

Appendix I

Badger Wind Reclamation and Weed Management Plan

Badger Wind, LLC
February 2024

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BADGER WIND ENERGY PROJECT

Badger Wind Reclamation and Weed Management Plan

Badger Wind, LLC

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List of abbreviations

Abbreviation	Meaning
ADLS	Aircraft Detection Lighting System
APHIS	Animal and Plant Health Inspection Service
BMPs	best management practices
DNV	DNV Energy USA Inc.
EPA	Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
MW	megawatt
NDCC	North Dakota Century Code
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
O&M	Operation and maintenance
PLS	pure live seed
SPCC	Spill Prevention, Control, and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
USDA	U.S. Department of Agriculture



1 INTRODUCTION

Badger Wind, LLC (“Badger Wind” or “Customer”) retained DNV Energy USA Inc. (“DNV”) to review and update the February 2022 Reclamation and Weed Management Plan developed by Atwell [1] for the proposed Badger Wind Energy Project (the “Project”) in Logan and McIntosh Counties, North Dakota. Since the February 2022 plan was developed and accepted by the Logan County Weed Board during a meeting on 27 June 2022 (Appendix A), Badger Wind has altered the Project layout. The Project would comprise a nameplate capacity of up to 262.26 megawatts (MW), with up to 252 MW delivered to the grid. This would be accomplished by construction and operation of up to 93 wind turbines with an approximately 35,227-acre Project Area. The Project is located in Logan and McIntosh Counties, in south-central North Dakota. Project infrastructure includes turbines, access roads, a collector substation(s), collection lines, a transmission line, up to three permanent meteorological evaluation towers (MET towers), an Aircraft Detection Lighting System (ADLS) tower, and an operation and maintenance (O&M) facility. Crane walk paths and temporary laydown yards will be employed during Project construction.

The updates DNV has included herein are minor, but DNV has made new references to weed control and other appropriate guidance documents, some of which have also been added as Appendices.

2 RECLAMATION PLAN

The objectives for this reclamation effort are to:

- Reclaim areas affected by surface-disturbing activities to as near as practicable to the conditions as it existed prior to the beginning of Project construction
- Prevent soil and water erosion on the Project site
- Prevent the introduction and spread of noxious weeds on the Project site.

The Project Area currently supports a matrix of grasslands, pastures, hayfields, and croplands. Because the duration of construction is expected to be relatively short, Badger Wind's revegetation approach places a strong emphasis on conservation and the re-use of existing site resources such as topsoil. Strategic implementation of revegetation activities will have the goal of minimizing changes to native soil conditions as well as the number of equipment passes through the project area to accomplish successful revegetation. Revegetation will include seeding with vegetation similar in composition to surrounding areas and free of noxious weeds. Revegetation with appropriate seed mix will be conducted immediately upon completion of the project installation.

Fertilizer and soil amendments will not be applied. Soil that is currently supporting native vegetation or agricultural crops within the Project Area indicates that sufficient soil nutrient content is present. Even slow-release organic fertilizers can stimulate weed establishment, and in keeping with the strategy of changing native soil conditions the least amount possible, soil amendments are not warranted in this situation. However, application of granular humate and an endomycorrhizal inoculum are recommended to increase the potential of local topsoil to support germination and establishment of seeded plant species.

The methods for accomplishing this approach are described in the sections below.

2.1 Topsoil Care

Living organisms in healthy topsoil improve the ability of native plants to capture and uptake water and nutrients, establish, and reproduce. Preservation of soil structure and organisms during construction enhances revegetation success. Topsoil will be treated with care, as a resource for successful vegetation. Topsoil will be salvaged, segregated from subsoil, stored, and replaced as described below.

- A North Dakota Public Service Commission (Commission) third-party construction inspector will be present on the Project site during initial topsoil removal/segregation to observe that topsoil is being properly removed and kept segregated from subsoil.
- Badger Wind will establish the date and time for the third-party construction inspector's topsoil removal oversight in the preconstruction conference.
- To the extent practicable, erosion and sediment control measures (e.g., construction footprint will be minimized in areas of native vegetation, all vehicle traffic will be limited to roads or specific construction pathways) shall be installed prior to any required grading activities. At all times during Project construction, all temporary and permanent erosion and sediment control measures shall be maintained and repaired as needed to prevent accelerated erosion on the site and any adjacent properties.
- All topsoil to a depth of up to 12 inches, or to the depth of cultivation, whichever is greater, will be salvaged from all areas of temporary and permanent surface disturbance. This should include any rooted herbaceous plants, roots, shrub twigs, and branches that are present.
- Unless otherwise approved by the Commission, topsoil must be removed before topsoil freezes in the late fall/ early winter to the point that frost inhibits proper soil segregation.

- Any area on which excavated subsoil will be placed must be first stripped of topsoil, to the specified depth.
- Topsoil will be carefully stripped to the specified depth and segregated from subsoil.
- Stripped and segregated topsoil will be stockpiled for storage. No topsoil shall be removed from the site. Topsoil stockpiles must not be placed in natural drainages and will be protected from water erosion and compaction by heavy machinery.
- Runoff from stockpiled topsoil areas will be controlled to prevent erosion.
- For collection line trenches, topsoil will be stripped to the specified depth, including any rooted herbaceous plants, roots, shrub twigs, and branches that are present, and will be bladed from Project disturbance areas into windrows at each outer edge of temporary construction limits. Topsoil windrows will be constructed to lie parallel to slopes.
- After backfilling excavation areas with subsoil is complete, any excess subsoil must be placed over the excavation area, blending the grade into existing topography.
- Topsoil will be redistributed after subsoils have been integrated into the disturbed areas. This surface will be rough graded to provide a suitable base for topsoil. Topsoil will be evenly distributed and lightly raked or harrowed to provide an appropriate surface to be seeded and/or planted.

2.2 Construction Sequencing

Sequence of Project construction activities will generally be as follows, and may vary depending on Project constraints:

- 1) Grading of access roads and installation/replacement of culverts, as necessary
- 2) Construction of access roads
- 3) Preparation of crane walk paths
- 4) Trenching for collection lines, including boring protected areas such as wetlands, waterways, and other natural areas
- 5) Construction/installation of Project infrastructure, including establishment of permanent, non - vegetated surface cover, as necessary
- 6) Temporary reclamation in areas with anticipated further surface disturbance
- 7) Final reclamation of all temporary disturbance areas not included in permanent infrastructure footprints.

2.3 Prevention of Soil Loss Due to Water Erosion

- A National Pollutant Discharge Elimination System (NPDES) permit, Storm Water Pollution Prevention Plan (SWPPP), and associated best management practices (BMPs) will be developed and implemented prior to the commencement of construction. Erosion and sedimentation will be reduced through the use of BMPs, which may include mulching, hydroseeding, erosion control blankets, silt fence installation, jute matting, revegetation, and/or interim reclamation.
- Silt fences are used to intercept sediment and sheet flow from disturbed areas during construction. They shall also be used for perimeter control across the site. Silt fences should be placed prior to any site grading and regularly checked to ensure that runoff has not eroded a channel beneath the fence. The fence itself should also be checked for tears and sagging that can occur during construction activities. Regular maintenance shall be provided at a minimum of once every 14 days or when deficiencies in the fencing are found.

- Straw bales are used to intercept and filter sediment in the runoff and prevent it from entering local drainage systems. Straw bales shall be installed prior to any site grading and shall remain in place until the upstream disturbed area is stabilized.
- Surface flows will be directed away from cut-and-fill slopes and into ditches that discharge into natural drainages.

2.4 Prevention of Soil Loss Due to Wind Erosion

- Fugitive dust emissions resulting from grading activities and/or wind shall be controlled using the best available control technology as defined by the North Dakota Department of Health at the time of grading.
- Sediment control logs (which may act as perimeter control if silt fencing is not used) shall be installed prior to any up-gradient land-disturbing activities.

2.5 Reclamation Soil Preparation

- Following the completion of construction, impacted soils that will not continue to be used for operation of Project facilities will be restored to pre-construction condition in accordance with landowner lease agreements and Commission requirements.
- Subsoil to be used as backfill will be spread out around the construction areas, graded in some locations to drain away from turbines or other infrastructure, and topped with gravel or topsoil as appropriate. As part of the post-construction reclamation efforts, compacted soils in areas where Project infrastructure is not located will be ripped with a grader, spread with topsoil stockpiled during construction, and revegetated by seeding. Depending upon the timing of reclamation activity, these areas may be reseeded with temporary cover crops or planted with row crops.
- At the end of the Project's life, Project facilities will be decommissioned, and soils will be returned back to agricultural or other desired use in accordance with the Commission's requirements and the Project's Decommissioning Plan.

2.6 Seeding Preparation and Seeding

Successful site reclamation via seeding is most successful when the following steps are taken, in order described.

- Temporary soil stabilization measures shall be applied as quickly as reasonably possible to disturbed areas. Permanent soil stabilization measures shall be applied to disturbed areas as quickly as reasonably possible after final grade is reached on any portion of the site.
- Any areas severely compacted by machinery and equipment during construction should be ripped by tractor or backhoe to loosen soils and allow for water infiltration and root growth.
- Disturbed surface areas will be final-graded to match previous conditions and tied into new parking and road areas in a natural grade, as possible.
- Topsoil and composite plant debris will be redistributed within the graded areas to be revegetated after rough grading to provide a suitable base for areas that will be seeded.
- Following seed bed preparation, soil surface stabilization will comprise seeding with a seed mix appropriate to site-specific conditions:
 - a temporary cover crop when additional surface - disturbing activities are anticipated;
 - a pasture seed mix, developed in coordination with local U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) office and landowners (subject to Commission approval, as needed); or
 - a mix of native grass and forb species common to natural local grasslands, developed in coordination with local NRCS office and landowners (subject to Commission approval, as needed).



- Per NRCS recommendations, as necessary, temporary soil stabilization shall consist of seeding with Canada wildrye (*Elymus canadensis*) at 40 pounds pure live seed (PLS)/acre. Temporary seeding areas will be hydromulched with wood fiber/tackifier at one ton/acre.
- Following soil surface preparation, areas of permanent reclamation will be drill seeded with the appropriate seed mix at the specified seeding rate. Smaller areas may also be broadcast seeded at double the seeding rate used for drill seeding.
- Seeding areas will be hydromulched with wood fiber with tackifier at a rate of one ton/acre. Alternative acceptable mulching will be 1.5 tons of weed-free straw per acre, mechanically or hand crimped into topsoil.



3 WEED MANAGEMENT PLAN

This weed management plan provides general information on an integrated approach to noxious weed management during the construction and operation of the Project.

3.1 Plan Goals

Noxious weeds and other invasive plant species pose an increasing threat to native ecosystems, croplands, and other plant communities. Invasive and noxious weeds are not only a problem on disturbed sites, but they can also easily become established within relatively undisturbed ecosystems. Because they have few, if any, natural predators, competitors, or pathogens, the growth of invasive and noxious weeds can increase unchecked, removing moisture, nutrients, and sunlight from surrounding plant communities. In addition, invasive and noxious weeds can alter ecosystem structure and function, threatening wildlife biodiversity and ecosystem integrity.

The overall goal of this plan is to describe weed management practices to prevent and control the spread of noxious weeds and other nonnative invasive plant species on lands owned, leased, and managed by Badger Wind.

3.2 State and County Noxious Weed Law and Policy

North Dakota law (North Dakota Century Code [NDCC] §4.1-47-02) [2] requires every person to do all things necessary and proper to control the spread of noxious weeds. The North Dakota Department of Agriculture coordinates the efforts of county and city weed boards and state and federal land managers to implement integrated weed management programs. The agricultural commissioner is required to create and maintain a list of noxious weeds within the state. There are currently 13 noxious weeds on the list that require management, as follows:

- Absinth wormwood (*Artemisia absinthium*)
- Canada thistle (*Cirsium arvense*)
- Dalmatian toadflax (*Linaria genistifolia* spp. *dalmatica*)
- Diffuse knapweed (*Centaurea diffusa*)
- Houndstongue (*Cynoglossum officinale*)
- Leafy spurge (*Euphorbia esula*)
- Musk thistle (*Carduus nutans*)
- Palmer amaranth (*Amaranthus palmeri*)
- Purple loosestrife (*Lythrum salicaria*, *Lythrum virgatum*, and all cultivars)
- Russian knapweed (*Centaurea repens*)
- Salt cedar or tamarisk (*Tamarisk* spp.)
- Spotted knapweed (*Centaurea maculosa*)
- Yellow toadflax (*Linaria vulgaris*)

Counties have the option to add additional weeds to the noxious weeds list for enforcement within their jurisdiction. Logan County designates black henbane (*Hyoscyamus niger*) as a noxious weed. McIntosh County has no additional noxious weed designations. A guidance document developed by the North Dakota State University Extension and the North Dakota Department of Agriculture is included in Appendix B. This guidance document provides information on the identification of the aforementioned noxious weeds and various control methods that can be applied to prevent and treat the spread of noxious weeds.

3.3 Weed Management Strategy

Weed management is a constant and iterative process that accommodates the specific ecological conditions, weed species, and land uses of a site. To control activities of extensive existing populations requires an integration of techniques that will be implemented for multiple years.

However, in the meantime, small, incipient populations will be eradicated to prevent them from expanding and requiring additional, large management efforts.

Weed management must be accomplished through several integrated actions that address the varied aspects of weed incidence, occurrence, and management. These actions are discussed in the context of their application at the Project in greater detail below:

- Prevent new weed infestations with scrupulous use of best land management practices and increased public awareness;
- Monitor site for incipient weed infestations;
- Detect and eradicate small and incipient weed populations; and
- Prioritize and rigorously manage large weed populations emphasizing integrated weed management methods with the intention of containment and control.

3.3.1 Prevent New Weed Infestations

Prevention is a proactive control measure with long-term ecological and economic benefits. If new weed populations are prevented from establishing, ecological health is encouraged, and future control actions are considerably minimized.

Weed prevention can be addressed by:

- Limiting opportunities for weed propagules (e.g., seeds, shoots, root fragments) to enter the property
- Reducing negative human impacts to existing vegetation
- Maintaining healthy and vigorous plant communities that can exclude weeds, should they enter the local system.

Many weeds enter a location via seeds or other propagules in contaminated construction and fill material, sand and gravel, or topsoil. Weeds can also be transported from colonized areas to weed-free areas through maintenance activities. Weeds and plant propagules can be transported on vehicles or human workers.

Human visitors may also inadvertently transport problem plant species on vehicles, clothing, shoes, and dogs. Human transportation corridors such as roads and trails are often the point source of weed infestations into natural plant communities. Making these areas a high priority for monitoring and spot treatment will reduce the chance that additional weeds that enter as point infestations will spread into adjacent areas and become large management issues.

Some noxious weeds have been known to enter new sites as planted ornamentals in landscaped areas and gardens. These types of plants are usually well adapted to local conditions, which make them appealing to landscapers and gardeners. However, these characteristics also allow some plant species to escape cultivation, naturalize, and spread in the surrounding open lands. Raising the awareness of residents to this problem may prevent similar infestations in the future. The invasive nature of any ornamental plants used in future site landscaping should be investigated before planting.

Several sources have noted that thick cover of a healthy, strongly competing native plant community can be an important component of weed control. Management practices that minimize disturbance to native plant communities reduce opportunities for weeds to invade the site. This includes careful use of off - road vehicles and avoiding soil disturbances in natural vegetation areas whenever possible.

Careful revegetation of surface disturbed areas will also help prevent new weed infestations by using certified weed - free fill, topsoil, seeds, mulch, and vigorous native plant materials. A seed mix of native grasses found to grow well on, or in the vicinity of the Project, will be developed in coordination with the NRCS for revegetation of disturbed areas.

Construction activities for the Project will be conducted in a manner that supports the goal of preventing new weed infestations. The following best management practices will be employed during construction and will be included in the Final Plat and plans for site grading, drainage, and erosion control as notes:

- Other than vehicles essential to construction and maintenance activities, no motorized vehicles will be allowed off-road on open space or any other common property.
- Soil from areas with noxious weed populations will not be removed or introduced to the construction site, to avoid transport of weed seeds or other propagules.
- Construction activities will not be conducted such that noxious weeds are disturbed when they bear mature seed heads (to prevent release of seed into other areas). Or, before construction activities in such areas the weed plants will be cut or mown, and the material removed and disposed of before plants set seed.
- All earth moving equipment will be washed at a controlled location prior to being moved onto the Project site.
- All seed, soil, and mulch imported onto the Project site will be certified as weed-free.
- All excavations, placement of fill soil, or other areas of surface disturbance will be revegetated with appropriate site seed mix within 14 days of completion of grading, in order to facilitate establishment of desirable vegetation and discourage weed infestation.

3.3.2 Monitor for Incipient Weed Populations

Studies have shown that most weed infestations begin as small points of one or a few individual plants. These point infestations tend to gradually expand over time, then spread explosively into large populations with the potential to seriously impact native vegetation. Control at the point infestation stage is easier, more economical, and more effective than after a weed population becomes established.

Monitoring known weed populations and checking for new introductions should be done throughout the growing season. This is especially important along road and parking lot edges and other heavily used areas. This process is facilitated if all maintenance personnel are trained to recognize the potential noxious weeds in the area and keep track of new point infestations, the boundaries of established weed populations, and monitoring the success of management activities.

3.3.3 Detect and Eradicate New Weed Populations

Small weed infestations are much easier to control than larger ones because they have less-developed root systems, smaller seed reserves in the soil, and fewer resources accumulated in roots and rhizomes. The goal of managing small, focal weed populations can appropriately complete eradication. This can be accomplished with any of the methods described below in Section 3.3.4 that are appropriate for a specific weed. Mechanical methods are often very effective at this stage of a weed infestation, as are spot herbicide treatments of individual plants. Any particular treatment will need to be repeated several times to eradicate new point infestations. These areas should continue to be monitored following control activities and treatment methods should be reevaluated if the populations do not respond or increase in size.

3.3.4 Treatment Method

Expansion of noxious weeds is a dynamic process. Existing infestations of weeds can continue to spread and new infestations can become established. Reducing the spread of noxious weeds requires a timely, adaptive, and integrated

approach. Due to the dynamics of noxious weeds, treatment areas and approaches vary from year to year. The following sections describe the methods that may be employed to control invasive and noxious weed species.

