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Thistles in Pastures and Beyond: Biology and Management

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Weeds may limit the productiveness of pastures by competing with desirable grass and legume species. The most troublesome weeds in Wisconsin pastures are thistles which are especially troublesome because in addition to lowering productivity of pastures, their spiny nature prevents livestock from grazing near them. In fact, heavy thistle infestations may cause large areas of pastures to be left ungrazed. Four species of thistles are of greatest concern. Canada thistle *(Cirsium arvensis)* and bull thistle *(Cirsium vulgare)* occur throughout Wisconsin and all the North Central states. Musk thistle *(Carduus nutans)* is common in the south eastern counties plus other "hot spot" areas around the state. Plumeless thistle *(Carduus acanthoides)* occurs principally in south western and south central areas of Wisconsin. Some incorrectly call plumeless thistle by the name "Russian thistle." This can create confusion because another plant's official name is Russian thistle (*Salsola kali)*.

Thistle Biology:
Biennial thistles: The most common thistles in pastures have a two-year life cycle. Bull, musk, and plumeless thistles are biennials and only grow vegetatively during the first year. Seeds germinate during the spring and summer when soil moisture and temperatures are favorable. After germination, they form a rosette ranging from 4 to 18 inches in diameter before becoming dormant in the late fall of the first year. Exposure to cold winter temperatures (vernalization) is necessary to trigger these thistles to flower during the second year. In the spring of the second year, bull, musk, and plumeless thistles resume vegetative growth. In late May musk and plumeless thistles begin to bolt (send up a flower stalk). Bull thistles normally bolt and flower 2 to 3 weeks after musk and plumeless thistles. Each plant can send up several stalks and produce many flower heads, each with many viable seeds. After flowering or with the first frost, biennial thistles die in the second year. Biennial thistles reproduce only by seed; therefore, successful management programs must strive to prevent seed production.

Canada thistle is a perennial species. Infestations can start from seed, but plants primarily regrow and spread each year from Canada thistle's creeping root system. The roots have adventitious buds that form new shoots each spring and summer. Canada thistle is one of the first pasture weeds to resume growth after winter. Buds at the crown and on vertical stems below the soil surface also produce shoots after mowing. To measure how many roots Canada thistle can produce, researchers in three states planted either a single root segment 12 inches long or a 6-inch diameter plug of Canada thistle plants in 4x4 x8-ft above-ground boxes filled with soil. No

tillage or irrigation was done, nor were crops planted in the boxes. Within 12 to 16 months, buds on these roots produced an average of 174 shoots and 930 feet of new roots, illustrating this weed's ability to spread.

Canada thistle has male and female flowers on separate plants. Female shoots can produce 50 to 100 flower heads, each with 80 to 90 seeds. Viable seeds are formed 8 to 10 days after flowering and single plants can release more than 5,000 seeds. Long distance dispersal by wind is unlikely because seeds often remain in the flower head while the pappus detaches and floats away. However, seed attached to the pappus may move long distances from the parent plant under the right conditions.

Thistle Management

Cultural weed management refers to those practices used to establish and maintain competitive, productive, weed-free pastures. One of the most important cultural methods of pasture weed control is rotational and controlled grazing. Overgrazing weakens the pasture species and makes them less competitive with weeds. Controlled and rotational grazing helps avoid weed invasions. Avoid spreading manure contaminated with weed seeds. Do not move animals from weed-infested pastures into weed-free pastures without a quarantine period to allow them time to clean themselves of weed seeds in their digestive systems. Likewise be sure to clean mowers or choppers after leaving weed-infested pastures so that seeds are not transported to other pastures. Keep fence rows weed-free to prevent weeds from migrating into pastures. Crop rotation is not an option in permanent pastures. However, it is a valuable weed management tool for temporary pastures. Crop rotation is effective on biennial thistles because they cannot tolerate tillage or crop competition. Rotating temporary pastures infested with musk or plumeless thistles to small grains, corn, or soybeans will control these thistles. Rotation alone will not affect Canada thistle but does allow you to use a management strategy you could not use in pastures: planting a Roundup Ready corn hybrid or soybean variety and applying glyphosate when Canada thistles are in the bud to early flower growth stage.

Biological control

Musk thistle. The rapid spread of musk thistle in North America is due in part to the lack of natural enemies. Scientists found a seed-eating weevil (*Rhinocyllus conicus*, the musk thistle weevil) in Italy, and after extensive testing it was imported and released in several states in 1969. The musk thistle weevil adult emerges in the spring, adult females lay 100 to 150 eggs on the underside of developing flower heads. The eggs hatch and the larvae burrow into the seed producing tissues of the flower head. If the weevil infestation is sufficiently high, most thistle seeds are destroyed.

These weevils were released in southeastern Wisconsin in the mid 1970's. They have survived and moved several miles from the release site. However, little evidence of reduced musk thistle populations is noticed. Part of the reason is that the weevils attack primarily the "first generation" of flower heads. Additional flowers arise from secondary branches and flower 10 to 20 days later. The weevils are no longer laying eggs when these flowers appear so they proceed to produce seed. Secondly, no attempt to spread the weevils to new sites has been made because of concern that the insect might attack the dune thistle *(Cirsium pitcherii)*, a threatened species, found on the shores of Lake Michigan. Biological control alone will never eradicate a thistle infestation, but a successful program should help reduce thistle populations, especially in undisturbed, remote, or inaccessible areas.

