

Noxious Weeds of Nebraska

Canada Thistle

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Canada Thistle

Canada thistle [*Cirsium arvense* (L) Scop.] is one of the nine species defined by Nebraska law as a noxious weed. At least 35 other states also have determined by law that Canada thistle poses a threat to the economic, social, and aesthetic well-being of the residents of their state. Canada thistle is probably the most widespread of all the thistle species and many land managers consider it the most difficult thistle to control. In Nebraska, Canada thistle is estimated to infest 375,000 acres.

Canada thistle differs from musk and plumeless thistle in that it is an aggressive weed in tilled cropland, range, pasture, and non cropland areas. The other thistles are not considered problem weeds in tilled cropland. Dense infestations of Canada

thistle growing in corn, soybeans, and wheat have been shown to reduce crop yields by 80 percent, 95 percent, and 60 percent respectively. Native grass forage production can be reduced by as much as 60 percent in dense infestations of Canada thistle (Figure 1). It is estimated that Canada thistle growing in Nebraska crop and pasture land causes over \$3 million in lost production each year. Canada thistle also harbors insects and is an alternative host for some diseases. Canada thistle can release toxic substances into the soil from both live and decaying plants, inhibiting the growth of some plants. When roots and shoots of Canada thistle plants are mixed with soil, growth of sugarbeet, wheat, alfalfa, and Canada thistle seedlings is reduced.



Figure 1. Dense infestations of Canada thistle can reduce native grass forage production by up to 60 percent.

History

Canada thistle is a native of Eurasia and was probably introduced to America around 1750. Canada thistle was first described in taxonomic texts in 1753 under the Latin name *Serratula arvensis* L. The first state to enact noxious weed legislation against Canada thistle was Vermont in 1795 followed by New York in 1831. Canada thistle was proclaimed a noxious weed in Nebraska in 1873. Since the early 1800s, Canada thistle has spread throughout the northern United States and Canada. It also is a serious weed in Africa, Europe, Japan, the Middle East, India, New Zealand, Australia, and South America.

Biology

Canada thistle is a member of the Asteraceae or sunflower family of plants. It is a perennial that reproduces from seed and by extensive horizontal roots from which arise aerial shoots. Once Canada thistle becomes established, plants can live and reproduce for many years (see *life cycle*, page 5). Horizontal roots spread rapidly and in a single season may grow 9 to 18 feet laterally and 6 to 9 feet deep. Canada thistle may form large circular patches with many of the plants interconnected through a common root system. Cultivation or tillage through these patches can cut roots; however, root segments as small as 1 inch can survive and produce new plants, spreading the original infestation.

Canada thistle is classified as a long-day plant. It requires a 16-hour day length to induce shoot elongation and flowering. In Nebraska flowering generally occurs in mid-June. If the day length is less than 16 hours, newly emerged shoots remain as low-growing rosettes. Canada thistle is dioecious — male and female flowers are produced on different plants so cross pollination is necessary for seed production. In most situations male flowers are smaller and don't have functional female parts, but occasionally small quantities of seed can be set. Female flowers may produce 40 to 80 seeds per head with large plants capable of producing 5,000 seeds. Viable seeds are produced after flowers have been open 8 to 10 days. Viable seeds generally will not be produced if plants are mowed during the flower bud stage.

Seed is important in the spread of Canada thistle and can be carried by wind for distances up to a half mile. Seed also can be carried by irrigation water, streams, rivers, and by man as a contaminant in crop seed or hay. Seeds may germinate once they have left the seed head or they may remain dormant in the soil for up to 20 years. Seed germination will occur on the soil surface or in the soil to a depth of 3 inches. Canada thistle seedlings that have four true leaves and are 20 to 30 days old begin to produce lateral roots that

contain adventitious root buds. These small plants can reproduce vegetatively and regenerate from the root system.

Canada thistle grows best where temperatures and rainfall are moderate. Summer temperatures above 90°F can retard plant growth, which is why the plant is more common in the northern United States.