3.3.4.1 Manual or Mechanical Removal

Manual techniques involve the use of tools such as shovels, axes, rakes, grubbing hoes, and hand clippers to expose, cut, and remove most of the target plant's central root mass. Hand grubbing (uprooting individual plants by hand) is another technique used where soil disturbance must be held to a minimum. Manual treatments can be far more species-selective and can be used in sensitive habitats where herbicides would not be appropriate or in areas not accessible to ground vehicles.

Mechanical methods primarily include mowing to cut herbaceous vegetation above the ground surface. Tillage for noxious weed control generally involves plowing, sweeping, or disking of a site to kill and incorporate existing vegetation in preparation of a seedbed. However, these methods involve a significant amount of ground disturbance and are generally not recommended.

3.3.4.2 Biological Control

Biological noxious weed control programs employ living organisms to selectively suppress noxious weed populations. Primary techniques include controlled foraging by herbivorous animals (e.g., sheep or goats) and introduction of host-specific pathogens or insects.

Grazing can aid in control of noxious weeds through removal of herbaceous vegetation. Also, by timing grazing to correspond with the peak palatability of a noxious weed species or peak vulnerability of a species, effects on surrounding vegetation can be minimized. In addition, depending on the species and the site conditions, grazing can be used to remove decadent aboveground biomass and noxious weed litter. This can temporarily decrease soil surface moisture and open the canopy, which may be favorable for native species competition and regeneration. Grazing animals may also eat desirable vegetation, and replanting afterward may be necessary.

Insects, pathogens, or a combination of the two may be released in an area infested by noxious weeds to selectively feed on or infect target plants. Introduced insects and or pathogens can weaken the target species directly by attacking vital plant parts (e.g., roots, seeds, or leaves) or indirectly by creating an environment that reduces the species' competitive advantage. The insects to be introduced must be approved and recommended for use by the USDA Animal and Plant Health Inspection Service (APHIS) [3] and any importation, interstate movement, and environmental release of biocontrol agents will require a permit ([PPQ 526](#)) unless they are obtained from a commercial or public source that has such a permit for release of the biocontrol agent in North Dakota. Information on obtaining insects for biological control for noxious weeds can also be provided by the local USDA-APHIS Plant Protection and Quarantine office. Any proposed inoculation of noxious weeds with larval stage insects will require specific approval from County Weed Coordinators, depending on the location of the proposed release. DNV notes, however, that biocontrol with insects or pathogens works best when weeds and other pest populations are widespread; small populations would be best controlled by using another control method.

3.3.4.3 Herbicide Treatments

Chemical treatment methods employ herbicides to control noxious weeds. All applications of herbicides will adhere to required and recommended restrictions on herbicide labels. A communication plan will be implemented to provide notification of treatment activities. Herbicides will be applied from ground vehicles (e.g., trucks, all-terrain vehicles, and tractors), from backpack equipment, or small hand sprayers. Target species will be spot treated where this method is practical and effective. Ground vehicles and backpack applicators will be equipped with handheld spraying equipment (e.g.,



wands and spray guns) for spot treatment. Additional items in backpack equipment may include drip and wick applicators, or whirling disk applicators. Dry formulations may be applied with mechanical broadcast equipment, or by hand. Truck mounted boom sprayers or broadcast spreaders would be used only where target vegetation is dense enough and infestation size large enough (usually >1 acre) to warrant such methods.

All herbicides used in weed control on the Project Area will be registered by the U.S. Environmental Protection Agency (EPA) for forestry, right-of-way, and rangeland uses. Specific chemicals will be selected for each treatment area based on efficacy of control for the target species, relative risks to non-target species (both plant and animal), and human safety. Species-specific chemical control recommendations are updated annually and printed in the “North Dakota Weed Control Guide”.

In the event of an herbicide spill, the emergency spill plan outlined in Section 3.4 will be followed. All workers, including contractors, will have the appropriate knowledge and equipment to carry out the plan, and a copy of the spill plan will be kept in all project-related transport vehicles.

All herbicide applications will follow EPA label instructions. Seasonal application of herbicides will be species-specific and follow North Dakota (Appendix B) and County Weed Board guidance. Application of herbicides will be suspended when any of the following conditions exist: wind velocity exceeds six miles per hour during application of liquid or granular herbicides; snow or ice covers the foliage of noxious weeds; or precipitation is occurring or is imminent.

Vehicle-mounted sprayers (e.g., handgun, boom, injector) will be used mainly in open areas that are readily accessible by vehicle. Hand application methods (e.g., backpack spraying) that target individual plants will be used to treat small or scattered weed populations in rough terrain. Calibration checks of equipment will be conducted at the beginning of spraying and periodically to ensure that proper application rates are achieved.

Herbicides will be transported to, and applied within, the Project site with the following provisions:

- All herbicide use will be conducted in compliance with the North Dakota Department of Agriculture Pesticide Program, under delegated authority to enforce the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) under state laws and administrative rules.
- Herbicides will be transported to the Project site daily or will be stored under proper precautions at the Project O&M facility.
- On-site herbicide quantities will be limited as practicable.
- Concentrate will be transported in approved containers only and in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment.
- Mixing will be conducted in an upland area and at a distance greater than 100 feet from open or flowing water or wetlands, greater than 200 feet from private wells, and greater than 400 feet from public wells.
- All herbicide equipment and containers will be inspected for leaks daily.
- All herbicide applicators will have a Commercial Applicator’s license with the State of North Dakota for the use of restricted use herbicides and have adequate training for the use of general herbicides.
- Exercise “safety first” at all times.
- Herbicide will be applied only as intended and consistent with state and federal pesticide use laws.
- Herbicide will only be applied as directed by the product label.

3.3.4.4 Safety Considerations and Herbicide Restrictions

Always wear gloves and eye protection when hand pulling or digging. Several weed species have irritating effects to human skin and eyes. Weeds removed through pulling, digging, or cutting should be bagged and removed from the site. County Weed Coordinators may be able to provide a disposal site, or suggestions for such a site, depending on location.

If chemical weed control methods (herbicides) are chosen for integration into the weed management program, the physical characteristics of each specific site must be carefully considered. Incorrect application of an herbicide can cause severe damage to native plant species as well as the physical environment. Particular attention should be paid to soils, water table depth, surface water locations, and specific native plants that occur alongside the target weed species.

Only experienced personnel, using calibrated equipment and appropriate personal protection, should apply herbicide treatments. Before using any herbicide, all label instructions and restrictions must be read, understood, and followed precisely. Please note that herbicide labels are changed regularly and should be reviewed often. Supplemental labels are also often available for specific areas and environmental conditions. Herbicides must be applied in conformance with every aspect of their label. Herbicide application beyond the bounds specified on the label is illegal.

3.3.5 Control Existing Populations

To successfully control or manage established weed populations, several factors need to be examined and understood. Priorities for control must be established and management activities should be planned for efficient use of resources and optimal control results. The planning process must consider the physical characteristics of each site, the surrounding non-target plant species, and the life history and phenology of each target weed species, which provides windows of vulnerability to different mechanical, biological, or chemical control methods. The timing of all control techniques must be carefully considered and implemented to maximize effectiveness and minimize risk to non-target organisms.

Types of noxious weed species that could be found on the Badger Wind site are discussed below. Appropriate control measures are discussed in terms of life histories and specific site conditions.

3.3.5.1 Annual Species

Annual species complete their entire life cycle (germinating, growing, flowering, and producing seeds) in one year. Because annual plants depend entirely on seeds for reproduction, seeds are the focus of most control measures. Mechanical control methods include preventing seed set, blocking entrance of seeds into the soil seed bank, and optimizing conditions that will hasten the depletion of viable seeds from the seed bank.

The single listed annual noxious weed in North Dakota is Palmer amaranth.

3.3.5.2 Biennial Species

Biennial plants complete their entire life cycle in two growing seasons. The first year an individual biennial plant grows as a cluster of basal leaves or a rosette without producing flowers its first growing season. The rosette overwinters and in the second year the plant produces a flowering stalk, seeds, and dies. This life history strategy implies a large dependence upon seeds, and the two-year old seed-bearing individuals, for continuing in current locations and colonizing new sites.

Removing the seed head buds before flowering by cutting the stalks, mowing, or hand-pulling is an effective way to reduce or eliminate seed formation. These activities should begin in the late spring and summer and must be repeated throughout the growing season, as the plants will continue to produce flower buds in an attempt to reproduce. Assiduous mechanical control that involves prevention of seed set by biennial weeds for multiple growing seasons will eventually exhaust the viable seed bank in the soil and reduce or eliminate additional seeds from entering the plant community.

Biological control agents also usually target seed production, or seed producing individuals, in biennial species.

Herbicides are usually applied to biennials at the rosette stage, either in the fall or spring, depending on the species. Herbicide treatments are particularly effective when combined with mechanical methods that have weakened individual plants and reduced the number of seeds entering the system.

Biennial species listed as noxious weeds in North Dakota include diffuse knapweed, houndstongue, musk thistle, spotted knapweed (or a short-lived perennial), and black henbane.

3.3.5.3 Perennial Species

Individuals of perennial species persist for several years due to their formation of extensive root systems. Many perennials are able to reproduce both by seed and vegetatively. These life history traits make control of perennial weed species more difficult than annuals or biennials as individual plants must be eradicated both above - and below - ground. Seeds and growing plants (including the belowground component) must be destroyed at the same time for effective control. Because of this, mechanical methods are often not sufficient in themselves for control. But mowing or pulling throughout the growing season does weaken perennials, making them more susceptible to herbicides applied in the fall.

Perennial species listed as noxious weeds in North Dakota include absinth wormwood, Canada thistle, Dalmatian toadflax, leafy spurge, purple loosestrife, Russian knapweed, tamarisk, spotted knapweed (can also be a biennial), and yellow toadflax.

3.3.6 Monitoring

Weed management is a constant and iterative process. Continual monitoring of treated populations, and the entire Project site, is strongly recommended. If weed management goals are not being met, or new species or populations are observed, the control strategies may need to be recalculated. Likewise, species may be shifted to different priority-to-control groups based on response to control treatments and behavior within the surrounding plant community. It is important to note that research on weed ecology and management techniques is ongoing. The methods discussed above only include those known at the time of the writing of this plan. New techniques should be integrated into this plan, as information is available.

3.4 Emergency Spill Plan for Herbicides

Badger Wind will implement a Spill Prevention, Control, and Countermeasure (SPCC) Plan for construction and operations that incorporates all reasonable precautions to be taken to avoid herbicide spills. In the event of a spill, cleanup will be immediate. Employees and contractors will keep spill kits in their vehicles and in herbicide storage areas to allow for a quick and effective response to spills. Items to be included in the spill kit are:

- Protective clothing and gloves
- A minimum of 10 pounds of suitable commercial adsorbent and barrier materials
- Plastic bags and bucket
- Shovel
- Fiber brush and screw-in handle
- Dustpan
- Caution tape
- Detergent



The response to an herbicide spill will vary depending on the material spilled, and the size and location of the spill. The order of priorities after discovering a spill are to protect the safety of personnel and the public, minimize damage to the environment, and conduct cleanup and remediation activities.

All herbicide contractors and employees will obtain and have readily available copies of the appropriate material safety data sheets and the herbicide labels for the herbicides used. All herbicide spills will be reported in accordance with applicable laws and requirements.



4 REFERENCES

- [1] Atwell, LLC, Badger Wind Reclamation and Weed Management Plan, prepared for Badger Wind, LLC, Project No. 19000785, dated February 2022.
- [2] North Dakota Department of Agriculture, North Dakota's Noxious Weed Law and Regulations, dated May 2021.
Available online at:
<https://www.ndda.nd.gov/sites/www/files/documents/files/2021%20Noxious%20Weeds%20Book.pdf>.
- [3] U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Technical Advisory Group for Biological Control Agents of Weeds Manual, Second Edition Issued 2021.

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APPENDIX A – LOGAN COUNTY WEED BOARD MEETING MINUTES

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Logan County Weed Board Meeting Minutes

Monday, June 27th, 2022, 8:11 PM: Logan County Courthouse Commissioner's Room

Roll call: Bobby Buchholz, Dustin Hammond, Elmer Schlecht, Blanche Schumacher, Adam Schumacher, Sheldon Gerhardt

Absent: Randy Ben, Heather Moser

Call Meeting to Order: Bob Buchholz called the meeting to order at 8:11 PM

Minutes from Previous Meeting (Dustin)

- May 17th minutes were provided to the LCWB. No edits or corrections. Adam motioned to accept the minutes as presented. Blanche seconded. Motion passed

Weed officer report

- No report

Treasurer's Report (Dustin)

- Copy of year-to-date budget provided (5/31/2022) \$77,125.15
- Balance available: \$77,125.15
- Overall weed control board fund: \$105,208.97
- TAG has a two-year allocation for July 1st, 2021– June 30th, 2023
 - TAG (Targeted Assistance Grant) (covers 75% equipment/cost share)
 - Grant \$5,000 (spend \$6,666.66 to receive full amount)
 - Equipment needs or problem weed areas
 - Sheldon advised that we can use the funds for either spraying of county roadsides or to pay off the excess amount of cost-share expenses
- LAP (Landowners Assistance Program) now has a one-year deadline of June 30th, 2022
 - Covers 100% of expenditures (Landowners Assistance) Grant \$14,338.44.
 - The current total cost-share expenditures are \$8794.73
 - Balance of \$5205.27 for the spring cost-share program.
 - TAG funds can be used to offset the costs of cost-shares or offset expenses in the county weed spraying budget

Old Business: (Bob)

- Plateau Inventory: 19.5 gallons in inventory
 - Courthouse inventory: 9 gallons
 - ~~Heather 8.5 Unknown; strike from the record~~
 - Bob 2
 - Order or wait? Possible rise in cost in July 2022
 - Adam; purchase 20 gals of Plateau
 - Elmer seconded. Motion carried
 - ACTION ITEM! Contact South Dakota

New Business: (Bob)

- Emmons County Weed Control
 - Updates regarding costs and availability (Blanche)
 - Producer suggested that we contact Emmons County
 - \$125 per hour with trucks, \$100 per hour with SxS/4-wheeler, always a crew of 2
 - Concerns:
 - Mileage costs to the far side of the county (Elmer)
 - Will the CoComs support it?
 - County or state roads? Both
 - State roads first or county roads first
 - Same area is the most cost effective
- Call to CJ Jahner (7013299090)
 - CoComs from EC (Emmons County) are OK with the spraying?
 - Budgets are OK; Approved by CoComs
 - Weed Board will meet on Wednesday, June 29th
 - Logistics: 2 guys will work in Logan, rest of the crew will work in EC.
 - Fed aid and highways will be sprayed.
 - Water? Available at DFC, Highway Dept. No water in Gackle
 - One year or ??? If yes for next year, they would have to get more help.
 - Public and private work (pastures)
 - Billing? Biweekly?
 - Chemical costs are very high this year
 - EC uses Grassland, Opensite primarily (with 24-D added)
 - Jugs and shuttles; whichever is available.
 - Bills paid at the end of the month
 - DOT contracts: We would have to contact and bill the DOT.
 - EC is projecting that our spraying costs will be very high (17K +)
 - EC will complete the paperwork as necessary (time, mileage, chemicals, etc)
 - \$110 an hour for the labor + chemicals
 - EC will supply the chemicals (at cost)
 - Fuel costs/surcharge: Board will decide on Wednesday
 - Discussion
 - Budgetary amount for spraying
 - Federal aid? State budgets? County funds?
 - Sheldon will contact the DOT for additional funds for roadside spraying
 - Adam moved to allot 20K for the budget
 - Blanche 2nd
 - Passed unanimously
- Badger Wind Management Plan (Handouts)
 - Ratify/Approval requested

- Discussed and proposal accepted.
 - Blanche Motioned
 - Adam 2nd
 - Passed
 - Notify Francesca (notified)
- Fall 2022 Cost Share: Discussion? Changes? (Bob et al.)
 - Fall 2022 program: Leafy Spurge, Yellow Toadflax, Spotted knapweed, Canada Thistle, and wormwood (80% rangeland, 100% roadside, additional limits \$500 on wormwood and Canada Thistle and \$5,000/year/producer) \$500 for manual removal of Palmer amaranth.
 - Houndstongue (Sheldon)
 - Add to the Cost Share program. Within the \$5000 dollar mix
 - M Adam, 2nd Elmer
 - Motion passed
- Approve vouchers for the Spring Cost Share Program (14 applicants)
 - Approved: All
 - Tabled: None
- Sign travel allowance vouchers. (All)
 - All signed.

Adjourn: 10:02 PM

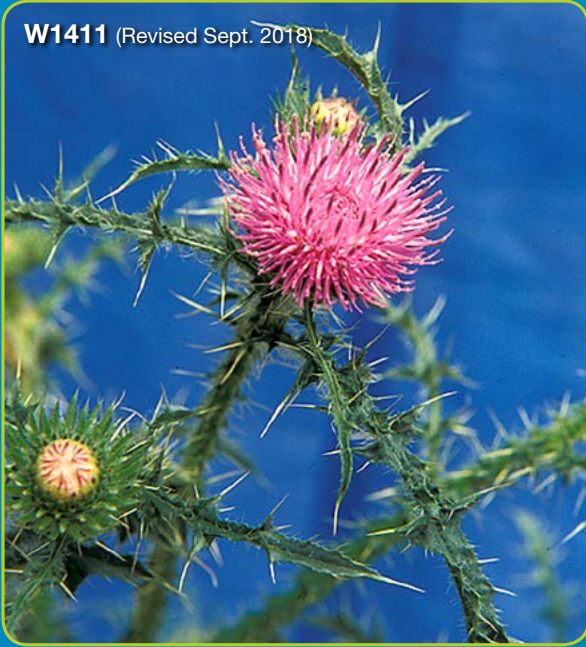
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APPENDIX B – IDENTIFICATION AND CONTROL OF INVASIVE AND TROUBLESOME WEEDS IN NORTH DAKOTA

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W1411 (Revised Sept. 2018)



Identification and Control of INVASIVE AND TROUBLESOME WEEDS in North Dakota

Rodney G. Lym, Professor of Weed Science
NDSU Department of Plant Sciences



NDSU NORTH DAKOTA
STATE UNIVERSITY

N.D. Agricultural Experiment Station
NDSU Extension

Revised and reprinted September 2018

This publication was made possible by collaboration of the author, North Dakota State University Extension and the North Dakota Department of Agriculture, with funding from the U.S. Forest Service for printing. This publication is intended to help land managers properly identify and control noxious and invasive weeds found in the state. The current list of 11 noxious weeds are included, as well as species listed by various counties as noxious. Other species included are either invasive weeds found in bordering states with the potential to move into North Dakota or are commonly misidentified native species that do not require control efforts, such as the native thistles.

