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Noxious Weeds of Nebraska

Plumeless Thistle

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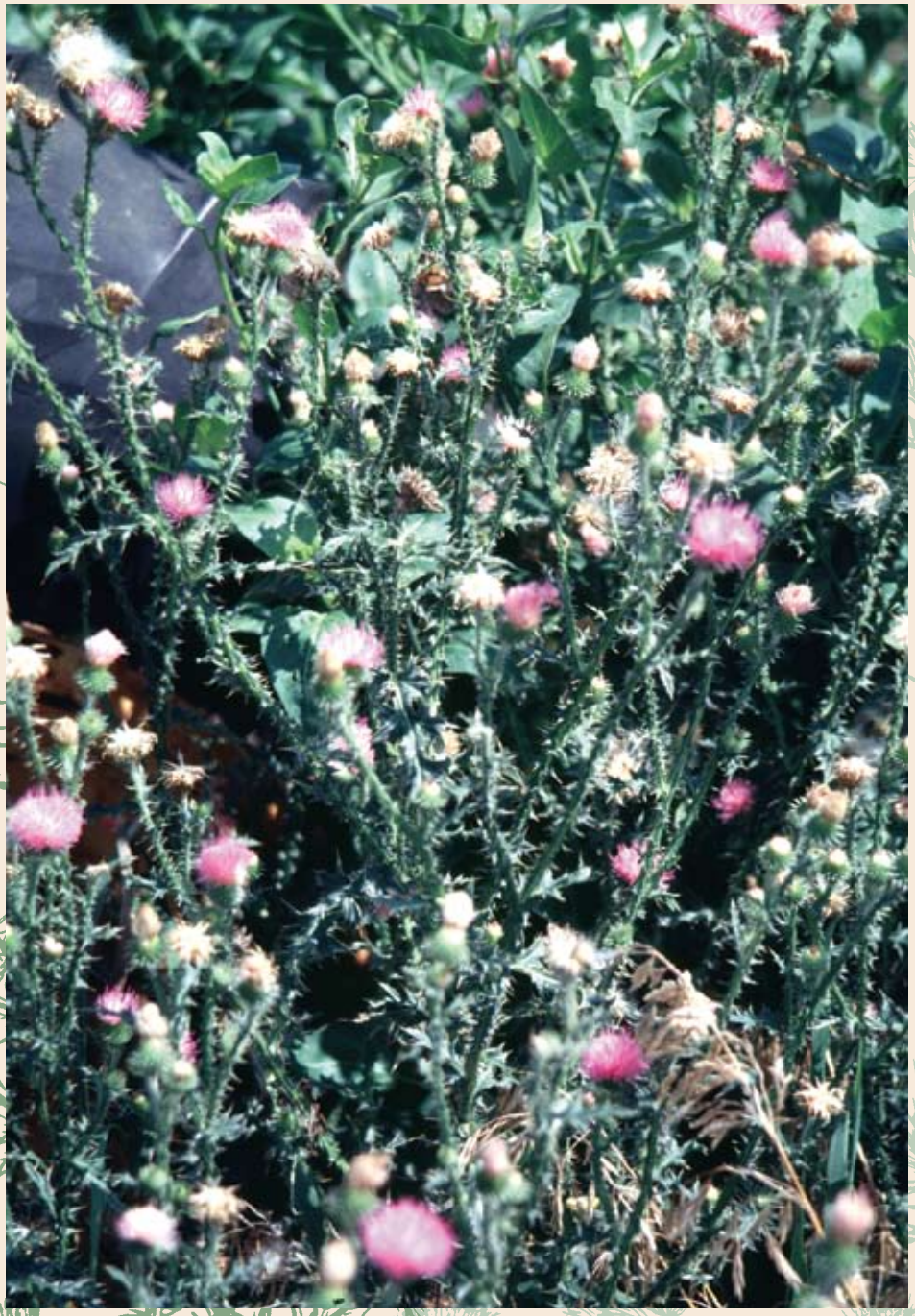

Biology
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Plumeless Thistle

Plumeless thistle (*Carduus acanthoides* L.) is an invasive broadleaf weed native to Europe and Asia. Sometimes referred to as spiny plumeless thistle, it currently infests about 51,000 acres in Nebraska, primarily in the northeast. It is economically important because it reduces the productivity of pastures and rangeland by competing with and suppressing the growth of desirable species *(Figure 1)*. Plumeless thistle can colonize overgrazed pastures, rangeland, and disturbed open sites, e.g. roadsides, ditches, etc. Plumeless thistle is similar in appearance, biology, and ecology to its close relative, musk thistle (*Carduus nutans* L.). Although plumeless and musk thistle occupy similar habitats, they are seldom found in mixed populations. Because of plumeless thistle's status as a noxious weed, landowners and producers in Nebraska spend thousands of dollars each year to control it.