The carbohydrate composition of Canada thistle roots allows the plant to overwinter in frozen soils. The total carbohydrate content in plant roots increases in October and remains high through April. Glucose, fructose, sucrose, and fructose polymers of various lengths are the main constituents of carbohydrates in the root. The composition of these carbohydrates changes in response to plant stresses such as moisture, freezing temperatures, and control measures. As freezing temperatures occur in the fall, long chain fructose polymers break down while short chain fructose polymers increase along with fructose and sucrose. The short chain fructose polymers are water soluble and reach high concentrations in small layers of water, preventing ice adhesions and protecting cell walls and membranes. This allows the root to overwinter.

Identification

In the seedling stage, Canada thistle cotyledons are oblong and fleshy. The first true leaves are obovate and do not have a petiole (Figure 2). Leaf margins have regularly spaced, coarse, marginal hairs that resemble the spines of later-developing leaves. Canada thistle usually grows to 2 to 3 feet tall with alternate, dark green leaves that vary in length from 2 to 7 inches and in width from 0.5 to 2.5 inches. Leaves are oblong or lanceolate, usually with crinkled edges

and spiny-toothed margins. The underside of leaves may be hairy or hairless when mature (Figure 3). Canada thistle stems are erect, branching, grooved, and without hair above and pubescent below (Figure 4). Flowering heads form in clusters on the ends of branches. Heads are about 0.5 inch in diameter and flowers are usually pink to purple but may be white (Figure 5). Seeds or achenes are smooth, light brown to straw colored, and 0.1 to 0.2 inches long (Figure 6). The seeds end in a conical point where a tan pappus is attached. When mature the seed falls from the plant and the pappus



Figure 2. Canada thistle cotyledons are oblong and fleshy. The first true leaves are obovate and do not have a petiole.



Figure 3. The underside of Canada thistle leaves can be hairy or hairless.



Figure 4. Canada thistle stems are erect, branching, and grooved. Flowering heads form in clusters.



Figure 5. Flowering heads are usually pink or purple, but also may be white. Mature seeds may remain attached or detach from their protective pappus covering.



Figure 6. Seeds are smooth and straw-colored to light brown.



Figure 7. The variety *horridum* has thick wavy leaves with numerous, long spines along the leaf margins.



Figure 8. The variety *integrifolium* has thin flat entire leaves with few marginal spines and spines that are short.

may remain attached to the seed and be dispersed by wind or become detached from the seed (Figure 5).

Several varieties or subspecies of Canada thistle have been identified and are distinguished by differences in leaves. Some varieties have leaves that are densely hairy on the underside (*vestitum*). The remaining varieties have no hairs or cobwebby loose long hairs on the underside of leaves. The variety *horridum* has thick wavy leaves with numerous, long spines along the leaf margins (Figure 7), while the variety *integrifolium* has thin flat entire leaves with few marginal spines and spines are short (Figure 8). The variety *arvense* has leaves that are shallow to deeply pinnate-shaped with few marginal spines.

Control Methods

Canada thistle can be managed through cultural, mechanical, biological, and chemical control methods. The most successful and sustainable management programs integrate several methods. The first step in the management plan is the prevention of invasion by Canada thistle. This involves planting crops free of Canada thistle seeds, preventing the movement of infested hay, cleaning farm equipment before transporting between infested and noninfested fields, and controlling individual plants or small patches before the plant has a chance to spread.

Once Canada thistle has infested an area, the infestation needs to be mapped and a control strategy developed. The control strategy can involve several suppression methods.

Cultural

Crop competition can be an effective tool in Canada thistle control if a vigorous crop is established. Alfalfa and forage grasses are the best competitors due to the repetitive cutting associated with these crops. The greatest success has occurred when Canada thistle infestations are weakened by mowing or treating with a short residual herbicide before the land is prepared for seeding. Alfalfa and forage grass seeding should be delayed until herbicide residues have dissipated.

Introducing forage grasses can be as effective as repeated herbicide applications in suppressing Canada thistle. Compared to biannual mowing for three years, which provided 75 percent Canada thistle control, yearly application of Stinger provided 83 percent control, and established hybrid wheatgrass or intermediate wheatgrass provided 82 percent control. The key to effective use of competitive grasses is to first suppress Canada thistle with herbicides, tillage, or mowing, then plant a competitive grass and get it off to a vigorous start, allowing it to achieve a competitive advantage over the weed.