Control recommendations are current at publication, but options change rapidly. Before beginning any management program, please consult with your local county Extension agent and/or weed officer for the latest chemical, cultural and biological control recommendations. Chemical control recommendations are updated annually and printed in the “North Dakota Weed Control Guide,” Extension publication W253, and are updated more frequently on the Web at www.ndsu.edu/weeds.

For the latest in biological control options, contact the North Dakota Department of Agriculture and/or the local staff of the U.S. Department of Agriculture –Animal and Plant Health Inspection Service in Bismarck.

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ABSINTH WORMWOOD

(*Artemisia absinthium* L.)



ABSINTH WORMWOOD

State Listed Noxious Weed

Absinth wormwood is a member of the sagebrush family, which is easily recognized by the strong sage odor. The plant also is known as American or common wormwood, mugwort or madderwort, and wormwood sage. Unlike other plants in the sagebrush family, absinth wormwood dies back to the root crown each winter, with new shoots emerging each spring. Absinth wormwood is grown in herb gardens for the sage flavor of the leaves. The young flower heads are the source of aromatic oil used to prepare vermouth and absinth. The oil of absinth wormwood is also an active ingredient in antiseptic liniments.

Identification and growth form:

Absinth wormwood is a perennial fragrant forb or herb. The plant commonly grows 3 to 5 feet tall at maturity. Absinth wormwood is woody at the base and regrows from the soil level each spring from a large taproot. Leaves are light to olive green, 2 to 5 inches long and divided two or three times into deeply lobed leaflets. Leaves and stems are covered with fine, silky hairs that give the plant a grayish appearance. Flower stalks appear at each upper leaf node and produce numerous yellow flower heads 1/8 inch in diameter, which appear from late July through mid-August in North Dakota. Each fruit contains one seed, which is less than 1/16 inch long, smooth, flattened and light gray-brown. These small seeds are scattered easily by wind, water and animals, and in hay. Absinth wormwood is a prolific seed producer but also can spread by short roots. The plant is most often found on dry soils, in overgrazed pasture and rangeland, wastelands and roadsides.

Why is this plant a concern?

Absinth wormwood causes economic losses by reducing available forage, tainting the milk of cattle that graze it, and medically as a pollen source for allergies and asthma. Absinth wormwood can reduce forage production severely in pasture and rangeland and is especially troublesome when land is overgrazed. Allergy sufferers should avoid walking through absinth wormwood infestations when the plant is flowering in late July and August.

How do I control this plant?

Chemical. A variety of auxin-type herbicides, including products that contain clopyralid (Stinger, Transline or Curtail), dicamba (various), Milestone (aminopyralid), 2,4-D, Tordon (picloram) and glyphosate (various), will control absinth wormwood. These herbicides should be applied when the plant is at least 12 inches tall and actively growing. Herbicides applied too early in the growing season generally result in poor control. If a fall treatment is desired, the plants should be mowed in early to midsummer to promote active regrowth and to improve herbicide coverage.

Cultural. Livestock generally will not graze absinth wormwood except in early spring. Mowing and cultivation do not control this weed.

Biological. No biological control agents or pathogens are available for this weed.

BABY'S BREATH

(*Gypsophila paniculata* L.)



BABY'S BREATH

County Listed Noxious Weed

Baby's breath is an ornamental plant of Eurasian origin introduced to the U.S. in the 1800s. The plant is a member of the Pinks or Carnation family and is used by the floral industry as a filler in bouquets. The plant escaped cultivation and now infests pasture and rangeland in several areas of the West.

Identification and growth form:

Baby's breath is a perennial with widely branching stems. The plant often grows to 3 feet tall and is easily identified by the presence of many small white flowers. The leaves occur in pairs of up to 4 inches long and end with a point. The number of leaves decreases with increasing plant height and during flowering. The flowers are small, about 1/8 inch, and generally white and five lobed, often with a purple midstripe. Flowering occurs from late June to late August in North Dakota.

Seeds are black, with two to five contained in capsules, and resemble pepper. The seeds can germinate in 10 to 15 days and plants grow rapidly. Each plant can produce 10,000 or more seeds, which are spread when the branches dry, break off and are moved in the wind similar to Russian thistle and kochia. The plant has a large, deep taproot that allows it to grow well in dry and poor soil conditions.

Why is this plant a concern?

Baby's breath forms dense stands and displaces desirable grasses and forbs. Because of the large taproot and the ability to produce millions of seeds in a small area, this plant is difficult to remove once it has established in an area. Baby's breath has been listed as a noxious weed in several Western states.

How do I control this plant?

Chemical. Baby's breath can be controlled with herbicides that contain metsulfuron (Escort or Ally) applied during the bolt to preflower growth stage.

Cultural. Hand-pulling this weed is not practical because of the large taproot. Baby's breath has not become a problem in cropland that is cultivated.

Biological. No biological control agents or pathogens are available for this weed.

BLACK HENBANE

(*Hyoscyamus niger* L.)



BLACK HENBANE

County Listed Noxious Weed

Black henbane is native to Europe and was cultivated as a medicinal and ornamental plant. In 1670, the plant escaped cultivation in the United States and became sparingly naturalized by 1859. Black henbane has since spread throughout much of the United States, particularly in the Northeast, Midwest and the Rocky Mountains. Two alkaloids in black henbane tissues (hyoscyamine and scopolamine) are useful sedative or anti-spasmodic drugs when used under controlled conditions.

Identification and growth form:

Black henbane is an annual or biennial plant that can range in height from 1 to 3 feet. Rosette leaves are alternate and have petioles almost as long as the leaf blades. Stems of mature plants are erect, leafy, thick, coarse and widely branched. Leaves are alternate, oblong to ovate, coarsely toothed to shallowly lobed and grayish green. The foliage is covered with fine, sticky hairs and has a foul odor. Flowers are funnel-shaped, five-lobed, brownish yellow with dark purple veins, and arranged in long, leafy, spikelike clusters. Fruit of the plant is pineapple shaped, approximately 1 inch long, and contains hundreds of tiny, black seeds.

Seeds germinate and develop a rosette with a large, whitish branched taproot the first growing season. During the second growing season, the plant bolts and flowers from June to August. The plant produces hundreds of seeds from July to October that can remain viable for five years or more.

Why is this plant a concern?

Black henbane contains alkaloids (hyoscyamine, hyoscyne or scopolamine, and atropine) that have caused occasional livestock poisoning. The plant is not usually grazed by animals unless more palatable forage is unavailable. All parts of the plant, including the seeds, contain the alkaloids that can be toxic to humans and animals if eaten. Even just smelling the flowers can cause headaches and nausea in some people.

How do I control this plant?

Chemical. Herbicides recommended for black henbane control include 2,4-D, dicamba (various), glyphosate (various), metsulfuron (Escort or Ally), Milestone (aminopyralid) and Tordon (picloram). Herbicides should be applied prior to flowering to prevent seed production.

Mechanical. Hand pulling, cutting or digging small infestations of black henbane can be effective. Wear gloves and protective clothing when handling these plants. Disking or plowing should be repeated annually because seeds can persist in the soil for an extended period of time.

Biological. No biological control agents or pathogens are available for this weed.

FALSE and SCENTLESS CHAMOMILE

[*Matricaria recutita* L. and *Tripleurospermum perforatum* (Mérat) M. Lainz]



False chamomile

County Listed Noxious Weed: Scentless chamomile only.

False chamomile (aka German chamomile) and scentless chamomile are members of the aster family and have flowers that resemble the common daisy. Some taxonomists place these plants in the genus *Anthemis*. Both plants are native to Eurasia, are considered naturalized in the northern Great Plains and are common in the region. The most obvious difference between the two species is the pleasant aroma of false chamomile, while, as the name implies, scentless chamomile has very little odor when crushed.



False chamomile
(from NRCS plants database)



Scentless chamomile
(from NRCS plants database)



Scentless chamomile

FALSE and SCENTLESS CHAMOMILE

False chamomile has been used for medicinal purposes for hundreds of years and most often is consumed today as chamomile tea, which reportedly has relaxation benefits. As with many homeopathic medicines, chamomile is credited with curing a variety of aches and illnesses, including soothing and calming of nerves, reducing inflammation and aching muscles, and reducing hay fever, asthma and morning sickness. Today chamomile commonly is found in air fresheners, cosmetics, insect repellents and potpourri.

Identification and growth form:

Both chamomile species are annual herbs and have white daisylike flowers. False chamomile blooms from May through August, and scentless chamomile blooms somewhat later from June through September. Plants grow 6 to 18 inches tall and commonly are found in wet sites, road ditches, old gardens and weedy (waste) areas. Scentless chamomile flowers tend to be larger (1 to 1.5 inches across) than false chamomile (0.5 to 1 inch across). Seeds are approximately 1/16 inch long, dark brown, with three ribs on one side and a broad brown central area on the other. Both plants have very finely divided leaves from 0.75 to 2.3 inches long, but scentless chamomile generally has more leaves and appears more bushy than false chamomile.

Why is this plant a concern?

False chamomile was a candidate for the North Dakota state noxious weed list in the late 1970s and early 1980s because the weed was spreading fast in cropland, especially in the north-central region of the state. Many farmers were concerned because false chamomile was tolerant to all herbicides then available for use in crops. However, with the introduction of Glean (chlorsulfuron), landowners had an effective herbicide for false chamomile control. This plant is listed on several county noxious weed lists. Spring and fall-emerging plants can reduce wheat yields by 20 percent to 60 percent if left unattended. In addition, scentless chamomile has poor nutrition value and is not palatable to livestock.

Several other members of the “daisy” family, including pineapple-weed (*Matricaria discoidea* DC.), oxeye daisy (*Leucanthemum vulgare* Lam.) and dog fennel or mayweed chamomile (*Anthemis cotula* L.), also can become weedy. Of these species, oxeye daisy has been the most invasive and is included on several state and provincial noxious weed lists.

How do I control these plants?

Chemical. Today, chamomile species can be controlled easily with any sulfonylurea herbicide such as Ally, Cimarron or Escort (metsulfuron) and Telar (chlorsulfuron). Bromoxynil plus MCPA and Tordon (picloram) also provide good chamomile control.

Mechanical. Hand-pulling can be an effective control method in small infestations of chamomile. Mowing early in the growing season or before plants flower will reduce populations but should be repeated often. Shallow tillage is recommended during hot, dry weather.

Biological. No biocontrol agents for false chamomile are permitted in the U.S. In Canada, the seed-head weevil, *Omphalapion hookerorum*, feeds on developing seeds of the plant, thereby reducing seed production. The stem-boring weevil, *Microplontus endentulus*, feeds on the interior of the stem and produces hollow areas that reduce the vigor of the plant. *Rhopalmyia tripleurospermi*, the scentless chamomile gall midge, forms a gall on the plant, which acts as a nutrient sink that can interrupt and stunt the growth of the plant.

COMMON BURDOCK

[*Arctium minus* (Hill) Bernh.]



COMMON BURDOCK

County Listed Noxious Weed

Common burdock, also referred to as wild rhubarb, is a member of the Asteraceae or sunflower family. Common burdock is native to Europe and now is established throughout much of North America. A tea once was made from the roots to treat gout and rheumatism. The plant is able to spread to new areas by seeds that are found within burs of the plant that cling to hair, fur or clothing of passing animals or people.

Identification and growth form:

Common burdock often is found growing along roadsides and ditch banks and in pastures and waste areas. Burdock is a taprooted biennial that reproduces only by seed. In the first year of growth, the plant forms a rosette of large, heart-shaped, thickly hairy leaves similar to rhubarb. Burdock plants bolt in the second year of growth and grow 3 to 10 feet tall. Leaves of the plant are alternate and large with the broadest leaves located at the base. Leaves are dark green above and whitish green and woolly-hairy beneath with margins that are toothed or wavy. Flowers of the plant are pink, lavender, purple or white and 0.75 inch across. Numerous flower heads present are borne in leaf axils or at the end of branches. The heads are enclosed in a prickly bur that is composed of numerous smooth or woolly bracts that are tipped with hooked spines.

The head, or bur, of the flower breaks off and scatters the seeds. Achenes are gray to brown, mottled, oblong, about 0.25 inch long, flattened and slightly curved. Flowering and seed production occur from July to September. One plant is capable of producing 15,000 to 60,000 seeds.

Why is this plant a concern?

The plant is a host to powdery mildew and root rot that can spread to economically important plants. Burs of common burdock can become entangled in the wool of sheep and significantly damage the quality. Burs also can become entangled in the hair of livestock, allowing seeds to be distributed to new areas. The burs can cause eye disease, mouth sores and skin infections. In addition, milk products may become tainted if the plant is grazed in large quantities.

Common burdock has been used as a medicinal herb; however, the plant has been listed as a poisonous plant due to its diuretic effects. The bristles of the plant also may cause localized allergic reactions for some individuals.

How do I control this plant?

Chemical. Burdock is controlled easily by herbicides such as 2,4-D, dicamba (various) and Escort (metsulfuron). However, the plant usually grows in areas difficult to reach with spray equipment. Herbicides are most effective when applied in the first year during the rosette growth stage of the plant.

Cultural. Hand-pulling or digging can be an effective control method for small infestations if conducted prior to seed production. The plant will not survive in areas that are tilled. Mowing or cutting can eliminate seed production if conducted after the plant has bolted but prior to flowering.

Biological. The burdock moth *Metzneria lappella* Zeller provides some control of seed production. The larvae feed on burdock seed but damage varies greatly from year to year since the number of healthy larvae per bur ranges widely. The adults emerge in late June to early July and have pale brown wings approximately 0.5 inch across.

COMMON MULLEIN

(*Verbascum thapsus* L.)



COMMON MULLEIN

County Listed Noxious Weed

Common mullein is a native of Asia but was introduced into the U.S. from Europe and now is common throughout North America. This plant is found most often in gravelly, dry soils, waste areas and bottomlands. Livestock do not graze the plant because of the pubescence. Leaves were smoked by Europeans to relieve asthma and other pulmonary diseases.

Identification and growth form:

Common mullein is a biennial that forms a large, thick- and fuzzy-leaved rosette the first year and a long tap root. The second season, the plant bolts and a single, stiff, erect stem of 2 to 6 feet tall emerges. The leaves are generally 10 to 20 inches long, alternate, overlap one another and generally light green. The leaves also are very pubescent, or woolly, which distinguishes this plant from most others. The flowers are found on long terminal spikes, and are sulfur or sometimes pale yellow, five petaled and approximately 1 inch in diameter. The flowers are seen in June and July, are fragrant and attract several species of insects. Seed capsules are two-chambered and contain many small brown seed.

Why is this plant a concern?

Common mullein is not a concern in cropland but can spread from wastelands to pasture, especially during dry seasons and/or in overgrazed situations. Woolly leaves complicate control by discouraging grazers and obstructing herbicide contact. Common mullein can become dense following a controlled burn or wild fire and slows the re-establishment of native herbs and grasses. The plant is unpalatable to livestock due to the heavy pubescence.

How do I control this plant?

Chemical. Several herbicides will control common mullein, but all must be applied with a surfactant to overcome the extreme pubescence of the plant. Tordon (picloram), Milestone (aminopyralid), dicamba (various) and Telar (chlorsulfuron) will control this weed.

Mechanical. Individual plants can be dug out or cut just at the soil surfaces as long as the whole rosette is removed. Common mullein will not survive cultivation.

Biological. The larvae of the mullein seed-eating weevil, *Gymnetron tetrum*, feed on the seeds, reducing seed production by approximately 50 percent.

COMMON TANSY

(*Tanacetum vulgare* L.)



COMMON TANSY

County Listed Noxious Weed

Common tansy, also referred to as garden tansy, golden buttons and bitter buttons, is a member of the Asteraceae or sunflower family. Common tansy is native to Europe and first was introduced to the United States as early as the 1600s as an ornamental plant and for medicinal purposes. The plant contains alkaloids that can be toxic to humans and livestock if consumed in large quantities. However, animals rarely ingest common tansy due to the strong smell of the plant. Illnesses in humans have been reported after hand pulling, suggesting toxins may be absorbed through unprotected skin. Common tansy still is used in some medicines and is listed in the United States Pharmacopoeia as a treatment for colds and fever.

Identification and growth form:

Common tansy is an aromatic perennial forb or herb that commonly grows from 1.5 to 6 feet tall. The plant reproduces both by seed and creeping rootstocks. Roots of the plant are fibrous and produce rhizomes. Stems of the plant are purplish-red. Leaves are alternate, smooth to slightly pubescent, 2 to 10 inches long and 1.5 to 3 inches wide, and deeply divided into numerous narrow, toothed segments that appear fernlike. Glandular dots on the leaves of the plant produce the strong, unique odor of the plant. Flowers of the plant are yellow, 0.25 to 0.5 inch across and buttonlike in flat-topped, dense clusters. Each head is composed of mainly yellow disk flowers that are arranged at the stem top in a flat-top cluster in which the outer flowers bloom first. Flowering typically occurs from July to September. Flower heads turn brown and maintain their shape at seed set. Seeds are yellowish brown with short five-toothed crowns.

Common tansy sometimes is confused with tansy ragwort (*Senecio jacobaea* L.). However, tansy ragwort is nonaromatic, has ray flowers and does not have the sharp, toothed leaves found on common tansy.

Why is this plant a concern?

