other plant growth above rosettes can result in reduced spray coverage on musk thistles.
- 3. Inadequate volume of spray used per acre:** Low spray volume can result in poor spray distribution and coverage.
- 4. Dry soil or cool temperatures:** This can result in little or no translocation of the herbicide.
- 5. Mature plants:** Treating musk thistles at stages later than the recommended stage can result in less effective control.
- 6. Improper calibration and adjustment:** Improper nozzle height may result in incomplete spray coverage or excess application. Improper sprayer speed or pressure can result in inaccurate rates of application.

primary heads have flowered and senesced (started to die).

Additional information regarding biological control is available from the Kansas State Board of Agriculture and from the Entomology Department, Kansas State University (see also Kansas State University Cooperative Extension publication L-873, *Biological Control of Musk Thistle in Kansas*).

Spring Application of Herbicides

Research conducted at Kansas State University has shown that 2,4-D, Banvel, Banvel + 2,4-D, Tordon, Ally, and Telar can all provide greater than 90 percent control of musk thistle rosettes when treated in the spring (Table 1). For most effective control in spring, apply the herbicide(s) while the musk thistle is in the rosette stage of growth and actively growing. The optimum time generally occurs after the soil thaws but before the flower stalk develops (bolting), usually in early May. Cool air temperatures and rainfall occurring too soon after the herbicide application can reduce the effectiveness of the treatment.

If farm work or other activities delay spring treatment until musk thistles bolt, the herbicide(s) may provide less effective control. Herbicide application to musk thistles in bloom reduces, but does not prevent, viable seed production. Herbicides recommended for bolted musk thistle control should be applied prior to the bloom stage (Table 2).

Fall Application of Herbicides

The fall period, from October 1 to soil freeze-up, is an excellent time to control musk thistle (Table 1). During the fall, most musk thistles are in the rosette stage of growth and most susceptible to herbicides. However, soil moisture may be limited and temperatures may be cool. To obtain best control of musk thistle under these conditions in the fall, apply 2 pounds 2,4-D low volatile ester or $\frac{1}{2}$ pound picloram acid equivalent per acre (Table 2).

Application of 2,4-D when temperatures exceed 60 degrees F, preferably 70 degrees F, for several hours may provide more favorable conditions for herbicide absorption and control of musk thistle than if application is made at lower temperatures.

Fall application has several advantages over spring treatment for musk thistle control. There is little hazard of injury from spray drift to foliage of nearby desirable plants after a killing freeze, and herbicide treatments may be applied to rosettes over a longer period in the fall than in the spring. Herbicide application is possible after crop harvest, if it is before soils freeze-up and air temperatures are favorable.

Factors for Optimum Control

Musk thistles are most susceptible to herbicides when they are growing rapidly under good soil moisture and favorable air temperatures (70 degrees to 90 degrees Fahrenheit). A six- to 12-hour rain-free period after application at the recommended rate is

adequate to allow herbicide absorption into the plant and achieve good control.

Herbicide Use Precautions

Chemical properties of a herbicide not only influence the effectiveness of controlling musk thistle and other weeds, but they also influence the effect on non-target organisms in the environment. Some herbicides are inactivated by the soil, but others may persist for weeks or months.

If improperly applied, a herbicide may result in (1) injury to the applicator, (2) spray drift that can injure or kill desirable plants, and (3) contamination of irrigation and domestic waters.

Herbicides registered for use to control musk thistle on pasture, rangeland, and/or non-cropland are 2,4-D, dicamba (Banvel), picloram (Tordon), chlorsulfuron (Telar), and metsulfuron (Ally/Escort). More than one treatment per year may be necessary. Annual treatments may be necessary for new seedlings.

Table 1.
Control of musk thistle rosettes treated in the fall or spring 1983-93, Kansas State University.

Herbicide	Rate (ai/A)	Fall		Spring	
		Range	Average	Range	Average
2,4-D amine	2 lb/A	0-100	85	89-100	99
2,4-D LVE	2 lb/A	56-100	92	80-100	99
Banvel	0.33 lb/A	55-100	88	51-100	94
Banvel + 2,4-D amine	0.25 + 0.75 lb/A	45-100	92	67-100	96
Tordon	0.125 lb/A	50-100	96	90-100	98
Ally	0.12 oz/A	17-100	77	55-100	92
Ally	0.18 oz/A	36-100	88	61-100	94
Telar	0.38 oz/A	0-100	67	17-100	83
Telar	0.75 oz/A	49-100	81	64-100	90

Table 2.
Herbicides registered for control of musk thistle

Herbicide and lbs acid equivalent needed per acre	Formulated product rate/acre	Comments and limitations
2,4-D amine or LV ester 1.5 to 2	1.5 to 2 qt 2,4-D amine or LV ester of 4 lbs/gal product	Apply during rosette stage of growth. In spring, apply at 1.5 lb ae/acre. For best control in fall, apply 2,4-D LV ester at 2 lb ae/acre. Can apply 2,4-D amine in fall if soil moisture is favorable and air temperature exceeds 50°F. Do not permit spray mist to contact desirable plants. Do not graze dairy animals within 7 days.
Dicamba (Banvel) 0.33	0.67 pt Banvel	Apply in spring during rosette stage of growth. Can apply Banvel in fall if soil moisture is favorable and air temperature exceeds 50°F. Do not apply near sensitive plants when temperature is > 85°F. Do not contaminate water for irrigation or domestic purposes. Follow label directions, precautions, and grazing limitations.
Dicamba (Banvel) + 2,4-D 0.25 + 0.75	0.5 pt Banvel + 0.75 qt, 2,4-D amine or LV ester of 4 lbs/gal product	Apply in spring during rosette stage of growth. Can apply in fall if soil moisture is favorable and air temperature exceeds 50°F. Follow label directions, precautions, and grazing limitations.
Picloram (Tordon) 0.1 to 0.125	0.375 to 0.5 pt Tordon 22K	Restricted-use herbicide. Apply during rosette stage in spring or in fall prior to freeze-up. Do not contaminate water or allow spray drift to contact desirable plants.
Picloram (Tordon) + 2,4-D 0.125 + 1	0.5 pt Tordon 22K + 1 qt, 2,4-D amine of 4 lbs/gal product	Tordon is a restricted-use herbicide. Apply to rosettes in the spring or fall or to bolted thistles prior to flowering.
Chlorsulfuron (Telar) 0.023 to 0.047	0.5 to 1 oz Telar + nonionic surfactant	Apply to rosettes in the spring or to bolted thistles prior to flowering. Do not apply to cropland. Do not contaminate any body of water.
Metsulfuron (Ally\Escort) 0.0075 to 0.011	0.2 to 0.3 oz Ally or Escort + nonionic surfactant	Apply to rosettes in the spring or to bolted thistles prior to flowering. No grazing restrictions. Do not apply to pastures with broadleaf species or ryegrass. Fescue may be injured. Prevent spray drift, runoff to adjacent sensitive crops, and do not apply to any body of water.

For ground application, apply the herbicide or herbicide mixture in water at 20 or more gallons of spray per acre or as directed on the label. Calibrate the sprayer so that it applies the recommended

rate of herbicide product per acre. Adjust the height of the spray boom for uniform spray coverage.

Carefully follow all directions and precautions on the herbicide product label

including those regarding (1) safety precautions, (2) wind conditions during application, and (3) hazards due to physiological and biochemical behavior.

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