Mechanical

Cultivation has been used to starve the plant roots by repeatedly destroying new shoots. It should be started in May and continued for up to two years at 10- to 15-day intervals during the growing season. Cultivation can be used in conjunction with herbicides to improve Canada thistle control. In winter wheat fallow areas, cultivation can fit into the cropping sequence. Cultivate with an implement which will cut thistle off about three to four inches below the

soil surface. Begin in May and continue until mid-August. Canada thistle can then be allowed to grow and be treated with a herbicide. Continual cultivation reduces carbohydrate reserves in roots which will weaken the plant and make it more susceptible to herbicides. In situations where it is not desirable to till after wheat harvest, treat stubble with a herbicide that controls all weeds. New Canada thistle shoots that emerge after herbicide treatment can be spot-treated with additional herbicide.

Biological

Several native North American insects can damage Canada thistle. Red Admiral, viceroy, and painted lady butterflies lay eggs on Canada thistle, and the subsequent larvae feed on leaves and stems (Figure 10). The painted lady butterfly is generally found in southern states but occasionally migrates north. Populations can build to high enough levels to defoliate thistle plants.

The thistle stem weevil (*Ceutorhynchus lituro*) has been successfully released in Nebraska. The weevil feeds on young Canada thistle plants as they sprout from the soil in early spring. The developing

Distribution

Canada thistle is found throughout Nebraska, especially in the northern and western portions of the state (Figure 9). The weed can be found in irrigated and non-irrigated cropland, pastures, lawns, parks, roadsides, and other noncropped areas. The plant flourishes along streams, ditch banks, and field areas where water may accumulate.

Canada thistle has been shown to accumulate toxic levels of nitrates which can be poisonous to livestock grazing it or fed hay containing large quantities of the plant. Seeds from the plant are eaten and dispersed by birds. The plant is beneficial to wildlife by

providing nesting cover for rails and shorebirds.

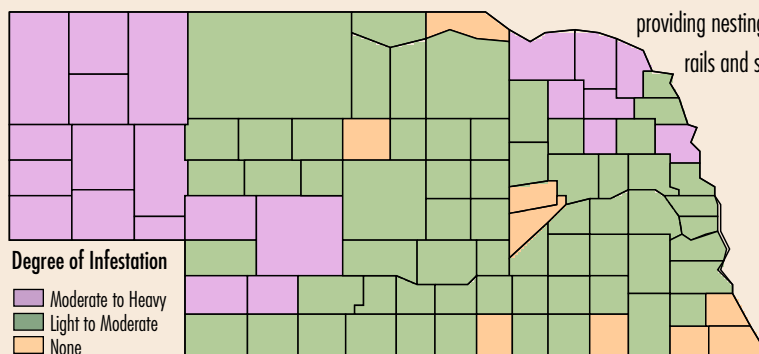


Figure 9. Distribution of Canada thistle in 2008 throughout most of Nebraska. It can be found in all but 9 of the state's 93 counties.

larvae bore into the plant stem as the shoot elongates (Figure 11). Fully developed larvae will leave plants in late June and pupate in the soil. Larval feeding reduces carbohydrate root reserves, but plants can recover from this injury. The weevil alone will not eradicate Canada thistle, but it can be combined with other methods to improve thistle control.

Thistle stem gall flies (*Urophora cardui*) are of European origin and attack the primary lateral stems of Canada thistle. Adults lay their eggs on the thistle plant in the early summer when plants are bolting. The developing larvae stimulate the plant to form a woody, stem gall (Figure 12). Plants infested with the insect are stunted and root and stem growth are reduced, but the stress is considered minor in the absence of other control measures. The thistle-defoliating beetle feeds on plant foliage. Adults emerge in the spring and lay eggs on thistle plants. The developing larvae and adults feed on thistle plants throughout the spring and summer.