Common tansy is an aggressive plant that can form dense vegetative colonies on disturbed sites and generally is found on roadsides, fence rows, pastures, vacant lands, stream bank, and waste areas. Disturbances can promote the colonization and spread of the plant. Common tansy reduces overall pasture productivity because the plant displaces desirable grasses and forbs and animals are reluctant to graze it. In addition, unpleasant tasting milk may result when dairy cattle graze the leaves of common tansy. Wildlife habitat also is affected negatively by the plant.

How do I control this plant?

Chemical. Herbicides for common tansy control include Escort (metsulfuron) and Telar (chlorsulfuron). Chaparral (aminopyralid plus metsulfuron) works well when infestations of common tansy also include thistle species. Herbicides may be most effective when applied in the spring during early bud development.

Cultural. Hand-pulling or digging may provide control for small infestations of common tansy if the entire root system is removed. However, gloves and protective clothing should be worn to prevent absorption of toxins through the skin. Mowing can reduce seed production if conducted during the bud stage; however, plants are able to regrow from rootstock.

Biological. No biological agents or pathogens are available for this weed.

DAME'S ROCKET

(*Hesperis matronalis* L.)



Fall rosette

DAME'S ROCKET

Not Listed by State or County

Dame's rocket is an escaped ornamental from Eurasia and most often found along roads, streams, near woods and in thickets. The first introductions to North America began in the 1660s and the plant is now considered naturalized. However, infestations have been increasing rapidly in the north-central states.

Identification and growth form:

Dame's rocket is a biennial or occasionally short-term perennial herb in the mustard family. The plant resembles phlox, but has four petals, not five. The plant grows 2 to 4 feet tall; the stems are erect and often branched. Leaves are alternate, lanceolate, sharply toothed and pubescent. Dame's rocket flowers are found from early May through June, fragrant and generally purple but occasionally pink or white. Seeds are produced in long pods typical of the mustard family. Dame's rocket overwinters as a rosette.

Why is this plant a concern?

Even though this common garden flower has been in the U.S. since colonial times, it is now becoming invasive in many areas of the north-central Plains, especially in woody areas. Dame's rocket is in the same family as garlic mustard, an invasive plant that has invaded woody areas and forests in neighboring states such as Minnesota and Wisconsin. Dames rocket aggressively competes with native species. This plant has been listed as a noxious weed in nearby states of Colorado and Wisconsin.

How do I control this plant?

Chemical. Herbicides used for mustard control in cropland such as MCPA and 2,4-D will kill Dame's rocket and can be used in wooded areas as long as the herbicide is not applied to the tree bark. Glyphosate will kill Dame's rocket and is best applied to rosettes in the fall to lessen damage to nearby vegetation. Typical pasture and rangeland control herbicides such as Tordon (picloram), dicamba (various), Milestone (aminopyralid) and Transline (clopyralid) will not control this weed.

Cultural. Hand-pulling or digging Dame's rocket is an effective control measure. Seeds remain in the soil for several years, so sites should be revisited each year to keep the plant from reestablishing.

Biological. No biological control agents or pathogens are available for this weed.

DOWNY BROME

(*Bromus tectorum* L.)



DOWNY BROME

County Listed Noxious Weed

Downy brome is native to the Mediterranean region and is thought to have been introduced first near Denver, Colo., as a contaminant in packing material. The plant now is distributed widely throughout North America. Downy brome often is found as a contaminant in grass and crop seed and is difficult to separate from the desirable species.

Identification and growth form:

Downy brome is an annual or winter annual grass that can range in height from 4 to 30 inches. Seedlings are bright green with conspicuously hairy leaves. Stems are erect, slender and glabrous or slightly hairy. Foliage and seed heads of mature plants often change color from green to purple to brown or tan as the plant dries. A single downy brome plant can be comprised of one or two tillers or as many as 20 tillers. Inflorescence is dense, slender, usually drooping, one-sided, and 2 to 6 inches in length. Spikelets are nodding, slender and up to 0.75 inch long. Plants have five to eight florets per spikelet. Long, straight awns are attached to florets that are 3/8 to 5/8 inch long and are usually purple at maturity.

Seedlings germinate in the fall or winter at very high rates as soon as moisture conditions are favorable. Downy brome grows rapidly until late fall when the soil freezes, although above-ground growth may continue during warm or rainy conditions. The root system often will continue to develop throughout the winter. In the spring, the plant develops rapidly and produces heads in late April to early May, flowers within a week and produces seed by mid to late June. Downy brome is a prolific seed producer with production ranging from 25 to 5,000 seeds per plant.

Why is this plant a concern?

Downy brome can thrive in a variety of habitats and the plant quickly displaces desirable plant communities and lowers plant diversity. Downy brome can be a ready fuel source for fires because the plant grows in high densities and dries down very early in the season. Downy brome is palatable to livestock but only for a brief period during the spring and early summer. The seeds have long awns that may cause sores in the mouth and eyes of livestock that graze it and reduce wool values when it attaches to sheep as they walk through an infested area. Downy brome can become especially weedy in winter wheat.

How do I control this plant?

Chemical. Glyphosate has been effective at any plant growth stage or seasonal timing. In cropland, PRE herbicides such as Dual (metolachlor), Zidua (pyroxasulfone), Prowl (pendimethalin) and Valor (flumioxazin, Payload for noncrop areas) reduce establishment of seedlings, and atrazine is effective PRE or POST to seedlings. See the latest edition of the “North Dakota Weed Control Guide” (W253) for additional herbicides useful for downy brome control. Plateau (imazapic) applied in the fall will control downy brome in pasture and rangeland.

Mechanical. Hand-pulling small infestations may eliminate current seed production. Disking is often ineffective, unless tilled 4 to 6 inches deep in order to bury seeds and prevent germination. Mowing may reduce plant production but seeds already may be viable and plants may regenerate new culms if conducted during the early growth stage.

Biological. No biological control agents or pathogens are available for this weed.

FIELD BINDWEED

(*Convolvulus arvensis* L.)



County Listed Noxious Weed

Field bindweed (creeping jenny) is a member of the morning glory family and is well-adapted to the North Dakota climate and environment. Field bindweed is a native of Europe and western Asia and was introduced to this country during colonial days when it was referred to as devilgut. Field bindweed primarily is a problem in the dryland farming areas of the Great Plains and Western states. Field bindweed is found in both cropland and pasture and rangeland in North Dakota.

Identification and growth form:

Field bindweed is a long-lived perennial that produces a dense ground cover. The twining stems vary from 1.5 to 6 feet or more in length. Leaf size and shape are variable, but generally the leaves are 1 to 2 inches long, smooth and shaped like an arrowhead. Flowers are funnel-shaped, about 1 inch diameter and white or pink. The flower stalk has two small bracts located 0.5 to 2 inches below the flower. The bracts, along with leaf shape and smaller flower size, distinguish field bindweed from hedge bindweed.

Field bindweed also may be confused with wild buckwheat because of similarities in leaf shape and vining habit. However, wild buckwheat is an annual rather than a perennial and has a very small (about 1/8 inch diameter) greenish-white flower.

Roots of established plants may extend 20 to 30 feet laterally and be excavated as deep as 30 feet below the surface. Buds along the root system can send up shoots that start new plants. The root system contains a large quantity of carbohydrates that provide energy for both above- and below-ground plant growth. Buds located all along the root can send up new shoots or establish a new patch when roots are cut and moved, such as from cultivation.

Seeds of field bindweed vary from dark to brownish gray and are about 1/8 inch long. The fruit is a small, round capsule that contains up to four hard-coated seeds that can remain viable for at least 50 years. Field bindweed produces numerous seed in growing seasons with high temperatures and low rainfall and humidity.

Field bindweed can be spread by seed, root fragments carried by farm implements, infested soil adhering to the roots of nursery stock, root growth from infested areas and by animals.

FIELD BINDWEED

Why is this plant a concern?

Field bindweed has a deep root system that competes with crop plants for water and nutrients. Vines climb on plants and shade crops, cause lodging of small grains and

make harvesting difficult by clogging machinery. Dense field bindweed infestations may reduce crop yields by 50 percent to 60 percent. Land infested with field bindweed is reduced in value.

How do I control this plant?

Established field bindweed is difficult to control. An effective control program should prevent seed production, kill roots and root buds, and prevent infestation by seedlings. This plant is very persistent and a successful control program must be more persistent.

The best control of field bindweed is obtained with a combination of cultivation, selective herbicides, and competitive crops or forage grasses.

Chemical. Long-term control of field bindweed from herbicides depends on movement of a sufficient amount of herbicide through the root system to kill the roots and root buds. This requires use of systemic (movement throughout the plant) herbicides. Examples of herbicides that will reduce field bindweed infestations are products that contain dicamba (various), Facet L (quinclorac), Tordon (picloram) and glyphosate (various).

Successful control of field bindweed requires a long-term management program. A herbicide applied once never will eliminate established stands; rather, several re-treatments are required to control field bindweed and keep it suppressed. Because of long seed viability and tremendous food reserves stored in the roots, repeated chemical and/or mechanical control measures must be used.

Herbicides should be applied when field bindweed is growing actively and stems are at least 12 inches long. Herbicide performance can vary greatly due to environmental conditions in which the plants have been exposed. Plants growing under moisture or

heat stress usually have smaller leaves with a thicker cuticle and slower biological processes than plants growing in more favorable conditions. As plant stress increases, herbicide uptake and translocation decreases, which in turn decreases herbicide performance. This is the reason why field bindweed is harder to control in the more semiarid area of central and western North Dakota than in the eastern region.

Cultural. Intensive cultivation controls newly emerged seedlings, may kill young field bindweed infestations and contributes to control of established stands. Timely cultivations deplete the root reserves of established plants and stimulate dormant seeds to germinate.

Intensive cultivation alone is not practical because crops cannot be grown during the tillage period, and repeated tillage exposes the soil to erosion. However, applying herbicides in combination with cultivation has been successful in reducing both field bindweed infestations and the number of tillage operations.

Biological. Two non-native insects have been released to control field bindweed with minimal success to date in North America. The bindweed gall mite (*Aceria malherbae*) is microscopic in size and feeding by nymphs causes galling of field bindweed stems. The larvae of the bindweed moth (*Tyta luctuosa*) feed at night on field bindweed flowers and leaves. Several native insects occasionally feed on this weed but damage to the plant is minimal. No insect has been released to feed on field bindweed roots, which would be the most likely method of success in controlling this weed.

HALOGETON

[*Halogeton glomeratus* (M. Bieb.) C. A. Mey.]



HALOGETON

County Listed Noxious Weed

Halogeton, also called saltlover, is a poisonous weed introduced from Eurasia and first was reported in Nevada in 1934. Since then it has spread to millions of acres in the western U.S., especially in range and wildlands. This plant often is found in alkaline soils and semiarid regions, particularly when the areas have been disturbed by overgrazing, off-road vehicles, new roads and similar disturbances. Halogeton was reported in North Dakota for the first time in 2009, but because of the size of the infestations, it likely has been in the state for some time.

Identification and growth form:

Halogeton is an annual weed in the goosefoot family and grows from a only a few inches to more than 24 inches tall, depending on location and moisture. Each plant has about five main stems that grow out and then up from the crown, branching out similarly to Russian thistle, which this plant resembles. The blue-green leaves are small and sausage-shaped, and have a short bristle or spine at the end. The flowers are found in the leaf axils, greenish and not showy. Even though the plant is an annual, the taproot can grow nearly 2 feet down and out from the crown. Mature plants have red stems. The brown-black seeds are contained in a bracted pouch that often are mistaken for flowers and give the plant a “wooly” appearance at maturity. Halogeton produces as many as 75 seeds per inch of stem and seeds are viable from one year (early season production) to more than 10 years (developed after mid-August).

Why is this plant a concern?

Halogeton contains soluble sodium oxalates that are poisonous to sheep and cattle. The plant is not palatable when green but may be consumed in toxic quantities in late summer, fall and winter. Dried plants may contain 30 to 40 percent sodium oxalate, and the lethal dose for an adult sheep is reached when the animal consumes 0.3 to 0.5 percent of total body weight in a short time. Cattle are not likely to eat enough to be poisoned unless feed is short. Sheep can develop a tolerance to halogeton through time and consume this weed without illness if foliage from other plants is also part of the diet.

How do I control this plant?

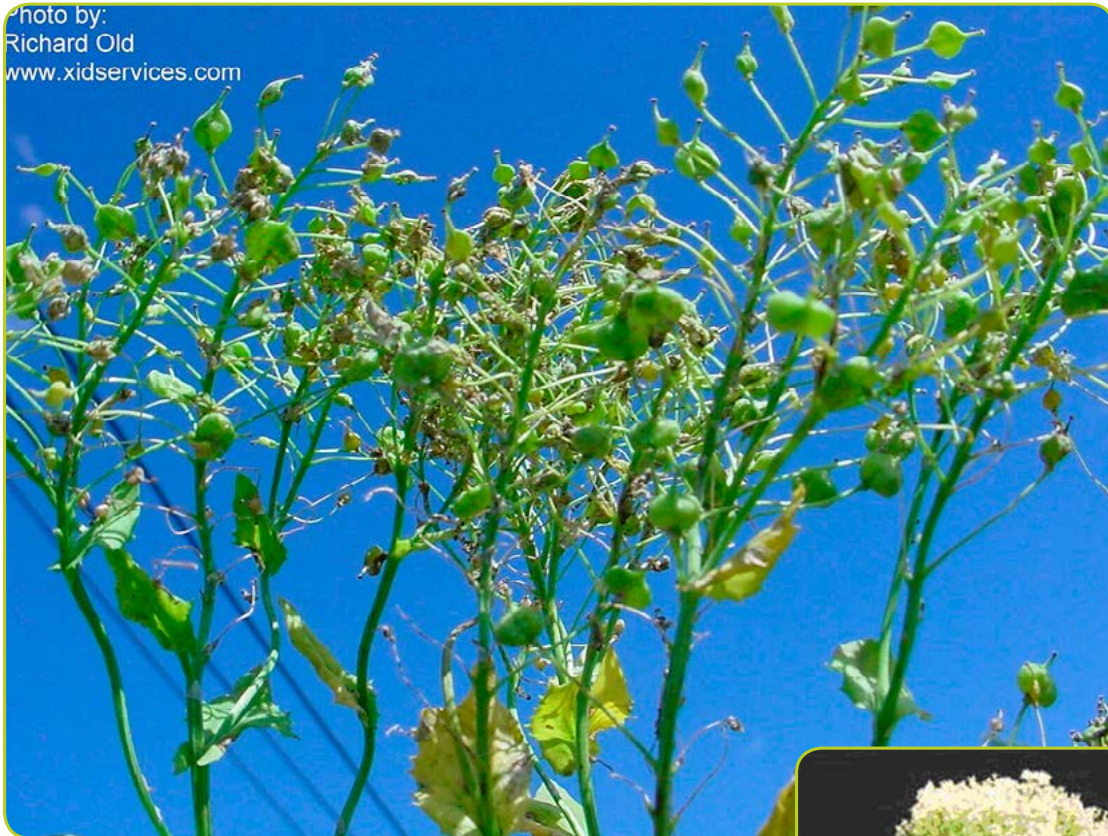
Chemical. 2,4-D will control plants if applied very early in the spring prior to flowering. Escort (metsulfuron) is very effective and can be applied throughout the growing season. Plateau (imazapic) also will control this weed and can be applied both pre- and post-emergence. Spike (tebuthiuron) provides total vegetation control for several years and may be desirable for use on railroad ballast and oil field locations, where halogeton often is found.

Cultural. Halogeton is an early invader of disturbed sites. Avoid overgrazing an area and reseed disturbed sites to native grasses and forbs to prevent halogeton from becoming established. Halogeton competes poorly with established perennial vegetation.

Biological. No biological control agents or pathogens are available for this weed.

HOARY CRESS

[*Cardaria draba* (L.) Desv.]



HOARY CRESS

County Listed Noxious Weed

Hoary cress (also called whitetop) is native to the Balkan Peninsula, Armenia, Turkey, Israel, Syria, Iraq and Iran. The plant is widely introduced and naturalized throughout Europe and all other continents. Hoary cress first was introduced to the United States at Long Island, N.Y., in 1862 through a ship's ballast or contaminated seed.

Identification and growth form:

Hoary cress is a deep-rooted perennial forb that can grow up to 2 feet tall. Stems of the plant are erect, branching above, glabrous or slightly to densely pubescent below, and appear gray. Hoary cress has both basal and stem leaves. Basal leaves have scattered to dense pubescence, are irregularly toothed to entire and taper to a short stalk that attaches to the crown of the plant near the ground. Middle and upper stem leaves are sparsely pubescent, have two lobes clasping the stem and are grayish green. Flowers of the plant are white, four-petaled and borne on slender stalks. Seed capsules are shaped like an inverted heart and usually contain two seeds. The seeds are oval or round at one end, narrow to a blunt point at the other and reddish-brown.

Seedlings of hoary cress germinate in the fall and overwinter as rosettes. The perennial root system is established the following spring and consists of vertical and lateral roots. Both root types can produce adventitious buds that develop into rhizomes and new shoots. Plants flower from May to June and begin producing seeds by July. A single plant can produce between 1,200 and 4,800 seeds each year, with a single flowering stem capable of producing as many as 850 seeds. Seeds can remain viable in the soil for approximately three years.

Why is this plant a concern?

Hoary cress is an aggressive plant that can form dense monocultures on disturbed land. Disturbances such as grazing, cultivation and especially irrigation can promote the colonization and spread of the plant. Hoary cress can displace native plant species, thereby reducing biodiversity and forage production. Whitetop contains glucosinolates that can be toxic to cattle but livestock only graze hoary cress in the spring if more palatable forage is not available.

How do I control this plant?

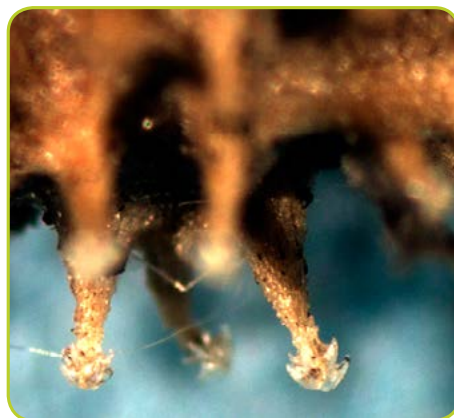
Chemical. Hoary cress is in the mustard family so herbicides commonly used to control mustards generally work well on this weed. Escort or Ally (metsulfuron), Oust (sulfometuron) or Telar (chlorsulfuron), MCPA and 2,4-D have been used to control the plant. However, timing of herbicide application is important and should be done in early spring or in the fall after seed germination. Glyphosate (various) can be used as a spot-treatment for small infestations.