Canada thistle. A natural organism, *Pseudomonas syringae* pv *tagetis*, infects Canada thistle in undisturbed sites like pastures and roadsides. Once infected, the organism produces a toxin that inhibits chloroplast formation and plants appear cream colored to yellowish white. This weakens plants and minimizes flowering and seed formation. Canada thistle populations with infected plants often diminish and on occasion completely disappear over a period of years.

Mechanical. Persistent and timely mowing, clipping or hand weeding can greatly reduce biennial thistle infestations but will have minimal effect on Canada thistle. Biennial thistles should be cut as close to the ground as practical each time they begin to flower. Field observations indicate that bull thistles have less regrowth capability after clipping than musk or plumeless thistles. This may explain why bull thistles are not increasing, while musk and plumeless thistles are spreading into new areas and becoming more abundant in already infested pastures. Nevertheless, repeated, timely mowings are beneficial because they reduce seed production. To prevent seed production for musk and plumeless thistle, plants must be cut at the soil surface; higher cutting allows crown buds to resprout and flower.

Herbicides. Even with the best cultural and mechanical efforts, thistles may become established in pastures. Fortunately, effective and economical herbicides are available to control thistles in pastures. Timeliness of application is the key to success and this depends wholly on the plant's life cycle. Table 1 compares the effectiveness of several herbicides on our common thistle species. Performance ratings assume the herbicide was uniformly applied, at the correct rate, and at the appropriate stage of development, and the growing conditions.

Table 1. Effectiveness of several herbicides on biennial thistles and Canada thistle[1].

	Curtail	Cimarron/ Escort	Crossbow	Dicamba	Forefront	Glyphosate	Milestone	Stinger/ Transline	Weedmaster	2,4-D
Bull thistle	G/E	G/E	E	G/E	G/E	E	E	E	E	G/E
Musk thistle	G/E	G	E	G/E	G/E	E	E	E	E	G/E
Plumeless thistle	G/E	G	E	G/E	G/E	E	E	E	E	G/E
Canada thistle	G	F/G	F/G	F/G	G	G/E	G/E	G/E	F/G	F

[1] Consult the pasture section of UWEX Bulletin A3646 (Pest Management in Wisconsin Field Crops) for a more complete listing of herbicide performance on specific pasture weeds; available on-line at http://cecommerce.uwex.edu/pdfs/A3646.PDF.
E = excellent; G = good; F = fair; P = poor

Biennial thistles (bull, musk and plumeless) must be treated when plants are in the rosette stage. After bolting, they become much less susceptible to most herbicides. 2,4-D amine or ester applied in early spring or mid to late fall controls biennial thistles because at these times all biennial plants are in the rosette stage, the stage at which they are easily controlled with herbicides with a growth regulator mode of action. The ester formulation of 2,4-D should be used unless crops sensitive to vapor drift are in close proximity to the application site. Once thistles start to bolt (late May) or flower (mid June), aminopyralid is more effective than dicamba

alone or the combination of 2,4-D and dicamba , and 2,4-D. All herbicides that control thistles kill desired legumes like clovers and trefoil also. Selective applicators like rope wicks or rollers can be used to apply glyphosate to biennial thistles taller than the grass-legume mixture in interseeded pastures. Research done at the University of Wisconsin Agricultural Research Station at Lancaster indicates that glyphosate applied with two passes of either a roller or rope wick applicator gave partial kill of bull thistles. What is more important, flowering (and therefore seed production) was completely stopped when the thistles received two passes with either the rope wick or roller applicator.

Canada thistle. Treatment timing is much different for perennial than biennial species. Effective herbicides are systemic (they move from the foliage into the roots) and this movement is usually greater when plants are in the bud to early flower growth stages than at earlier stages. Recommended herbicides include aminopyralid (Milestone, Forefront) dicamba (Clarity, Banvel, Overdrive), clopyralid (Stinger, Curtail), triclopyr plus 2,4-D (Crossbow), and glyphosate (Roundup, Touchdown and many other brands). A single application of any product will reduce but not eliminate Canada thistle infestations. Milestone and Stinger provide the best long-term suppression but will not eradicate populations. All herbicides that kill Canada thistle also kill forage legumes. Glyphosate gives excellent Canada thistle control but kills all treated vegetation; so if glyphosate is used, treated areas will need to be reseeded.

Fall applications to any thistle species offer several advantages over spring treatments. Because thistles are building up root reserves in the fall, the herbicide moves readily from the foliage to the roots with the sugars. In the spring, carbohydrates move from the roots to the leaves so less downward herbicide movement would occur. Fall applications also ensure that biennial thistles will be controlled because any shoots present in the fall are in the rosette stage and thus are very susceptible to herbicides. Even if the herbicide does not totally kill the plants, winter weather will finish what the herbicide starts. Also, land managers may have more time to treat infested sites in the fall than during the rush of spring and early summer field activities. Finally, with fall treatment there are fewer risks that herbicide drift will injure nearby sensitive crops like soybeans or tomatoes as these have already matured. Fall applications should be made while daytime high temperatures are still in the 60s or 70s and the plants are actively growing. This is usually from early to mid September in southern Wisconsin and perhaps a week or two earlier in the northern region.

Integrated Management

No single practice will produce or maintain thistle-free pastures. An organized system that combines the appropriate preventive, cultural, mechanical, and chemical measures for each pasture is required. Start by taking an inventory of the weed situation in your pastures and devise a three- to five-year plan of pasture management and improvement. Integrate the above recommendations with all the other principles of pasture management and with diligence and perseverance, you will achieve more production from your grass and grass-legume pastures.

Mention of specific herbicides is for your convenience and is not an endorsement or criticism of one product over other similar products. You are responsible for using herbicides in full compliance with the current product label.