Several plant pathogens have been examined for suppression of Canada thistle. The possibility of controlling Canada thistle with thistle rust was investigated as early as 1923. Plants infected with thistle rust are stunted and chlorotic, with injury symptoms resembling those caused by a growth regulator herbicide. White mold also may have potential as a biocontrol agent for Canada thistle. Canada thistle shoot density was reduced 80 percent when plants were inoculated with white mold. More recently, studies have examined *Pseudomonas syringae* as a bioherbicide. The organism causes the growing point of Canada thistle to turn white and reduces seed production and winter survival of thistle plants. Work with this organism is promising and may provide a method for selectively controlling Canada thistle in wheat and soybean.

Some organisms are pathogenic to Canada thistle and can cause limited injury. Similarly, the thistle stem weevil and thistle stem gall fly feed on Canada thistle and weaken the plant, but by themselves cannot kill the plant. Insects, diseases, and crop competition are alternate methods for Canada thistle control. By themselves, they cannot eradicate the

Table I.
Results from Canada Thistle control studies conducted in western Nebraska.

Herbicide	Rate/acre	Time of treatment	Percent Canada thistle control 1 year after treatment
Clarity	1 qt	June September	81 86
Glean/Telar	0.5 oz	June September	40 77
Roundup Original	2 qt	June September	20 80
Milestone	7 oz	June September	95 95
Stinger (Transline)	1.3 pt	June September	90 92
Forefront	2.5 pt	June September	95 95
Tordon 22K	1 pt	June September	92 98
Tordon + 2,4-D	0.5 pt + 1 qt	June September	45 87
Curtail	6 pt	September	56

plant, but when combined in an integrated system they may provide satisfactory Canada thistle suppression.

Chemical

Herbicides have been used with varying success for Canada thistle control. Numerous strains of Canada thistle exist and these strains vary in their susceptibility to herbicides. If an infestation of Canada thistle has been treated

repeatedly with limited success, consider rotating herbicides.

Control of Canada thistle with herbicides decreases when plants are under moisture stress. If plants are wilted or moisture appears limited in the upper one foot of soil, delay herbicide application until after rainfall.

The infestation location will partially determine which herbicide is used. No matter what herbicide is used,



Figure 10. Painted lady butterfly larva feeds on stems and leaves of Canada thistle.