Mechanical. Digging can provide control for small infestations of hoary cress if the entire root system is removed. Hand-pulling generally is not effective because the root system may not be entirely removed. Cultivation is the major factor for the spread of the plant because root fragments that are left behind can produce new plants. Cultivation can eradicate plants if cultivations are repeated frequently throughout the growing season for a period of two to four years.

Biological. No biological control agents or pathogens are available for this weed.

HOUNDSTONGUE

(*Cynoglossum officinale* L.)



HOUNDSTONGUE

State Listed Noxious Weed

Houndstongue is a biennial poisonous herb that is native to Eurasia. The plant is a member of the Borage family, which includes more commonly known plants such as Virginia Bluebells, Forget-Me-Nots and the fiddlenecks. Houndstongue commonly is found in disturbed areas, including roadsides, trails, and in pasture and woodlands following soil disturbance or overgrazing.

Identification and growth form:

Houndstongue is a biennial that forms a rosette the first year of growth and bolts and flowers the second season. The plant only reproduces from seed, but can spread great distances because the barbs on the nutlets cling to clothing, machinery and animals. The leaves are oblong, very pubescent and rough, which resembles a hound's tongue. Plants bolt during early summer, the second year of growth, to a height of 1 to 4 feet and flower in mid-June. The flowers are small, arranged in clusters and not showy. Flower color ranges from red to burgundy. Each flower produces three to four nutlets, which are flat and tear-drop shaped with a very hard seed coat and numerous barbs. Plants generally are found along trails and roadsides, on the edge of wooded areas and in disturbed habitats. Infestations often establish near areas where cattle and other livestock rub against something such as fence posts and trees or shrubs.

Why is this plant a concern?

Houndstongue tends to be a nuisance weed rather than a noxious plant unless infestations grow to become large patches. The nutlets often become imbedded in the wool or hair of livestock, which can cause a loss of value of the wool and/or increase costs to remove the burs. Eye damage can occur if burs become embedded in the eye or eyelids. The burs can be problematic for hikers, hunters and fishermen and also to their pets.

Houndstongue contains alkaloids that are especially toxic to cattle and horses. The plant is rarely eaten in the green

state; however, animals will eat the dried plant in hay. Sheep are more resistant to the pyrrolizidine alkaloids than other livestock, while horses, especially when confined to small areas infested with houndstongue, are more likely to ingest toxic levels. Fatal liver disease in horses occurred following two weeks of feeding hay with as little as 6 percent houndstongue.

How do I control this plant?

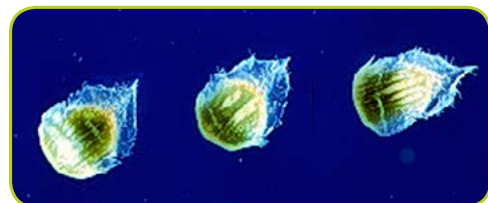
Prevention is the best method to keep houndstongue from invading North Dakota. Use only certified weed seed-free hay and eradicate new infestations before the plant can spread.

Chemical. Escort (metsulfuron) is very effective for controlling houndstongue and can be applied throughout the growing season. First-year houndstongue rosettes are easily controlled with 2,4-D applied from late May to mid-June. Second-year plants are much less susceptible to 2,4-D. Plateau (imazapic) at high rates will control houndstongue both pre- and post-emergence, but grass injury, especially to the cool season species is likely when Plateau is applied at the maximum rate.

Biological. A root weevil, *Mogulones crucifer*, has been released for control of houndstongue in Canada. The insect has become well-established in Alberta and has greatly reduced the houndstongue infestation in that province. The insect has spread naturally and become established in Washington state. However, this biological control agent has not been approved for release in the U.S. and interstate movement is not allowed. Several other insects have been evaluated for biological control of houndstongue; however, initial results were not nearly as promising as those of the root weevil.

RUSSIAN KNAPWEED

[*Acroptilon repens* (L.) DC.] syn. (*Centaurea repens* L.)



RUSSIAN KNAPWEED

State Listed Noxious Weed

Russian knapweed is the most widespread of the knapweeds in North Dakota. It also is the only perennial of the noxious knapweeds and is the most difficult to control. Russian knapweed often is found in poorly drained and saline/alkaline soils with supplemental water sources such as rivers and streams. This persistent weed often is found in southwestern North Dakota, but increasingly infestations have been found statewide. Russian knapweed grows especially well in areas with supplemental water sources such as the Little Missouri and Heart rivers in North Dakota.

Identification and growth form:

Russian knapweed is a long-lived, deep-rooted perennial with growth characteristics similar to Canada thistle. The weed emerges in the spring from roots and grows to 2 to 3 feet tall and is shrublike with spreading branches. Once established, Russian knapweed spreads mainly by underground root stocks as seed production is limited compared with other knapweed species. The leaves are alternate and lobed lower on the plant while upper leaves are entire. Flowering occurs from June to September and flowers vary from light pink to lavender. The stems die back to the soil surface each year.

Two key characteristics distinguish Russian knapweed from spotted and diffuse knapweed. First, the flowers have rounded bracts with transparent tips that are quite different in appearance than the dark bracts of spotted and diffuse knapweed. Second, the root of this perennial is dark brown to black, scaly as if the plant had been burned, and can grow to depths of greater than 20 feet. The flowers of Russian knapweed vary from light pink to lavender.

Why is this plant a concern?

Russian knapweed can spread rapidly and is very competitive with native species. Russian knapweed will reduce forage production to near zero as the site often becomes a monoculture. Russian knapweed also will infest roadsides, pasture and rangeland and is the only knapweed in the state that causes significant losses in cropland.

How do I control this plant?

Russian knapweed is one of the most difficult perennial weeds to control. If the plant is found in cropland, then a combination of cultivation and herbicide treatments will suppress the plant. However, herbicides at labeled rates for cropland use will not control Russian knapweed.

Chemical. Tordon (picloram) is one of the most effective herbicides used for Russian knapweed control. The best control is obtained when picloram is applied following several hard frosts (mid-October). Russian knapweed plants may be dormant with gray stems and no leaves, but control the following spring is nearly 100 percent. Application in mid-September or during flowering in midsummer provides shorter-term control than late applications. Other herbicides used for Russian knapweed control include Escort (metsulfuron) and Milestone (aminopyralid).

Cultural. Livestock generally will not graze Russian knapweed. Mowing and cultivation do not control this weed.

Biological. Exploration and evaluation of biocontrol agents for Russian knapweed are in progress. The gall fly *Jaapiella ivannikovi* was released in 2009, has established and will be available for wider distribution. A gall wasp, *Aulacidea acroptilonica*, also was released but has had minimal impact.

SPOTTED and DIFFUSE KNAPWEED

[*Centaurea stoebe* spp. *micranthos* (Gugler) Hyek]
and (*C. diffusa* Lam.)



Diffuse knapweed flower with
spiny bracts



Spotted and diffuse knapweed



Spotted knapweed flower with
black bracts



SPOTTED and DIFFUSE KNAPWEED

State Listed Noxious Weed (both species)

The knapweeds are one of the most rapidly spreading invasive species in the western U.S. Knapweeds already infest more acreage than leafy spurge in Montana and Minnesota, and have been found in more than 25 counties in North Dakota. Knapweeds are related to thistles and can spread even faster. For instance, spotted knapweed infested approximately 25 acres in eight North Dakota counties in 1984 and had spread to more than 1,000 acres in 14 counties by 1997. Diffuse knapweed can spread as quickly as spotted knapweed but has been kept in check in North Dakota and infests less than 650 acres. Spotted knapweed had infested more than 30,000 acres by 2017.

Identification and growth form:

Both are short-lived perennials or sometimes biennial plants reproducing solely by seed. Seed remains viable in the soil five years or more, so infestations may occur a number of years after vegetative plants have been eliminated. The seeds can germinate from spring through early fall. Seedlings emerging in the fall often overwinter as a rosette of leaves, resuming growth again in the spring. The plants grow 2 to 4 feet tall with one or more stems. The leaves are pale green and 3 to 4 inches long. Rosette leaves are deeply lobed. The physical appearance of these two knapweed species is similar, except diffuse knapweed is generally shorter and more highly branched. Plants flower from early July through August and produce 1,000 or more seeds per plant.

These species are distinguished by the bracts below the flower. Spotted knapweed has stiff, black-tipped bracts while diffuse knapweed has a rigid terminal spine about one-third of an inch long with four to five pairs of shorter, lateral spines (crablike). If the plant is not flowering, search for last season's flower stalk and identify the plant based on the flower bracts. Both species have pink to light purple and occasionally white flowers.

Why is this plant a concern?

Spotted and diffuse knapweed are aggressive, introduced weed species that rapidly invade pasture, rangeland and fallow land and cause a serious decline in forage and crop production. Spotted knapweed has few natural enemies and is not preferred by livestock as forage. Knapweed infestations in North Dakota largely can be traced to seed or hay brought in from neighboring states. Researchers in Montana have observed that spotted knapweed may remain in a confined location for several years and then spread rapidly to adjacent areas. Controlling spotted and diffuse knapweed plants when they are first observed and monitoring the site for several years to prevent reinfestation from seed are important

How do I control these plants?

Chemical and Cultural. Spotted and diffuse knapweed confined to small, well-defined areas should be pulled by hand or treated with a herbicide as soon as detected to avoid spread of the weed. First, all visible knapweed plants should be removed and destroyed by burning or mulching. Then the areas should be treated with a herbicide to prevent reinfestation from seedlings. The most effective herbicides for spotted and diffuse knapweed control include Milestone (aminopyralid), Tordon (picloram) and dicamba (various). Treat an extra 10 to 15 feet around the knapweed patches to control seedlings. A careful follow-up program is necessary to control missed plants and seedlings. Many attempts to control knapweed have failed because follow-up treatments were not applied.

Biological. In general, the knapweed infestations are small enough that herbicide and hand removal are the best and most cost-effective treatments in North Dakota. Biological control agents have been introduced in neighboring states to control spotted knapweed. There are 13 biological control agents currently permitted for use against knapweed species. Consult the N.D. Dept. of Agriculture or NDSU weed specialists for the latest information on which agents may be successful in the state.

KOCHIA

[*Bassia prostrata* (L.) A.J. Scott]



KOCHIA

County Listed Noxious Weed

Kochia, also referred to as fireweed, summer-cypress or Mexican firebush, is a member of the Chenopodiaceae or goosefoot family. Kochia is native to Eurasia and was introduced to the United States in the early 1900s as an ornamental. Kochia is palatable to livestock and has good forage quality when grazed early in the season. Kochia sometimes is referred to as tumbleweed.

Identification and growth form:

Kochia is a taprooted annual forb that typically grows from 1 to 6 feet tall. Stems of the plant are erect and spreading, much branched from the base and usually soft-hairy, but occasionally smooth. Stems are usually yellowish-green to green and often turn red with maturity. Leaves of the plant are alternate, lance-shaped and 0.5 to 2 inches long and have fringed hairs on the margins. The upper surface of the leaf is usually smooth and the lower surface usually is covered with soft hairs. Kochia flowers are inconspicuous and greenish and form short, dense, terminal, bracted spikes. Flowering generally occurs from July to September.

Kochia reproduces only by seed with more than 14,000 seeds produced per plant. Seeds are oval or egg shaped, dull brown, slightly ribbed and dispersed in the fall when the plant becomes a tumbleweed. Seeds germinate in the spring and have little or no seedbank viability and either germinate or decay in one year.

Why is this plant a concern?

Although kochia has been grown as a drought-resistant forage and may have reclamation value on disturbed land, the plant is a serious cropland weed. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield losses. Kochia is highly adaptable and can be found on pasture, rangeland, road sides, ditch banks, wastelands and cultivated fields.

Kochia can contain high nitrate levels and is toxic if overgrazed. Nitrate poisoning in livestock causes bloat and

photosensitization. Toxic substances identified within the plant include saponins, alkaloids, nitrates and oxalates. Kochia is a main contributor to fall hay fever sufferers.

How do I control this plant?

Chemical. Kochia has become resistant to several commonly used herbicides. ALS- and 2,4-D/MCPA resistance is widespread throughout North Dakota, and glyphosate resistance can be found in the eastern half of the state. Resistance to dicamba and Starane (fluroxypyr) products is scattered, and triazine resistance is fairly rare. Use of multiple sites of action within a season is important to reduce the risk of resistance establishment or spread. Where possible, the use of soil-applied PPO inhibitors Spartan/Authority/Portfolio (sulfentrazone) or Valor/Payload (flumioxazin) products provides several weeks of residual control. Treatments that contain bromoxynil, atrazine or PPO-inhibiting herbicides such as Aim (carfentrazone) or Flexstar (fomesafen) can provide excellent control when plants are small, 2 inches tall or less, but treatments that include Starane (fluroxypyr) and/or dicamba have provided the most reliable control across plant sizes.

Mechanical. Early tillage in the spring provides good control when conducted during the seedling stage of the plant. Mowing kochia prior to flowering reduces seed production but may not kill the plant.

Biological. No biological agents or pathogens are available for this weed.

LEAFY SPURGE

(*Euphorbia esula* L.)

State Listed Noxious Weed

Leafy spurge was once the most difficult noxious weed to control in North Dakota and infests all 53 counties. Scientists at the North Dakota Agricultural College (NDAC) recognized leafy spurge could be a problem soon after it was first identified in the state, growing along a Fargo street in 1909. However, the plant was not added to the state noxious weed list until 1935, when leafy spurge was found growing in all but 10 counties. The largest single infestation at that time was estimated to be 193 acres in Foster County.



Latex is found in all plant parts



True flower



Leafy spurge gall



Aphthona lacertosa



Aphthona nigriscutis

LEAFY SPURGE

Despite several control programs led by the State Agriculture Department and NDSU Extension, leafy spurge doubled in acreage every 10 years, reaching nearly 1.8 million acres in the 1980s. A coordinated integrated program of biological, chemical and cultural methods directly led to the first-ever reports of a decline in leafy spurge infestation in the state in the 1990s.

Identification and growth form:

Leafy spurge is a long-lived perennial that normally grows 2 to 3 feet tall from a woody crown from below the soil surface. Each crown area produces several upright stems, giving the plant a clumplike appearance. The plant bears numerous linear-shaped leaves with smooth margins. The leaves have a characteristic bluish-green color but turn yellow or reddish orange in the fall. Stems originating from crown buds and roots begin growth in late April, making leafy spurge one of the first plants to emerge in the spring. The early and rapid growth gives leafy spurge a competitive advantage over crop and pasture plants. All parts of the plant contain a milky juice called latex, which is a useful identifying characteristic.

Leafy spurge produces a flat-topped cluster of yellowish-green petal-like structures called bracts, which surround the true flowers. The showy, yellow bracts appear in late May and early June, giving the plant the appearance of “blooming.” However, the true flowers, which are small and green, do not develop until mid-June. Spring-applied herbicides are more effective on plants with developing true flower parts than on plants with developed bracts but undeveloped flowers.

Seeds are borne in pods, which contain three gray-brown, oblong, smooth seeds. After the seed has matured, the seed pods burst explosively and throw seeds up to 15 feet from the parent plant. An average of 140 seeds is produced per stem, and seeds may remain viable in the soil at least eight years.

Leafy spurge seeds may germinate to re-establish infestations where total control of leafy spurge tops and roots has been achieved. The peak period of germination is late May and early June, but seeds can germinate and seedlings become established throughout the growing season. Leafy spurge seedlings have a remarkable capacity for vegetative reproduction and can reproduce vegetatively within seven to 10 days after emergence. Seedlings typically do not flower during the first year.

The root system of leafy spurge is extensive and consists of numerous coarse and fine roots that occupy a large volume of soil. Roots are most abundant in the upper foot of soil, but some roots can extend to a depth of 15 feet or more. The roots are woody and durable in structure, with numerous buds capable of producing new shoots. The root system contains a large nutrient reserve capable of sustaining the plant for years.

Why is this plant a concern?

Leafy spurge infestations may have more than 200 stems per square yard in sandy soil and even higher densities in heavy clay soil. Patches of leafy spurge usually spread vegetatively from 1 to 3 feet per year and form dense stands that crowd out other plants by shading and competing for moisture and nutrients. Forage production may be reduced to 20 percent or less and most native plants are eliminated because they cannot out-compete this weed.

Leafy spurge contains a toxic substance that, when consumed by livestock, is an irritant, emetic and purgative. It causes scours and weakness in cattle and may result in death. The toxin has produced inflammation and loss of hair on the feet of horses from freshly mowed stubble during haying and has caused mortality of sheep that grazed leafy spurge exclusively. However, sheep and goats will graze leafy spurge as a portion of their diet and can be used as a form of cultural control. Animals will eat dried plants in hay, but many livestock, particularly cattle, avoid eating live plants

LEAFY SPURGE

How do I control this plant?

Leafy spurge control must be considered a long-term management program. Generally, less than 6 inches of the root system is destroyed regardless if the control method is biological, chemical or cultural. Research at North Dakota State University has shown that more of the root system is killed when a combination of control methods are used, compared with any method used alone.

Chemical. Proper timing of herbicide applications is essential for good leafy spurge control. Leafy spurge is most susceptible to dicamba (Banvel and other trade names), Facet L (quinclorac), Method (aminocyclopyrachlor), and Tordon (picloram). Plateau (imazapic), fall-applied, provides better long-term control and less grass injury than spring or summer treatments. Combinations of Tordon plus Plateau or Tordon plus Plateau plus 2,4-D applied in June provide improved leafy spurge control compared with Tordon plus 2,4-D or Plateau applied alone in June. The Tordon plus Plateau combination is not recommended for use in the fall.