Biology

Plumeless thistle is a member of the sunflower family (*Asteracea*). It generally completes its lifecycle as a biennial *(Figure 11)*, but may grow as a winter annual or rarely as a summer annual, depending on environmental conditions. Biennials take two seasons to complete their life cycle, with vegetative growth in the first year and continued vegetative and then reproductive growth in the second. Plumeless thistle seeds begin germinating in April and can germinate through the summer and early fall as conditions allow (adequate moisture and open soil). The plant forms a rosette (a circular cluster of leaves growing close to the ground) the first summer or fall and overwinters in the rosette stage *(Figure 2)*. The plant bolts (forms a flowering stalk) in spring of the second year. In Nebraska, plumeless thistle flowering begins in June and continues into August.

Plumeless thistle reproduces by seed. Approximately 50 to 80 seeds are produced per head, and a typical plant will produce 35 to 60 heads. Although most seeds germinate the following year, they can remain viable in the soil for more than 10 years. Most seeds are found in the top 3 inches. Because of its high seed production and seed longevity, it can be a very persistent weed where it becomes established.

Plumeless thistle is cross-pollinated and relies on wind or pollinating insects (bees and wasps) for pollination. As a result, hybridization with musk thistle can occur. The hybrid plants are generally sterile and have flowers larger than those of plumeless thistle, but smaller than those of musk thistle.

Most plumeless thistle seeds fall near the parent plant. The expansion of a plumeless thistle patch depends on the number of seeds produced and the amount of open soil available for new plants to colonize. In a study conducted in Maryland, the spread of new infestations from a single plant was less than 3 feet per year. The seeds are attached to a pappus, a white feathery attachment that aids wind dispersal, and occasionally may be carried by the wind up to 330 feet from the mother plant. In most cases, however, the pappus breaks off and blows away while the seed remains attached to the flower head.

Figure 1. Dense infestations of plumeless thistle interfere with livestock grazing and degrade the value of pastures or range.

History

The center of origin of plumeless thistle is believed to be southern Europe because of the large number of *Carduus* species found there. The first record of plumeless thistle growing in North America was at Camden, N.J., in 1879. In a 1974 survey, the most severe infestations were in Virginia, Pennsylvania, Wisconsin, Minnesota, South Dakota, Nebraska, and Wyoming. Its present distribution stretches from Virginia into Canada, west across the Great Lakes states, through the Great Plains and into Idaho, Washington, and California. In 1967, the Nebraska Legislature declared plumeless thistle a noxious weed, thereby requiring all landowners in the state to control it.

Plumeless thistle is a source of nectar for many insect species. Songbirds eat the thistle seeds and contribute to seed dispersal. Livestock will usually avoid eating plumeless thistle because of the spines on its stems and leaf margins.

Identification

Plumeless thistle is similar in appearance to musk thistle, particularly in the rosette stage. Like musk thistle, it is supported by a stout, fleshy taproot, which can penetrate the soil to a depth of several feet. Leaves of a plumeless thistle rosette are narrowly oval or oblong *(Figure 2)* and are deeply lobed *(Figure 3)*. The underside of the leaf (and occasionally the upperside) is covered with hair (pubescence). Three or four of the points of each lobe end in a short spine. In contrast, the leaves of musk thistle are not as deeply lobed and lack hairs *(Figure 4)*.

The stem leaves of the plumeless thistle are alternate, similar in shape to those of the rosette, have hair, and are 4 to 8 inches long *(Figure 3)*. The leaves extend onto the stem, giving it a winged appearance (see photos on the front cover). Two other thistle species, Scotch and musk, also have leaves that extend onto the stem and form spiny wings. However, musk thistle leaves lack hair, and Scotch thistle leaves are less deeply lobed and are covered by matted, dense hairs that give it a bluish- or grayish-green appearance.