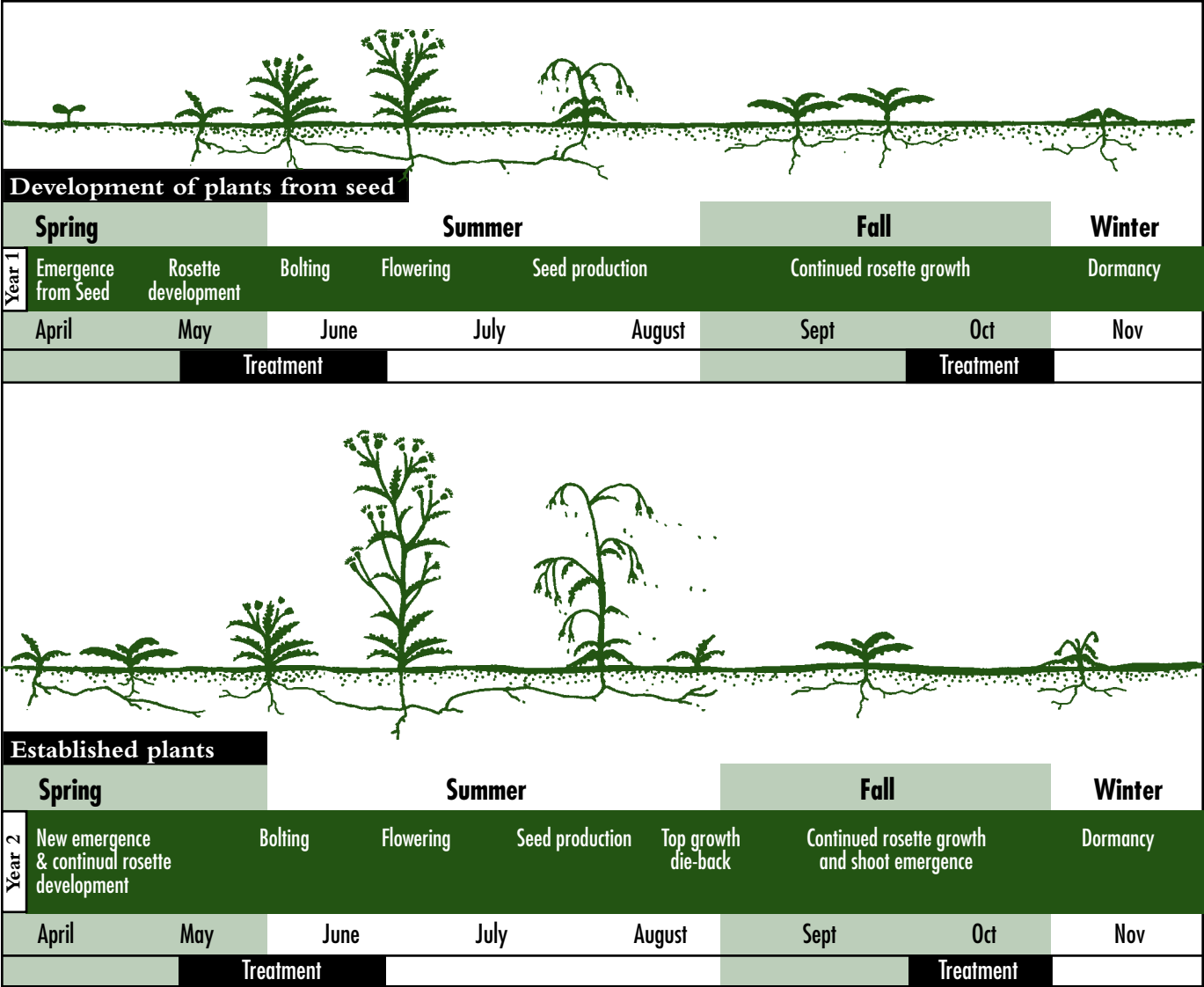


Figure 11. Thistle stem weevil. Larvae will feed on young Canada thistle plants as they sprout from the soil and will then burrow into the stem as it elongates, weakening the plant.



Figure 12. Thistle stem gall flies attack the primary lateral stems of Canada thistle. Their larvae will stimulate the plant to form a woody, stem gall which will weaken the plant.

Figure 13. Life cycle of Canada thistle



Canada thistle cannot be controlled with one herbicide application.

Seedlings may emerge in treated areas for up to 20 years. Therefore, once the perennial plant is controlled, continue scouting for seedlings.

The two most effective times for herbicide application to Canada thistle are at the flower bud stage and during fall regrowth. Results from experiments conducted in western Nebraska indicate that herbicides applied within a week after the first frost (29°F) have generally provided 15 percent to 60 percent more Canada thistle control than herbicides applied before the first frost or in June (Table 1). Herbicides such as Ally®/Escort®, Amber®, Clarity®, Distinct®, Curtail®, Glean®/Telar®, Roundup®,

Stinger® (Transline), Forefront®, Milestone®, and Tordon® have been successfully used for Canada thistle control.

Several successful Canada thistle control programs have been combined with corn production. Corn is a tall crop that can compete effectively with the weed, unlike more short-statured crops like dry bean, soybean, or sugar beet. Canada thistle growing with corn can be treated at planting with atrazine. After thistle emergence but before corn is 1 foot tall, treat the weed with postemergence herbicides such as Distinct, Curtail, or Stinger. Another approach would be to plant a Roundup Ready® crop and treat it with at least two applications of a glyphosate-based herbicide as Canada thistle develops in the spring.

Persistence is the key to a successful Canada thistle control program. Use multiple control measures to achieve control. Choose treatments that can be used for at least two to three successive years. Thoroughly plan a control program and adhere to it.

For more information on herbicides, rates, and sites where they can be used, consult the herbicide label or the UNL Extension publication, *Guide for Weed Management in Nebraska, EC130*.

Note: Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by Extension is implied.

Table 2.