The combination of Tordon plus Overdrive also will improve leafy spurge control compared with Tordon used alone. Overdrive contains dicamba plus diflufenzopyr, which is an anti-auxin compound that often improves broadleaf weed control when applied with auxin-like herbicides such as Tordon, dicamba and 2,4-D.

Glyphosate (various) applied for leafy spurge control has a different optimum application timing than the auxin herbicides (2,4-D, dicamba, picloram and quinclorac) or Plateau. Glyphosate is most effective for leafy spurge control when applied either after seed filling in midsummer or after fall regrowth has begun but before a killing frost. Glyphosate alone applied during spring growth stages generally provides poor long-term control.

Grazing. Sheep and goats provide an alternative for controlling leafy spurge top growth in pasture and rangeland. Grazing alone will not eradicate leafy spurge but will reduce the infestation, slow the spread of the weed and allow grasses to be grazed by cattle and horses.



Aphthona larvae



Longhorned beetle larvae



Leafy spurge hawkmoth



Grazing should be started early in the spring when the plant first emerges. On large infestations, pastures should be divided so animals can be rotated regularly and the entire infestation grazed in a timely manner.

Sheep and goats are best suited to control leafy spurge on large infestations or along waterways and tree areas where chemical control is restricted or cost is prohibitive and/or where success with biological control agents has been minimal.

Leafy spurge provides good forage value and compares favorably with widely used regional forages such as alfalfa (*Medicago sativa* L.), smooth brome (*Bromus inermis* Leyss.) and crested wheatgrass (*Agropyron desertorum* Fischer ex Link). Before moving animals to a leafy spurge-free area, they should be contained for three to five days so viable seed can pass through the digestive system.

Biological. Biological control of leafy spurge was initiated in the mid-1980s. To date, 10 species of insects have been released in North Dakota for control of leafy spurge, and six have become established. Four of the six established insects are flea beetles (*Aphthona* spp.), which have reduced the leafy spurge density more than any other agent.

LEAFY SPURGE

The first flea beetle released in North Dakota was *Aphthona flava* Guill in 1986. This flea beetle has established at only a few sites in the state and occurs at densities too low to be effective. In 1988, a mixed population of *Aphthona czwalinae* Weise and *Aphthona lacertosa* Rosenhauer were released near Valley City, N.D. By 1995, the majority (greater than 90 percent) of this mixed population was *A. lacertosa*. Two additional flea beetles, *Aphthona cyparissiae* Koch and *Aphthona nigriscutis* Foudras, were released the following year. *A. lacertosa* and *A. nigriscutis* were established in almost every county in North Dakota by 1996 and have become the major biocontrol agents used for leafy spurge control.

Although *Aphthona* spp. adults feed on leafy spurge foliage, the major damage to the plant occurs when the larvae feed on the roots. Larvae feed on both the fine feeder roots used by the plant to absorb water and nutrients and the storage tissue of the root crown. This feeding both destroys root tissue directly and causes the plant to be more susceptible to other methods of control, such as herbicides and infection from soil borne pathogens.

Research at North Dakota State University found flea beetle establishment was best on silt loam, silt clay loam, clay loam and clay soils with an organic matter content of 6 percent to 9.5 percent. Flea beetles were least productive in fine sand to loamy fine sand soils with an organic matter content of 1 percent to 3 percent. In addition, the release area needs to be well-drained and not subject to frequent prolonged flooding or standing water, which will kill the larvae. Generally, flea beetles have not been very successful in controlling leafy spurge growing along waterways, in shaded areas or in very sandy soil.

The *Spurgia esulae* gall midge causes stem tip galls on leafy spurge, thereby decreasing seed production. It has been most successful near wooded areas. However, a second control method was needed to reduce the original leafy spurge infestation and to prevent spread from roots. A stem-boring beetle, *Oberea erythrocephala* Shrank, has been released and established in North

Dakota in the 1980s, but to date, the population never has increased to sufficient numbers to decrease leafy spurge. The spurge hawkmoth (*Hyles euphorbiae* L.), a foliar feeder, was introduced in the 1970s but generally has not survived and when it did survive, control was too late in the growing season to be very useful.

Limitations to biological control. Although flea beetles have become established throughout North Dakota, they have not been successful in all environments. To date, approximately 30 percent of the releases have established and the leafy spurge stem density has been reduced. In another 30 percent of the releases, the insects have become established but the population density is too low to be effective. In the remaining releases, flea beetles have not established.

Cultural. Cultural control of leafy spurge includes properly timed cultivation and/or planting of competitive grass species. Cultural methods that only control leafy spurge top growth include mowing and fire. All cultural control methods are more successful when combined with herbicide treatments than when used alone.

Leafy spurge infestations must be controlled with herbicides such as glyphosate prior to seeding grass species. Some perennial grass species that have competed effectively to provide leafy spurge control include: Bozoiisky Russian wildrye [*Psathyrostachys juncea* (Fisch.) Nevski] and Luna pubescent wheatgrass [*Agropyron trichophorum* (Link) Richter], Rebound smooth brome (*Bromus inermis* Leyss.) and Rodan western wheatgrass [*Pascopyrum smithi* (Rydb.) A. Löve]. They are examples of grass species that can compete relatively well with leafy spurge. Not only were the grasses very competitive with leafy spurge, but they also provided high yields and good nutritive value for grazing. Grazing following grass establishment should be limited and conducted at the proper growth stage of the grasses or leafy spurge will re-infest the seeded area rapidly.

Mowing and burning have been ineffective for reducing leafy spurge infestations, but may result in uniform regrowth that allows a more timely herbicide treatment. Also, mowing will reduce seed production if repeated every two to four weeks during the growing season.

COMMON MILKWEED and SHOWY MILKWEED

(*Asclepias syriaca* L. and *Asclepias speciosa* Torr.)



Common milkweed



Common milkweed flower



Monarch butterfly larvae



Showy milkweed flower

COMMON MILKWEED and SHOWY MILKWEED

County Listed Noxious Weed:
Common milkweed only.

Common and showy milkweed are native to North America. Both species are robust, fleshy perennial plants that flourish in orchards, waste places and along roadsides. Milkweed has been used for medicinal, industrial, decorative and even for food purposes, despite having some degree of toxicity. Milkweed is best known as a primary food source for the monarch butterfly.

Identification and growth form:

As the common name implies, both species contain a thick, white, milky latex throughout the plant. Flowers are arranged in clusters at the top of the plant and are pink to white. Common milkweed flowers are held in tighter clusters and are more pink than white compared with showy milkweed. Showy milkweed flowers also have long lobes that stand upright, which are not found on common milkweed. Both species grow 2 to 4 feet tall and have large opposite leaves 3 to 5 inches wide and 6 to 10 inches long, which are covered with fine pubescence. These perennial plants have shallow fibrous roots. Milkweed grows over a wide range of soil moisture conditions, but can become dense under medium or high moisture levels.

Seed pods are 3 to 5 inches long and contain dozens of flat, reddish-brown seeds with tufts of hairs that allow the seed to travel long distances in the wind. An established market exists for milkweed seed floss as a nonallergenic fill to replace imported duck and goose down in comforters and for seed sales in prairie restorations and butterfly gardens. Most commercial milkweed supplies still are collected from the wild.

Why is this plant a concern?

Common milkweed can be aggressive in cropland areas given the right conditions. Reasons for the increase in milkweed densities in cropland include spread by the extensive root system, farmers using less tillage, several years of high rainfall and tolerance to most commonly used herbicides. Given the opportunity to spread and become established, common milkweed is extremely difficult to control.

How do I control these plants?

Since milkweed plants are native and a major food source for the monarch and other butterfly species, control is discouraged. However, if the plant becomes established in cropland, crop yield loss may occur and control would be warranted.

Chemical. Tordon (picloram) plus 2,4-D at high rates will reduce milkweed density but cannot be used in cropland. Glyphosate (various) will suppress milkweed temporarily in cropland while Express (tribenuron) can be applied with 2,4-D plus dicamba for spot treatment.

Cultural. Cultivation will reduce milkweed species in cropland but care must be taken not to spread the roots to noninfested areas.

Biological. Monarch butterfly larvae feed heavily on milkweed and often remove a majority of the leaves on a plant.

NARROWLEAF HAWKSBEARD

(*Crepis tectorum* L.)



County Listed Noxious Weed

Narrowleaf hawksbeard is native to Siberia and much of Eurasia. The plant is a member of the sunflower family and has bright yellow flowers very similar to dandelion or sowthistle. Narrowleaf hawksbeard commonly is found in most of Canada, including the neighboring provinces of Manitoba and Saskatchewan, where it is listed as a noxious weed. Narrowleaf hawksbeard will grow in many ecological zones, ranging from forests, lakeshores and seashores to dry prairies, mountains and parklands. Although narrowleaf hawksbeard can be found as far south as New Mexico and north to Alaska, the weed is primarily problematic in the northern tier of U.S. states and Canadian Prairie Provinces. Prior to 1950, O.A. Stevens of the North Dakota Ag College reported narrowleaf hawksbeard was well-established along a road in Walhalla, N.D., and had collected samples from Bottineau and Stark counties.



NARROWLEAF HAWKSBEARD

Identification and growth form:

Narrowleaf hawksbeard is a winter or spring annual that grows 2 to 3 feet tall from a tap-rooted basal rosette. The plant has a single main stem and often branches. The leaf shape gradually changes, going from the base to the tip of the plant. Rosette leaves are up to 6 inches long, 1 inch wide and coarsely toothed with a pointed tip. Basal leaves die off as the plant matures, which can help distinguish this plant from common dandelion or annual sowthistle. Stem leaves are alternate, and go from 4 inches long to less than an inch at the tip of the plant. Leaves are wider at the tip than the stem and often have a pair of small lobes at the base and curled edges. A white milky sap is found throughout the plant.

Mature narrowleaf hawksbeard has bright yellow dandelion-like flowers, which are found from late May through September in North Dakota. The seed are dark purple to brown, ribbed and attached to a pappus that will carry them in the wind or on animals. Each plant contains 30 to 70 flowers and can produce up to 50,000 seeds. Narrowleaf hawksbeard reproduces only by seed, which has a short dormancy and can germinate shortly after dispersal. Up to 90 percent of the seedlings that emerge from August to mid-September will overwinter. Survival declines the later in the season that seeds germinate, but even those that emerge in early to mid-October can overwinter and should be controlled.

Why is this plant a concern?

Narrowleaf hawksbeard traditionally was found along roadsides and disturbed land in North Dakota but now has become especially troublesome in no-till cropland, cropland seeded with cereals, pulses or oilseed crops, hay fields, and along newly established pipelines. Narrowleaf hawksbeard develops rapidly in the spring, which gives the species a competitive advantage, especially in forage crops. The weed will outcompete annual crops for nutrients and moisture, thus reducing yield, and can displace native plants in wildlands.

How do I control this plant?

Chemical. Narrowleaf hawksbeard is best controlled in late fall or very early spring with herbicides. The plant is much more difficult to control after bolting. Glyphosate applied alone or with other herbicides such as dicamba or 2,4-D will control rosettes in the fall. High rates of 2,4-D alone will control narrowleaf hawksbeard but can damage some crops. 2,4-DB is more effective than 2,4-D for control of this weed and is useful in forage crops such as alfalfa. Low rates of 2,4-D and dicamba generally do not control narrow leaf hawksbeard in the spring; rather glyphosate at 2 quarts per acre or more is required. ALS-inhibiting herbicides such as metsulfuron or tribenuron also will control this weed and often are mixed with glyphosate. Consult the latest edition of the “North Dakota Weed Control Guide” (W253) for additional herbicides used to control narrowleaf hawksbeard.

Cultural. Because narrowleaf hawksbeard only spreads by seed, plant certified weed-free seed and clean all farm equipment before moving from an infested to a noninfested field. Cultivation in late fall or very early spring will remove this weed from cropland. Preventive management such as maintaining good crop cover, minimizing disturbance and removing infestations when they are small will help contain the spread of narrowleaf hawksbeard. Mowing of noncrop sites before seed-set will reduce the spread of this weed.

Biological. No biological control agents or pathogens are available for this weed.

ORANGE HAWKWEED

(*Hieracium aurantiacum* L.)



ORANGE HAWKWEED

County Listed Noxious Weed

Orange hawkweed is native to northern and central regions of Europe. The plant first was introduced in North America in Vermont in 1875 as an ornamental. Orange hawkweed escaped from landscape plantings, gardens and cemeteries and now occurs throughout the eastern seaboard, into the Midwest, extending west to Minnesota and Iowa and south to Virginia and North Carolina, and has been steadily spreading to the West. Orange hawkweed is described as the worst weed problem in the northern Minnesota Iron Range and has become a major weed problem in the Pacific Northwest.

Identification and growth form:

Orange hawkweed is a herbaceous perennial that contains a milky sap and commonly grows up to 12 inches tall. In the vegetative stage, the plant appears as a basal rosette with many hairy leaves. Leaves are 4 to 6 inches long, dark green above, light green beneath, narrow and spatula-shaped. Each rosette is capable of producing 10 to 30 flower stems. Stems of the plant have short, stiff hairs and may have one to three small, clasping leaves located below the midpoint of the stem.

Orange hawkweed produces between five and 30 red-orange flower heads that are 0.5 to 0.75 inch diameter. Flower heads are arranged in a flat-topped cluster. Orange hawkweed seeds are tiny and black, and have a tawny tuft of bristles on the flattened end. The plant spreads primarily vegetatively through runners (like strawberries) and rhizomes or to new sites by seed.

Why is this plant a concern?

Orange hawkweed is an aggressive species that quickly can develop into large, dense patches, thus reducing native plant communities. The plant colonizes rapidly, forming a solid mat of rosettes. Orange hawkweed may have allelopathic effects on neighboring plants.

How do I control this plant?

Chemical. Orange hawkweed can be controlled with Tordon (picloram), products that contain clopyralid (Curtail, Stinger, Transline), Milestone (aminopyralid) or dicamba (various) plus 2,4-D. Monitor infested areas for several years to control new seedlings.

Mechanical. Pulling or digging is not recommended unless the infestation only consists of a few plants because digging stimulates the growth of new plants from rhizomes, stolons and fragmented roots.

Biological. Biological control of orange hawkweed is in the research stage. The gall wasp *Aulacidea subterminalis* was released in the U.S. for evaluation but did not establish.

PALMER AMARANTH

(*Amaranthus palmeri* S. Watson)



County Listed Noxious Weed

Palmer amaranth is a member of the pigweed family and is native to the southwestern and southcentral U.S. as far south as northwestern Mexico and as far north as southern Nebraska. The plant is one of the more aggressive pigweed species and often hybridizes with other pigweeds, including redroot pigweed (*A. retroflexus* L.) and waterhemp [*A. rudis tuberculatus* (Moq.) Sauer]. Palmer amaranth has developed resistance to multiple classes of herbicides and become one of the most difficult to control weeds in croplands of the Midwest and northern Great Plains.

Identification and growth form:

Palmer amaranth is a summer annual that emerges from seed throughout the growing season. The plant commonly grows 6 to 8 feet tall and can reach more than 10 feet in height. The plant has one very thick central stem, often more than 5 inches in diameter, which supports many lateral



PALMER AMARANTH

branches. Under optimum conditions, the plant can grow 2 to 3 inches per day. Palmer amaranth leaves are smooth, 2 to 8 inches long, arranged in an alternate pattern and lance or egg-shaped. The leaves have a small, sharp spine on the leaf tip. A whitish V-shaped or thumbprint mark is found on leaves of some but not all plants. Palmer amaranth is dioecious, with male and female flowers appearing on long leafless branching spikes at the top of the plant. The flowers are green, not showy, and end in three spiny bracts. The seed head spikes can be up to 3 feet long, and the female flowers are very prickly.

Palmer amaranth reproduces only by seed. Seed viability is more than 90 percent the first year after flowering and declines slowly through time, with some seed remaining viable for three to five years. Each plant can produce from 100,000 to more than 500,000 seeds, which are small (1 to 1.3 millimeters) and dark reddish brown. Palmer amaranth spreads from region to region as a contaminant in seed, livestock feed and hay. Once established in an area, the plant can be spread on farm equipment, in manure and by wildlife that feed on the seed.

Why is this plant a concern?

Palmer amaranth has reduced yield up to 91 percent in corn and 79 percent in soybean. The weed has a wide genetic diversity, which allows the plant to adapt to new environments and has enabled the weed to develop resistance to many herbicides used to control pigweed species. Palmer amaranth has developed resistance to ALS, HPPD and PPO inhibitors, dinitroanilines triazines and glyphosate, leaving few options for control in cropland. Once introduced, Palmer amaranth can spread quickly. For instance, it infested four southern Iowa counties in 2016 but was found statewide in more than a third of the counties one year later.

How do I control this plant?

Chemical. Palmer amaranth is difficult to control because it can be resistant to multiple classes of herbicides and their different modes of action. Foliar-applied herbicides must be applied before Palmer amaranth plants are taller than 4 inches. Herbicides that control or suppress susceptible Palmer amaranth include auxins such as dicamba, chloroacetamide, diphenylethers, glufosinate, glyphosate and HPPD inhibitors. Consult the latest edition of the “North Dakota Weed Control Guide” (W253) and the NDSU Palmer amaranth website (www.ag.ndsu.edu/palmeramaranth) for updates on controlling Palmer amaranth infestations.

Cultural. Early identification and eradication are the best method to prevent Palmer amaranth from becoming established in North Dakota. Use seed from reliable sources that are certified weed-free. Much of the spread of Palmer amaranth in neighboring states was due to planting infested seed. If plants are found, they should be removed by hand and destroyed. Place plants into large plastic garbage bags when removing them from fields to prevent seed spread, then burn or compost the plant material. Mowing is not an effective control method because plants will regrow from cut stalks and set-seed, often out of sight below the crop canopy.

Crop rotation is important to prevent Palmer amaranth from becoming established in North Dakota. Rotate soybean with grass crops such as wheat or corn or a perennial forage to help prevent the weed from spreading. Rotating crops allows the use of herbicides from various chemical families that are more effective on Palmer amaranth and other pigweed species than soybean herbicides and will reduce the buildup of herbicide-resistant populations.