Plumeless thistle may grow to a height of 1 to 5 feet, but usually are 3 to 4 feet. The stem is erect and freely branching, especially in the upper

Figure 2. Plumeless thistle rosette leaves are narrowly oval or oblong and deeply lobed.

Figure 3. Stem leaves of plumeless thistle are lobed almost to the midrib. Note the spines on the end points of each lobe and the hairs on the underside of the leaf.

Figure 4. Leaves of musk thistle (left) and the more deeply lobed leaves of plumeless thistle (right).

Figure 5. Plumeless thistle branches freely in the upper portion of the plant.

portion of the plant *(Figure 5)*. The stem can be densely hairy to nearly hairless. A distinguishing characteristic separating plumeless thistle from musk thistle is the presence of spiny wings on the flowering stalk (1/8 to 5/8 inch wide) up to the base of the plumeless thistle head *(Figure 6)*. Scotch thistle also has spiny wings to the base of the thistle head.

The flower of plumeless thistle is purple, or rarely white or yellow, and is 1/2 to 3/4 inch long *(Figure 6)*. The flower heads are solitary or in clusters of two to five. The heads are 5/8 to 1 inch tall and 3/8 to 3/4 inch wide. There are several series of bracts or small leaf-like structures below the flower head, including spiny outer bracts (1/4 to 1/2 inch) and spineless inner bracts (3/4 inch). Flower heads of plumeless thistle are smaller than those of musk thistle. In addition, plumeless thistle may have multiple heads per stem and the heads are erect, while musk thistle has only one head per stem and it is often nodding *(Figure 7)*. Scotch thistle flower heads are erect like plumeless thistle, but are larger (1 to 2 inches wide and 3/4 to 1 inch tall).

The seed of plumeless thistle is called an "achene" and is straw-colored to light-brown *(Figure 8)*. It is 1/8 inch long and slightly oblong to egg-shaped. It is marked by 10 brown ribs that extend the length of the seed. At one end of the seed, there is a ring of tiny barbed bristles where the pappus was attached.

Figure 6. Plumeless thistle has spiny wings on the flower stalk up to the base of the thistle head.

Control Methods

Plumeless thistle is best managed using a combination of cultural, mechanical, chemical and biological control methods. The primary management goal should be to limit seed production.

Cultural

The most cost effective strategy is to maintain healthy, competitive, desirable plants in pastures or grasslands. Dense cover limits thistle establishment, and plumeless thistle seedlings do not compete well with established forage grasses.

First, pastures should be fertilized appropriately. Either too much or too little nitrogen can create opportunities for invading weeds. Second, grazing animals should be carefully managed. Because plumeless thistle is unpalatable to livestock,

Figure 7. Plumeless thistle [left] and musk thistle (nodding) [right]. Plumeless thistle flower stems are winged, but musk thistles are not. Plumeless thistle flowers are smaller than those of musk thistle.

Figure 8. Seed is straw colored to light brown and 1/8 inch long.

they will preferentially graze the grass around it and increase the competitive advantage of the thistle over the grass. Overgrazing, especially when soil moisture is limited and grasses are stressed, may result in bare soil and open niches for plumeless thistle to spread. Third, periodic prescribed burning can be an important tool for maintaining vigorous grasses, but does not generally kill thistle crowns and has little effect on new seedling emergence. However, fire can reduce the amount of viable seed laying on the soil surface.

Unfortunately, even well-managed grasslands are not exempt from potential infestations. Landowners and land managers should regularly scout their pastures to identify and treat small patches of thistles before they become dense infestations. Where infestations have previously been controlled, repeated monitoring is necessary to prevent the seeds that remain in the soil from generating new patches.

Mechanical

Plumeless thistle does not tolerate regular cultivation, digging, or cutting. Mowing at late bloom stage effectively reduces seed production *(Figure 9)*. If mowing occurs before the first terminal buds bloom, the plants will regrow and produce viable seed. Mowing after the terminal buds have matured has little effect on reducing the amount of seed in the soil, even if there are still flowers on the lateral buds. At stages before flowering, plumeless thistle must be cut at the soil surface to prevent the crown buds from resprouting.