Herbicides for Canada thistle control¹

Herbicide	Product per Acre	Application Time ²	Notes
Tordon 22K	1 qt	In fall when actively growing or spring at early flower bud	For non-crop areas and spot treatment in pasture and range. Tordon may remain in the soil for three or more years.
Tordon 22K + 2,4-D ester (4L)	1 pt 1 qt	Fall; spring during flower bud	
Roundup UltraMax	1.75–2.5 qt	Flower bud to fall to actively growing plants	Idle ground or spot treatment in cropland before head or pod fill of crop. Avoid tillage for three days.
Banvel/Clarity/ Sterling	1–2 qt	In fall when actively growing or in spring	Idle ground or grassland. Avoid tillage for five days. Injury to forage grasses may occur. Broadleaf crops may be injured for one year after treatment.
Curtail Milestone Stinger/Transline Forefront	2–4 pt 7 oz 0.67–1.3 pt 2.5 pt	Rosette to pre-bud or in fall when actively growing	Curtail — use lower rate in wheat and barley, higher rate in fallow, pasture, or CRP. Milestone can be used in pasture, CRP, and non crop areas and near water. Use Stinger in sugarbeet and corn. Transline is labeled for rangeland and permanent grass pastures. Forefront can be used in range, pasture, or CPR.
Ally + Surfactant Telar + Surfactant	1.0 oz 1.0–3.0 oz	4–6" or rosette stage Prebloom to bloom or in the fall when actively growing	Escort or Telar are for use in non cropland only. Use Ally in wheat, barley, or fallow to be planted to winter wheat. One application suppresses Canada thistle.
Escort + Surfactant Grazon P+D* Redeem R&P*	1.0 oz 4.0–6.0 pt 2.5–4.0 pt		

¹These recommendations were current as of Sept 1, 2008. See "Guide for Weed Management in Nebraska" EC-130, for current information. It's available in print at local Extension offices or on the Web at <http://www.ianrpubs.unl.edu/sendIt/ec130.pdf>.

²Best control will be obtained if treatments are made when plants are actively growing. Treatment in following years may be required. Dust on leaves may interfere with herbicides.

A Message From the Nebraska Department of Agriculture

The State of Nebraska has had a noxious weed law for many years. Over the years, the Nebraska Legislature has revised this law.

The term "noxious" means to be harmful or destructive. In its current usage "noxious" is a legal term used to denote a destructive or harmful pest for purposes of regulation. When a specific pest (in this case, a weed) is determined to pose a serious threat to the economic, social, or aesthetic well-being of the residents of the state, it may be declared noxious.

Noxious weeds compete with crops, rangeland, and pastures, reducing yields substantially. Some noxious weeds are directly poisonous or injurious to man, livestock, and wildlife. The losses from noxious weed infestations can be staggering, costing residents millions of dollars due to lost production. This not only directly affects the landowner, but erodes the tax base for all residents of the state. The control of noxious weeds is everyone's concern and to everyone's benefit. The support of all individuals within the state is needed and vital for the control of noxious weeds within Nebraska.

It is the duty of each person who owns or controls land in Nebraska to effectively control noxious weeds on their land. County boards or control authorities are responsible for administration of noxious weed control laws at the county level. This system provides the citizens of Nebraska with "local control." Each county is required to implement a coordinated noxious weed program. When landowners fail to control noxious weeds

on their property, the county can serve them with a notice to comply. This notice gives specific instructions and methods on when and how certain noxious weeds are to be controlled.

The Director of Agriculture determines which plants are to be deemed as "noxious" and the control measures to be used in preventing their spread. In Nebraska, the following weeds have been designated as noxious:

Canada thistle (*Cirsium arvense* (L.) Scop.)
 Leafy spurge (*Euphorbia esula* L.)
 Musk thistle (*Carduus nutans* L.)
 Plumeless thistle (*Carduus acanthoides* L.)
 Purple loosestrife (*Lythrum salicaria* L. and *L. virgatum* — including any cultivars and hybrids)
 Knapweed (spotted and diffuse) (*Centaurea maculosa* Lam. and *C. diffusa* Lam.)
 Saltcedar (*Tamarix ramosissima* Ledeb.) and small flower Tamarix (*Tamarix parviflora* DC.)
 Phragmites (*Phragmites* sp.)

Whether farmer or rancher, landowner or landscaper, it's everyone's responsibility and everyone's benefit to aid in controlling these noxious weeds. If you have questions or concerns regarding noxious weeds in Nebraska, please contact your local county noxious weed control authority or the Nebraska Department of Agriculture.



Canada Thistle

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