Palmer amaranth sometimes is called carelessweed. Carelessness in allowing just a few plants to become established can result in large crop losses in only a few years. Be vigilant in scouting and removing even a single Palmer amaranth plant.

Biological. No biological control agents or pathogens are available for this weed.

POISON IVY

[*Toxiodendron rydbergii* (Small ex Rydb.) Greene]



POISON IVY

Not Listed by State or County

Poison ivy is a native species commonly found in wooded areas and in brushy areas, especially those along streams or lakes. It can grow as a small shrub or vine and is found in North America from Canada to Mexico. The first published records of poison ivy in North America date back to the 1600s. A similar plant called poison oak (*T. diversiloba*) is found only in states along the Pacific coast.

Identification and growth form:

Poison ivy is a perennial native small shrub that spreads by both rhizomes and seeds. The leaves are alternate with trifoliate leaflets. Remember the rhyme: Leaves of three — let it be! The leaves are shiny green in the spring and turn yellow and deep red in the fall. The flowers grow in axillary panicles, are yellow-green and not showy. The fruit is globed shaped, resembling small pumpkins, and turns yellow or light brown when mature.

Why is this plant a concern?

The “poison” in this plant is from a white oil called urushiol found in the phloem that causes an allergic contact dermatitis in about 85 percent of the population. Plants retain urushiol even after desiccation and smoke from burning poison ivy can carry the oil. The reaction is to the oil, not the plant itself, so one can react by touching objects that have come in contact with the plant, such as tools, and when removing footwear. Since it is an allergic reaction, people not sensitive to poison ivy can become sensitized through time.

How do I control this plant?

The best control is avoidance, but if the plant is found close to walking trails, near a home or in your favorite fishing area, herbicides that contain triclopyr such as Garlon are very effective.

PURPLE LOOSESTRIFE

(*Lythrum salicaria* L.)



State Listed Noxious Weed

Purple loosestrife, a beautiful garden plant with an aggressive nature, first was introduced into North America in the early 1800s. The plant was sold in North Dakota by its genus name, *Lythrum*, for at least 50 years. *Lythrum* plants were brought to North Dakota for flower gardens because of their striking color, ease of growth, winter hardiness and lack of insect or disease problems. The garden varieties of purple loosestrife were sold by many cultivar names, including Morden Pink, Dropmore Purple and Morden Gleam. These garden cultivars were thought to be sterile but now have been shown to cross-pollinate with the wild *Lythrum* type and sometimes with other *Lythrum* cultivars.

Identification and growth form:

Purple loosestrife is a rhizomatous perennial forb. Wild infestations are associated with moist or marshy sites. The stems are erect (1.5 to 8 or more feet tall) and four to six angled, and can be smooth or pubescent with few branches. Leaves are simple (0.75 to 4 inches long, 0.2 to 0.5 inch wide), entire, and can be opposite or whorled.

The most identifiable characteristic of purple loosestrife is the striking rose to purple flowers. The flowers are



Galerucella spp. feeding on leaves



PURPLE LOOSESTRIFE

arranged on a spike, which can be a few inches to 3 feet long. Each flower has five to seven petals arising from a cylindrical green tube. The plant usually flowers from early July to mid-September in North Dakota. The seed capsule is two-celled and contains many very small seeds (1 millimeter long or less). The roots become thick and woody in mature plants. The aerial shoots die in the fall and new shoots arise the following spring from buds at the top of the root crown. Although the root crown expands and produces more shoots each year, the maximum growth of the root crown diameter is limited to about 20 inches.

Spread of purple loosestrife is primarily by seed, but the plant also can spread vegetatively from stem cuttings. Research at NDSU has shown that seed viability of purple loosestrife growing in North Dakota wetlands ranged from 50 percent to 100 percent. With approximately 2.7 million seeds produced per plant, purple loosestrife has the potential to spread rapidly once established in an area.

Why is this plant a concern?

The most destructive impact of purple loosestrife invasions is on the ecology of aquatic sites. Purple loosestrife forms dense monotypic stands as it displaces native wetland plants. Under optimum conditions, a small, isolated group of purple loosestrife plants can spread to cover aquatic sites in just one growing season. When purple loosestrife replaces native vegetation, it also can displace wildlife. Waterfowl, especially ducks, avoid wetlands that have become dominated with purple loosestrife. In addition, overall waterfowl production decreases as suitable nesting habitat is eliminated. The plant's growth is generally too compact to offer cover, and cover may be as crucial to wildlife as food.

How do I control this plant?

Several methods are available for purple loosestrife control, including mechanical, biological and chemical. The size and location of a specific infestation will determine the best control methods. In general, small infestations of a few plants can be controlled by digging, especially when plants are only a few years old. Larger infestations require treatment with herbicides and/or biological control agents.

Chemical. Herbicides can be used to control purple loosestrife in areas too large to be controlled by digging. Also, herbicides can be applied to individual plants selectively in landscape situations to prevent killing desirable plants. Infestations growing along streams or in marshy areas may require specialized equipment and application by trained professionals.

Glyphosate (various trade names) will provide good control of purple loosestrife when applied from July to early September. Many formulations of glyphosate are sold but only those labeled for aquatic use can be applied in or near water. Garlon (triclopyr) is a selective broadleaf herbicide that will not kill cattail or other desirable monocot species. Garlon will provide good to excellent purple loosestrife control when applied in the pre- to early flower or late-flower growth stages but should not be used in landscapes or flower beds because soil residual of the herbicide may prevent establishment of other horticultural plants. Milestone (aminopyralid) and Capstone (aminopyralid plus triclopyr) can be used in seasonally dry wetlands.

Biological. Three biocontrol insect species were introduced in North Dakota in 1997. They were:

Galerucella pusilla — a leaf-feeding beetle

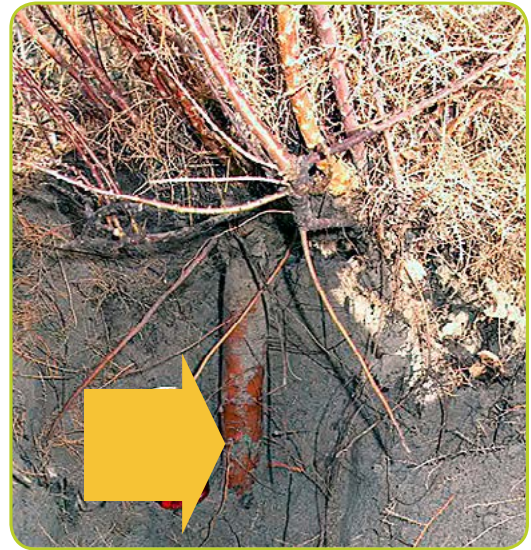
Galerucella californiensis — a leaf-feeding beetle

Hylobius transversovittatus — a root-mining weevil

Of these insects, the two *Galerucella* spp. leaf-feeding beetles have been most successful. These insects overwinter as adults and lay eggs in early June in North Dakota. The adults and especially the larvae feed on the leaves and flowers of purple loosestrife. Following several summers of heavy feeding, purple loosestrife infestations have been reduced greatly. However, since the largest infestations in North Dakota are in urban areas, mosquito control programs have kept these insects from becoming well established.

SALT CEDAR

(*Tamarix* spp.)



SALT CEDAR

State Listed Noxious Weed

Saltcedar is the common name for several introduced species of shrubs or small trees, including *Tamarix chinensis*, *T. parviflora* and *T. ramosissima*. Saltcedar is native to Eurasia and first was introduced into the U.S. to reclaim eroded areas and prevent further loss of stream banks, primarily in the southwest. Saltcedar has been sold in the horticultural industry, primarily for its wide adaptability and pink flowers. Saltcedar became established in North Dakota as escapes from ornamental plantings or from seed floating along rivers.

Identification and growth form:

Saltcedar is a shrubby bush or tree that can range in size from 5 to 20 feet tall. The bark is a reddish brown, especially on younger branches. The leaves are small and flat and resemble evergreen shrubs such as arborvitae. Flowers are pink to white and five-petaled, and appear from mid to late summer. The seeds are extremely tiny and similar in size and color to pepper. Each seed has a pappus, which allows it to float long distances in water or move in the wind. Seeds are short-lived and usually germinate within a few months after dispersal.

Once saltcedar seed germinates, it can grow rapidly to a small flowering shrub in one to two years. The plant is deciduous and very hardy, and horticultural varieties are advertised to grow “in sun or shade, and in wet or dry areas” from USDA hardiness zones 2 to 7. The plant quickly establishes a long, woody taproot to support a voracious thirst for water. The root system is capable of producing many new shoots if the top growth is removed by mechanical control methods or fire.

Why is this plant a concern?

Saltcedar can become a monoculture quickly along lakes and waterways. In the early morning and evening, moisture with high salt content is exuded from the foliage, causing the soil to become saline. Saltcedar can

choke waterways and even has dried up entire lakes. Native riparian species are quickly displaced by saltcedar, which in turn causes displacement of native birds and animals that generally do not feed on the leaves or eat the saltcedar seeds. Saltcedar, even in the seedling stage, will tolerate short-term flooding and can establish away from waterways when seeds are washed in during flooding. Once established, the plants can become so thick cattle will not graze the area.

How do I control this plant?

Prevention is the best method to keep saltcedar from invading North Dakota wetlands and wildlands. Scouting along waterways and removal of ornamental plantings have been effective in reducing the spread of saltcedar in North Dakota.

Chemical. Arsenal (imazapyr) is the most widely used herbicide to control saltcedar. Arsenal also can be applied with a glyphosate formulation labeled for use in water. Do not remove saltcedar top growth for three years following herbicide application or resprouting will occur. Garlon (triclopyr) has been effective when applied in the spring or late fall.

Cultural. Control methods such as burning or bulldozing have not been successful.

Biological. Several leaf beetles (*Diorhabda* spp.) have been released in North America to control saltcedar. The insects feed on leaves of saltcedar and slowly reduces plant vigor. However, the insects have not been consistently successful in reducing saltcedar infestations. Biological control of saltcedar in North Dakota is not recommended because of the small size of most plants and low infestation levels in the state.

ANNUAL AND SPINY SOWTHISTLE

[*Sonchus oleraceus* L. and *Sonchus asper* (L.) Hill]



Annual sowthistle



Spiny sowthistle



ANNUAL AND SPINY SOWTHISTLE

County Listed Noxious Weed – annual sowthistle only

These sowthistle species are from Europe and now are established widely in the region. The plants often are mistaken for perennial sowthistle. However, perennial sowthistle has a creeping perennial root system and larger and longer leaves, and grows 4 to 6 feet tall. Annual and spiny sowthistle often are found along roadsides and in waste areas, gardens and cultivated fields.

Identification and growth form:

Annual and spiny sowthistle are both annuals and differ primarily in leaf form. Spiny sowthistle, as the name implies, has sharp, stiff prickles along the stem and leaves. Leaves clasp the stem with rounded basal lobes (auricles) that resemble a ram's horn. Annual sowthistle leaves are deeply toothed lower on the plant but progressively less so on the upper stem and auricles are distinctly pointed. Both species have yellow flowers, borne on a long vaselike involucre, with several in a cluster. Annual and spiny sowthistle contain a milky latex and both grow from a small taproot. Spiny sowthistle has slightly larger flower heads (0.5 to 1 inch across) compared with annual sowthistle (0.25 to 0.75 inch). The seeds for both are flattened with three to five ribs. Both species grow 2 to 4 feet tall.

Why is this plant a concern?

These annual sowthistle species can become competitive in cropland, but otherwise are more nuisance species than invasive. Because annual and spiny sowthistle often are found in waste areas and heavily used ground, such as parking lots and trails, they can be an indicator that land is being overgrazed or otherwise abused when these species start to appear in pasture and hay land.

How do I control these plants?

Annual and perennial sowthistle species are not true thistles and control options differ between these weed families.

Chemical. Products that contain metsulfuron such as Escort or Ally are very effective in controlling sowthistle species. Commonly used herbicides for Canada thistle control such as Milestone (aminopyralid), Tordon (picloram) and dicamba (various) are less effective and require higher use rates.

Cultural. Cultivation will control annual sowthistle species in cropland.

Biological. No biological control agents or pathogens are available for these weeds.

PERENNIAL and MARSH SOWTHISTLE

[*Sonchus arvensis* L. and *Sonchus arvensis* L. ssp. *uliginosus* (M. Bieb.) Nyman]



Perennial sowthistle



Marsh sowthistle flower



PERENNIAL and MARSH SOWTHISTLE

County Listed Noxious Weed

Perennial sowthistle was introduced from Europe and placed on the state noxious weed list in 1935 when it became a severe problem, especially in the northwestern part of the state. The weed subsequently was removed from the list in 1999 after revised farming practices and new herbicides had severely reduced the infested acreage. Most sowthistle infestations in North Dakota are annual not perennial species.

Identification and growth form:

Marsh sowthistle is a subspecies of perennial sowthistle and thus the plants are very similar in form and growth habit. Both species have bright yellow flowers similar to dandelion, but perennial sowthistle flower bracts are covered with gland-tipped hairs, while marsh sowthistle has smooth flower bracts. Both weeds have an extensive creeping root system. Leaves are lobed below, but less so above and have prickles on the margin and are 4 to 10 inches long (longer than the annual species). Generally, perennial sowthistle has fewer but larger flowers (1 to 1.5 inches across) than the annual species and end in a terminal cluster. Some taxonomists consider marsh a separate species from perennial sowthistle; others consider it a subspecies. Both contain latex and grow from 1.5 to 6 feet in height. Seeds are dark brown, with prominent ridges and have a tuft of white pappus or bristles.

Sowthistle generally flowers from July through September. Seed production is highly variable, but typically averages 30 seeds per flower head. Seed viability is relatively low for sowthistle and seeds usually do not survive longer than a year.

Perennial and marsh sowthistle can tolerate variable environments and can adapt well to wet areas with little soil disturbance. The plant commonly is found in cultivated areas, ditches, meadows, waste areas, sloughs, woods, lawns, roadsides, beaches, along rivers and lake shores. Sowthistle is adapted to many soil types, but seems to prefer low, fine-textured loam soils.

Why is this plant a concern?

Perennial and marsh sowthistle can displace native plant communities by invading disturbed areas and undisturbed natural habitats. Sowthistle can cause reduced crop yields, and lead to increased cultivation and herbicide costs.

How do I control these plants?

Annual and perennial sowthistle species are not true thistles and control options differ between these weed families.

Chemical. Products that contain metsulfuron such as Escort and Ally or Express (tribenuron) are very effective in controlling perennial sowthistle species. Preharvest applications of glyphosate (various) and products that contain clopyralid or glufosinate will reduce perennial sowthistle. Tordon (picloram) and Milestone (aminopyralid) will control sowthistle species in noncropland.

Cultural. Cultivation will reduce perennial sowthistle species in cropland but care must be taken not to spread the roots to noninfested areas.

Biological. No biological control agents or pathogens are available for these weeds. Insects can be observed on the flower heads of these plants, especially perennial sowthistle, but they are feeding on sticky residue from the glands on the flower bracts, which does not harm the plant.

ST. JOHNSWORT

(*Hypericum perforatum* L.)



Not Listed by State or County

St. Johnswort, also referred to as Klamath weed, is native to Europe, North Africa and parts of Asia and first was introduced to the United States in the late 1600s for ornamental and medicinal purposes. St. Johnswort is sold as an antidepressant, often in the form of tea. However, St. Johnswort is also well-known to cause photosensitizing in man and animals. Numerous cultivated hybrids are available.

Identification and growth form:

St. Johnswort is a taprooted perennial herb that typically grows 1 to 5 feet tall. Stems are multi-branched, smooth, reddish and woody at the base. The leaves are opposite, entire, linear to oblong with in-rolled edges and 3/8 to 1 inch long. The leaves are dark green above and light green below and dotted with tiny, translucent glands. The “spotted leaf” appearance is a key characteristic for identification.



St. Johnswort has opaque spots on the leaves

ST. JOHNSWORT

Flowers of the plant are yellow, starlike with five petals and 0.5 to 1 inch in diameter, with tiny black dots on the margins. Petals are twice as long as the sepals and numerous stamens arranged in three groups are apparent. The seeds are egg-shaped and are held within a three-valved capsule that bursts at maturity. Seeds are tiny, dark brown, 3/64 inch long, somewhat cylindrical, slightly pointed at the ends and coarsely pitted.

St. Johnswort spreads both by underground and above-ground creeping stems, and by seed. Annual seed production ranges from 15,000 to 33,000 up to 100,000 with a small percentage germinating and reaching maturity. Seeds may remain viable in the soil for up to 10 years. Germination occurs during the warm summer months; however, seedlings may require several years to reach reproductive maturity. Basal foliage that has overwintered may begin to bolt during early March and by early April, older plants will have produced floral shoots. Flowering generally occurs from May through September and may be dependant on soil moisture.

Why is this plant a concern?

Glands found on the plant produce oils that contain hypericin, a phototoxin. Once the plant is consumed, animals become overly sensitive to sunlight, which results in dermatitis, an inflammation of the mucus membranes causing itching, swelling, blisters and open sores. All growth stages of the plant are toxic, including dried plants in hay. Poisoning or hypericism has been reported in cattle, horses, sheep and goats, with symptoms detectable within two to 21 days following ingestion of the plant. Light-haired or unpigmented skin areas such as the mouth, nose, ears and hooves are the most sensitive.

Livestock that suffer from hypericism generally lose weight, are difficult to manage and have reduced market value. Affected animals usually recover once consumption of St. Johnswort is stopped. St. Johnswort has become popular as an herbal stimulant and will induce photosensitivity in some people.

How do I control this plant?

Chemical. A variety of herbicides can be applied for St. Johnswort control and are most effective when applied to seedlings and young plants. Tordon (picloram) or glyphosate (various) are most effective when applied in the spring. Escort (metsulfuron) also will control St. Johnswort effectively. Herbicide treatments are most successful if applied at bud stage before flowering occurs and late in the fall when the plant is going dormant. Repeated applications often are required to achieve adequate management.

Mechanical. Hand-pulling or digging may be effective on small and isolated infestations if repeated several times per season and if conducted prior to flowering and seed production. In larger infestations, lateral roots of older plants left behind can give rise to new plants.