Chemical

Several herbicides are useful for managing plumeless thistle infestations *(Table 1)*. The timing of herbicide application is the key to success. Plumeless thistle is most susceptible to herbicides applied to plants in the seedling or rosette stage. Delaying herbicide application until bolting or later reduces herbicide effectiveness. However, herbicide application at late flower bud to early bloom can reduce seed production. The number of herbicide labels that describe use for plumeless thistle in the bud stage is limited (Chaparral, Cimarron, ForeFront, Milestone, Telar). When herbicides are ground-applied, use a minimum of 10 gallons per acre to ensure adequate coverage.

Fall is an ideal time to apply herbicides to control plumeless thistle. Applications should be made at the seedling stage (rosettes of 4–10 leaves) while plants are actively growing and daytime temperatures are above 50°F. In the fall, plumeless thistle is in the seedling or rosette stage and is actively translocating sugars and other compounds from the leaves to build up root reserves. Herbicides applied in the fall move to the roots with the translocating sugars and this increases their likelihood of killing the plant.

Many of the herbicides used to manage plumeless thistle can cause serious injury if they drift onto susceptible crops and trees like soybean, tomatoes, grapes, pecans, and walnuts. Applying herbicides in the fall can minimize the risk of injury from drift, especially if the crops have matured or the leaves have dropped. When herbicides are applied in the spring and sensitive species are nearby, avoid spraying on windy days. In addition, select nozzles that will provide the largest droplet size possible without reducing foliar coverage of the target plants.

It is important to scout pastures prior to herbicide application to determine if the infestation level justifies treatment over the whole

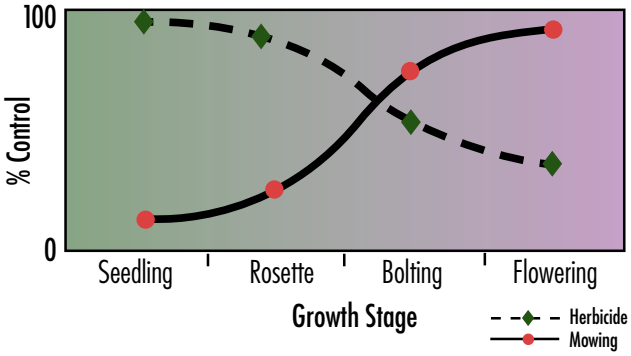


Figure 9. Response of plumeless thistle to herbicide application and mowing at different growth stages.

Distribution

Plumeless thistle infestations were reported in 31 Nebraska counties in 2006. The counties with the most infested acres were in northeast Nebraska. Smaller infestations were identified in southeast and central Nebraska and in the Panhandle. Plumeless thistle is seldom found in the Sandhills and is primarily found in pastures, rangelands, and disturbed non-crop areas. It prefers highly fertile soils that developed over limestone.

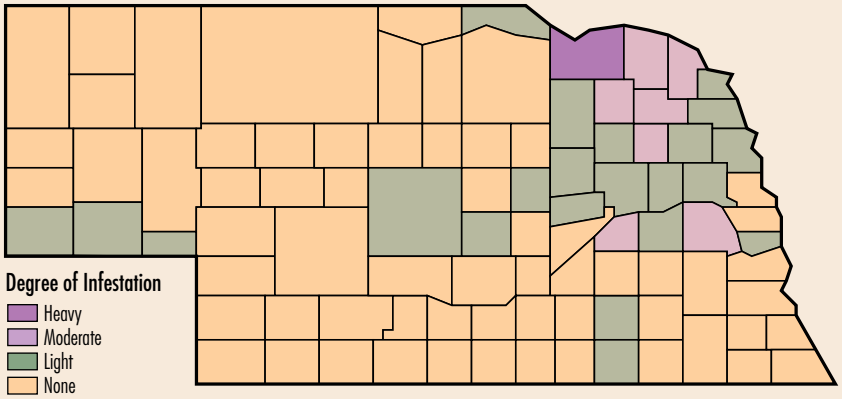
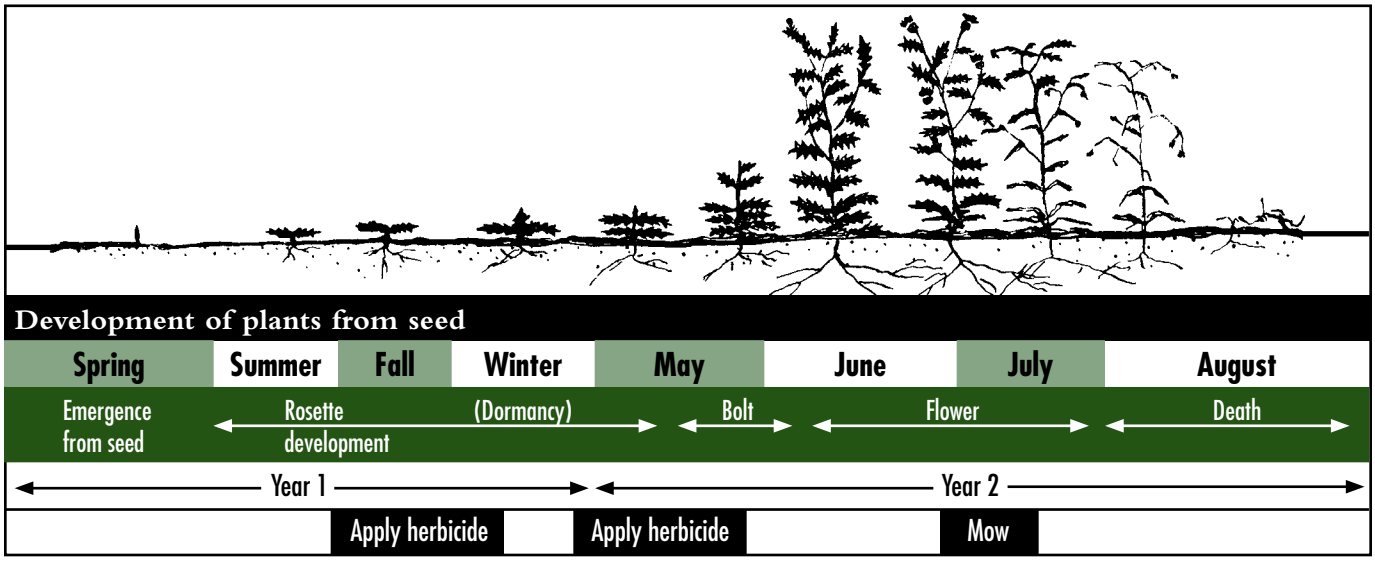


Figure 10. Distribution of plumeless thistle in Nebraska in 2006. Plumeless thistle is found less extensively than either Canada thistle or musk thistle.

Figure 11. Biennial life cycle of plumeless thistle in Nebraska.



pasture, or if spot treatment of smaller patches would be more appropriate.

Because plumeless thistle seeds remain viable in the soil for up to 10 years, it is likely that once a stand is established, treatments will need to be repeated for several years until the thistles are controlled and a good stand of desirable grasses is re-established.

Biological

Introduced (exotic) plants often lack the natural enemies (diseases or insects) that check their spread in native habitats. This increases their ability to compete against native plants and they become invasive when introduced into new habitats. Introducing exotic diseases or insects for biological control of these exotic plants can be risky, as the diseases or insects may affect related, native plant species more severely than the exotic plants.

Insects. Two exotic insects have been released for biological control of plumeless and musk thistle. The *Rhinocyllus conicus* head weevil, an insect of European origin, has been released in 23 states, including Nebraska. It lays eggs on bud bracts and after hatching, the larvae bore into receptacles and feed on the receptacles and florets, reducing the plant's ability to produce seed. Its success at reducing seed set in plumeless thistle has been limited because its egg-laying period only coincides with the formation of the terminal buds. The lateral buds that emerge much later are rarely affected.

A rosette-feeding beetle, *Trichosirocalus horridus*, also introduced from Europe, lays eggs on the lower side of rosette leaves. When the larvae hatch, they feed on the rosette crowns and can kill young rosettes. Both of these exotic insects have been established and have reduced plumeless thistle populations in Virginia. No information is available on the success of biocontrol agents in Nebraska.

Fungi. Four fungi are capable of infecting musk and/or plumeless thistle, including the rusts *Puccinia carduorum* and *P. galatica*, and the smuts *Ustilago cardui* and *U. violacea*. Of these, only *P. carduorum* has been introduced in North America.

Biological control agents should be considered as tools in plumeless thistle management; however, these practices should not be relied on to eradicate an infestation. The success of biological control agents depends on the survival of enough individuals of the invasive species (the thistle) to support the survival of the insect or plant disease. As a result, biological control may be most beneficial in remote areas where chemical or mechanical control methods are not practical.

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

Table 1.

Herbicide treatments for plumeless thistle control. Please refer to the section on chemical control for additional information on herbicide timing and drift control.[1,2]

Herbicide	Active Ingredient	Product per Acre	Application Time	Notes
2,4-D ester (4L)	2,4-D	1.5-2.0 qt	Late fall or early spring	Annual treatment may be necessary for control of new seedlings. In the spring, apply before bolting for best result, and prior to trees leafing out to reduce drift injury.
2,4-D ester (4L) + dicamba	2,4-D, dicamba	1 qt + 0.5 pt	Late fall or early spring	
Chaparral	aminopyralid, metsulfuron	1.0-2.0 oz	Rosette to early bolt	Apply as a coarse, low pressure spray. Add a non-ionic surfactant (0.25-0.5% v/v) for improved coverage. Increase rate to 2.5 oz and add 1 pt of 2,4-D when plants reach late bolt to early flowering. For use in pasture and range.
Cimarron Max	metsulfuron, dicamba, 2,4-D	0.5 oz Part A, 2 pt Part B	Rosette to early bolt	Add a non-ionic surfactant (0.25-0.5% v/v), a crop oil concentrate, (1-2% v/v) or a methylated seed oil (0.5% v/v). Also add 2-4 qt/ac urea ammonium nitrate[3] (28% N). For use in pasture and range.
Cimarron Plus	metsulfuron, chlorsulfuron	0.63 oz	Rosette to early bolt	Add a non-ionic surfactant (0.25-0.5% v/v), a crop oil concentrate or methylated seed oil (1-2% v/v). Also add 2-4 qt/ac urea ammonium nitrate[3] (28% N). For use in pasture and range.
Cimmaron X-tra	metsulfuron, chlorsulfuron	1.0 oz	Rosette to early bolt	
Curtail	clopyralid, 2,4-D	2-4 pt	Rosette to early bolt	Use lower rate for wheat or grasses sensitive to 2,4-D. For use in wheat, fallow, range, pasture, and non-crop areas.
ForeFront	aminopyralid, 2,4-D	1.5-2.0 pt	Rosette to early bolt	Apply as a coarse, low pressure spray. Add a non-ionic surfactant (0.25-0.5% v/v) for improved coverage. For use in pasture and range.
Grazon P+D	picloram, 2,4-D	2-4 pt	Rosette to early bolt	Use higher rate for bolting plants. A nonionic surfactant may be added to improve coverage. For use on range and permanent pasture.
Milestone	aminopyralid	3-5 fl oz	Rosette to early bolt	Use higher rate for bolting plants. Add a non-ionic surfactant (0.25-0.5% v/v) for improved coverage. For use on range, permanent pasture and non-crop areas.
Overdrive	diflufenzopyr + dicamba	4 fl oz	Late fall or early spring	Apply before bolting. Add a non-ionic surfactant (0.25% v/v). For use on range, permanent pasture, and non-crop areas.
Redeem R&P	triclopyr + clopyralid	1-2 pt	Rosette to early bolt	Use higher rate for bolting plants. Add a non-ionic surfactant (0.25-0.5% v/v). For use on range, permanent pasture, and non-crop areas.
Telar	chlorsulfuron	1 oz	Bolted plant prior to flowering	Add a non-ionic surfactant at 0.25% (v/v). For use in range, pasture, and non-crop areas.
Tordon 22K	picloram	8-12 fl oz	Late fall	Annual treatments may be necessary. For use on range, permanent pasture, and non-crop areas.
Transline	clopyralid	0.33-1.0 pt	Rosette to early bolt	Use higher rates for bolting plants. Add a nonionic surfactant (0.25-0.5% v/v). For use on range, permanent pasture, and non-crop areas.

[1]These recommendations were current as of September 1, 2009. For current information, see the *Guide for Weed Management in Nebraska*, EC-130, available in print at University of Nebraska-Lincoln Extension offices or on the Web at *http://www.ianr.unl.edu/pubs/fieldcrops/EC130.htm*

[2]References to commercial products is made with the understanding that no discrimination is intended and no endorsement by University of Nebraska-Lincoln Extension is implied.

[3]Spray grade ammonium sulfate (AMS) may be substituted for urea ammonium nitrate at 2-4 lb/ac.

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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 their control is 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.)
- Common Reed (*Phragmites sp.*)
- Salt Cedar (*Tamarix ramosissima Ledeb.*)

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.

Plumeless Thistle

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