Biological. Several biological agents have been introduced into the United States for St. Johnswort control since the mid-1940s. The Klamath weed beetle (*Chrysolina quadrigemina*) was one of the first highly successful biological control insects introduced into North America. This insect is credited with controlling St. Johnswort on millions of acres in California and the Pacific Northwest.

However, the Klamath weed beetle has not been successful in all areas St. Johnswort occurs, so other agents have been introduced. The root-boring beetle *Agrilus hyperici* and the leaf bud gall-forming midge *Zeuxidiplosis giardi* have become established but the effectiveness has been quite variable. More recently, a St. Johnswort foliage- and flower-feeding moth, *Aplocera plagiata*, has established in the northwestern U.S. with limited success in controlling this weed.

BULL THISTLE

[*Cirsium vulgare* (Savi) Tenore]



BULL THISTLE

County Listed Noxious Weed

Bull thistle is the least serious of the introduced thistles in North Dakota. Native Americans used bull thistle to treat hemorrhoids, which they likely learned from French fur trappers. Bull thistle often is referred to as edible. Many plant parts from the root to the flower are eaten. The flower petals are used as chewing gum.

Identification and growth form:

Bull thistle is a biennial that grows from a flat rosette of leaves the first year to a flowering stem the second year, often 5 feet or more in height. Plants are multibranched; stems have purple veins and are winged. The plant appears bushy rather than the candelabra appearance of plumeless or Canada thistle. A distinguishing characteristic of bull thistle is the leaves. Leaf margins are deeply toothed and toothed again (double dentate) with prominent stiff spines. The leaf surface has a distinct center vein with slight prickly hairs above and cottony pubescence below. The stems are very pubescent with dark purple veins. The rosettes of bull thistle are very pubescent with deeply lobed leaves and dark purple ribs.

Bull thistle flower heads usually are found singularly at the end of each stem branch. The flowers are gumdrop shaped, large (2 to 3 inches tall), with long, stiff, yellow-tipped spines. Bull thistle flowers from July to September, which is somewhat later than other thistles in the region. The flowers are generally purple but rarely a white form is observed. Achenes are 0.1 to 0.15 inch long, glossy light brown to pale yellow or white with narrow dark brown stripes and favored by birds.

Why is this plant a concern?

Bull thistle occurs in all 48 contiguous states and most of Canada, but is designated noxious in only a few states. Bull thistle generally is found growing singularly or in small patches in the northern and eastern counties of the state. The large size and showy flowers of the plant makes it quite noticeable in pasture and rangeland, but it has little economic or ecological consequence.

How do I control this plant?

Bull thistle seldom reaches high enough densities to warrant treatment.

Chemical. Fall is the preferred time for applying herbicides for bull thistle control. Fall treatment allows more time for herbicide application than in the spring and thistle control is generally best with fall treatments. Seedlings that emerge in summer after tillage or previous herbicide applications will not bolt but remain in the rosette stage. Bull thistles are most susceptible to herbicides in the rosette form.

Bull thistles can be controlled effectively with Milestone (aminopyralid), clopyralid (Stinger, Transline or Curtai), Tordon (picloram), or dicamba (various) or dicamba plus diflufenzopyr (Overdrive). Products that contain metsulfuron (Escort, Cimarron Max, others) will control bull thistles in the spring and will eliminate seed production when applied in the bolting to bud growth stages.

Cultural. Cultivation or hand-digging the rosette prior to bolting will kill the plant and prevent seed-set.

Biological. The seed head gall fly *Urophora stylata* lays eggs on flower buds and the larvae then feed on the seed. However, this insect has been only marginally successful in reducing bull thistle populations. This insect is not appropriate for control of small infestations.

CANADA THISTLE

[*Cirsium arvense* (L.) Scop.]



Female flower



Male flower



CANADA THISTLE

State Listed Noxious Weed

Canada thistle was introduced in North America as a seed contaminant in both French and British colonies. The first legislation to control the weed was passed by Vermont in 1795. Canada thistle has the dubious distinction of being one of three weeds listed in 1885 by Dakota Territory as required of “every person” to be destroyed. The native distribution of Canada thistle includes Europe, North Africa and central Asia. It also is found in China and Japan and has spread so extensively that it is difficult to distinguish the plant’s original native range. Canada thistle is considered to be naturalized in the northern Great Plains

Identification and growth form:

Canada thistle is a long-lived perennial that usually grows 2 to 3 feet tall and bears alternate, dark green leaves that vary in size. The leaves are oblong, usually deeply cut, and have spiny, toothed edges. Canada thistle has small (3/4 inch diameter), compact flower heads that appear on the upper stems.

Canada thistle has been classified into several varieties. Within these varieties are many ecotypes, which differ in growth characteristics, response to day length, and susceptibility to herbicides and cultivation. For example, leaf shape, head structure, and the number and size of spines can differ with ecotypes. Canada thistle requires a 14- to 16-hour photoperiod to bolt and flower (April 19 to Aug. 22 in North Dakota). Flower color can range from purple to light lavender or even white. Stem color also can differ from green to lavender.

Flowering occurs from June to September. Male and female flowers are produced on different plants, so cross-pollination is necessary for seed production. Flowers produce from 40 to 80 seeds per head, which can move long distances, although most seed remain in the head until winter and eventually germinate nearby.

The smooth, light brown seeds (achenes) have a conical point and are loosely attached to a tannish pappus at the tip, which aids in seed dispersal by wind. Seeds mature rapidly and are able to germinate within eight to 10 days after pollination. Canada thistle overwinters in the rosette growth stage.

Canada thistle has an extensive underground root system that may penetrate the soil to a depth of 10 feet or more and grow laterally 12 to 15 feet per year. Root buds occur randomly along the roots and initiate new shoots whenever environmental conditions are favorable. Root segments as small as 0.6 inch can initiate shoot growth and become established. Canada thistle is adapted to a wide range of soils, but it produces deeper roots in clay or muck soils than in sand, gravel or limestone soils.

Root bud development can occur nearly anytime during the growing season, but is greatest when soil temperatures are warm, air temperatures are cool and the photoperiod shortens to 13 hours. These conditions generally are found during the fall growing season. Therefore, more Canada thistle root-bud development occurs in the fall than any other time of the year. Canada thistle grows best in the northern regions of North America where temperature and rainfall are moderate. Growth ceases when temperatures exceed 85 degrees for extended periods.

Why is this plant a concern?

Canada thistle has the potential to form dense infestations rapidly through vegetative reproduction, and the spread of these clones may continue indefinitely, crowding out and displacing native grasses and forbs through shading, competition and possibly allelopathy. Canada thistle spread can change structure and species composition of natural areas and reduce plant and animal diversity. Infestations of Canada thistle may contribute to the elimination of endangered and/or endemic plant species. In wildlands, Canada thistle has the potential to increase fire frequency and perhaps severity as a result of its abundant and readily ignited litter and flammable above-ground biomass.

Canada thistle can reduce yield of many crops severely. Yield losses are directly proportional to the density and patchiness of the infestation, with more than \$40 million annually lost in production in North Dakota alone. Wheat is a poor competitor and Canada thistle infestations often increase in a continuous-wheat farming program. Canada thistle also can be a severe problem in corn and soybean grown in rotation, with greater losses in soybean than corn.

CANADA THISTLE

How do I control this plant?

Canada thistle is the only thistle in North Dakota that has become a cropland pest. Control strategies differ for Canada thistle in cropland compared with pasture, range and wildland.

Chemical. *Cropland.* The best approach to Canada thistle control in cropland should include an in-crop herbicide treatment to suppress Canada thistle growth, minimize crop yield losses and prepare the thistle for a fall postharvest treatment. Preharvest and fall-applied treatments provide the most effective long-term control. The best herbicide to use will vary depending on crop rotation. However, the control program must be uninterrupted for two to three years if the infestation is to be reduced.

Glyphosate (various trade names) can be used to control Canada thistle in glyphosate-resistant crops. In-crop applications will not kill established thistle stands. However, when used as part of an overall management program, glyphosate can reduce infestations.

Pasture, range and wildlands. Herbicides that control Canada thistle in noncropland include products that contain clopyralid (various), Tordon (picloram), dicamba (various) dicamba plus diflufenzopyr (Overdrive), Method (aminocyclopyrachlor) and Milestone (aminopyralid). Control is greatest when applied to Canada thistle at the early bud growth stage (early summer) or in the fall to plants in the rosette form. These herbicides applied at low rates may be the most cost-effective method for controlling dense infestations that require broadcast application. Re-treatment will be necessary for several years to obtain long-term control.

Cultural. *Cropland.* Canada thistle roots are much less winter hardy than many other perennial weeds and timely cultivation actually can increase winter kill. Soil temperatures of 20 degrees or colder can reduce

Canada thistle regrowth from roots by more than 50 percent. Following crop harvest, cultivate fields before the Canada thistle is 3 inches tall and repeat before regrowth reaches 3 inches tall until freeze-up. This method has the combined advantage of decreasing carbohydrate root reserves and the bare ground from the tillage will lead to colder soil temperatures, which increases winter-kill.

An option for Canada thistle in row crops and fallow that includes both tillage and herbicides is known as the rosette technique. The objective is to prevent the plants from bolting by using tillage and/or herbicide treatments until the day length is less than 15 hours, the photoperiod required for most Canada thistle plants to bolt. The thistles then will regrow as rosettes only. Research at North Dakota State University has found herbicide absorption and translocation to the roots of Canada thistle is greater when applied to the rosette growth stage than when applied to bolted plants, making fall treatment of rosettes the most cost-effective method for long-term Canada thistle control.

The rosette technique for Canada thistle control in fallow includes the use of tillage and fall-applied herbicides, while control in row crops includes in-crop herbicide treatments, tillage and fall-applied herbicides. Periodic tillage in fallow is used to control Canada thistle shoots and other weeds until late July, when the day length is less than 15 hours. Herbicides used for Canada thistle control, such as glyphosate or clopyralid, then are applied to rosettes in late September or early October. Research at NDSU has found that cultivation until late June prevented more than 90 percent of Canada thistle from bolting in corn and soybean.

CANADA THISTLE

Pasture, range, and wildlands. Repeated mowing will reduce Canada thistle infestations. Mow whenever the plants are in the early bud growth stage to prevent seed-set. Several mowings a year are needed because plant populations vary in maturity. Mow as close to the surface as possible. If plants are cut above the terminal bud before the stems elongate, they likely will regrow. Mowing before the flowers start showing color is important because plants mowed after that likely will produce some viable seed. Mowing for several years will reduce the root vitality of Canada thistle and will prevent seed production, reducing the seed reserve. Mowing should be combined with a chemical control program for best results.

Controlled burns often are used to help restore wildlands to a more natural plant community. Contrary to popular thought, research at North Dakota State University found that fall prescribed burns did not cause a long-term increase in Canada thistle density; rather, Canada thistle emerged earlier in the burned compared with the nonburned areas. The effect was short-lived and Canada thistle densities were similar regardless of burn treatment the second growing season after the burn. Also, no differences in Canada thistle control occurred when herbicides were used alone or combined with a prescribed burn.

Biological. Two biological control agents have been introduced for Canada thistle control, and a third was introduced accidentally. To date, none have been effective at reducing the weed on a large scale. The most widespread insect is *Hadroplontus litura* (formerly *Ceutorhynchus litura*) weevil, which first was released in North Dakota in the 1970s. The larvae feed on the underground parts of Canada thistle for a short time but infestations generally are not reduced. One may take advantage of the early season stress on Canada thistle from *H. litura* feeding by using additional control methods such as mowing or applying herbicides. In addition, natural

soil pathogens may become more destructive due to multiple entry sites established by the insect. However, do not expect these insects alone to reduce a Canada thistle infestation.

A gall-producing fly, *Urophora cardui*, causes meristematic galls but does little long-term damage to the perennial thistle. The Canada thistle bud weevil *Larinus planus* was an accidental introduction into North America and is not permitted for distribution. The insect feeds on developing flowers to prevent seed production. Although *L. planus* can survive under a wide range of climates, it has not reduced established Canada thistle stands.

The painted lady butterfly (*Vanessa cardui*) can be a very effective biological control agent but only on an intermittent basis. Larvae of the butterfly feed on Canada thistle plants and can eliminate an infestation. However, the insect generally is found only in southern states such as Arizona and New Mexico and will build up populations large enough to migrate north only once every eight to 11 years. The insect will migrate north as far as Canada and those fortunate enough to reside within the migratory pathway will see a dramatic decrease in the Canada thistle population. Unfortunately, the insect feeds on many plants, including crops such as soybean and sunflower, and is not a candidate for long-term biological control of Canada thistle.

A native pathogen, *Pseudomonas syringae* pv. *tagetis* (Pst), causes the top of Canada thistle plants to turn yellow to white. This pathogen may release a toxin into the phloem of Canada thistle and kill the plant. The pathogen is most widespread during wet periods. Attempts to produce this pathogen as a commercial biocide have not been successful. A native rust (*Puccinia punctiformis*) has reduced Canada thistle in the wild but has not been introduced successfully as an effective biological control agent.

FLODMAN THISTLE

[*Cirsium flodmanii* (Rydb.) Arthur]



FLODMAN THISTLE

Not Listed by State or County

Flodman thistle is a native species found from Saskatchewan and Manitoba to Iowa and Colorado. This thistle is a food source for a variety of insect and bird species. The stems of Flodman thistle can be peeled and eaten and were part of the Native American diet.

Identification and growth form:

Flodman thistle is a deep-rooted perennial and usually grows 3 to 4 feet tall. The leaves are shiny green on top with slight pubescence and are white and very pubescent below, alternate, rigid and deeply lobed. Stem leaves are prominently lobed; each lobe has three points that end in a spine. One lobe sticks out at nearly right angles, giving a flipping appearance, which is helpful to distinguish this plant from the often similar-appearing wavyleaf thistle.

The rosettes are often 4 to 6 inches in diameter with oblong or lanceolate leaves that vary from deeply lobed to nearly complete. The leaves are green to gray and especially pubescent below. The flowers are deep purple to pink, rarely white, tube shaped and approximately 1 inch long. The flower heads have a strong yellow spine and a sticky secretion that attracts and catches insects. Flodman thistle usually flowers from mid-July through September in North Dakota. The achenes are about 0.1 to 0.15 inch long and oval, and vary from tan to brown and have a conspicuous yellow collar.

Why is this plant a concern?

Flodman thistle is more competitive than most other native species and has the potential to infest large areas. It is tolerant to high salt concentration in soil but not as tolerant as Canada thistle. Although it grows best under moist conditions as most thistles do, it can survive under drought conditions, which gives it a competitive advantage on semiarid rangeland.

How do I control this plant?

Native thistle species such as Flodman thistle seldom become weedy because of the variety of insects and birds that feed on the plant and several pathogens that cause a variety of diseases. However, of the native thistles found in the region, Flodman thistle is one that can form dense colonies, especially in dry years.

Herbicides that are effective for controlling Flodman thistle in noncropland include products that contain clopyralid (various), Tordon (picloram), dicamba (various), Overdrive (dicamba plus diflufenzopyr) and Milestone (aminopyralid). Control is greatest when applied to thistle at the early bud growth stage (early summer) or in the fall to plants in the rosette form. Herbicide treatment will not be necessary if one allows the native pests to build in population and reduce this thistle through time. Flodman thistle has not been a problem weed in cropland.

MUSK THISTLE

(*Carduus nutans* L.)



State Listed Noxious Weed

Musk thistle is the most common biennial invasive thistle in North Dakota. Musk thistle is native in southern Europe and western Asia and was introduced into North America in the early 1900s. Two subspecies that differ in flower size and pubescence occur in North Dakota.

Identification and growth form:

Musk thistle likely is the most easily identified invasive thistle in North Dakota, yet many people confuse this plant with either bull thistle or plumeless thistle. Musk thistle often grows in excess of 6 feet tall, has very large flowers that tend to droop, and the flower has very characteristic brown bracts that resemble a pine cone. The flowers usually are deep rose, solitary and very large, ranging from 1.5 to 3 inches in diameter. Rosettes are dark green with a light green midrib, usually smooth and lacking pubescence and often grow 2 feet or more in diameter.

Musk thistle stems are usually very branched with spiny wings; however, the wings are interrupted and not complete along the stem as with bull or plumeless thistle. The leaves are oblong to lanceolate and lobed with slender spines along the margin. They generally have little pubescence underneath, which helps distinguish musk thistle from plumeless thistle. However, the subspecies *C. nutans macrocephalus* (Desf.) has very pubescent leaves.

Musk thistle flowers from July to late September. The average musk thistle plant produces in excess of 10,000 seeds per plant and, under favorable conditions, may produce 120,000 seeds per plant. Seed germination averages 30 percent. The seed generally germinates in the summer and fall, and the plant overwinters as a rosette. The following spring, the plant resumes vegetative growth, bolts and flowers. After setting seed, the plant

MUSK THISTLE

dies, thereby completing the life cycle. Occasionally biennial thistles have winter annual, annual or short-lived perennial characteristics.

Why is this plant a concern?

Musk thistle tends to invade overgrazed or otherwise disturbed pastures, rangeland, roadsides and waste areas. Movement into cropland is generally from nearby noncropland or roadsides. Musk thistle spreads rapidly and can form very dense stands that crowd out desirable forages and native species.

How do I control this plant?

Since biennial plants such as musk thistle reproduce only from seed, the key to a successful management program is to control the plants before flowering.

Chemical. Fall is the preferred time for applying herbicides for biennial thistle control. Fall treatment allows more time for herbicide application than in the spring and thistle control is generally best with fall treatments. Seedlings that emerge in summer after tillage or previous herbicide applications will not bolt but remain in the rosette stage. Biennial thistles are most susceptible to herbicides in the rosette form.

Biennial thistles can be controlled effectively with Milestone (aminopyralid), Stinger, Transline or Curtail (clopyralid), Tordon (picloram), Method (aminocyclopyrachlor), or dicamba (various) or dicamba plus diflufenzopyr (Overdrive). Products that contain metsulfuron (Escort, Cimarron Max, others) will control biennial thistles in the spring and will eliminate seed production when applied in the bolting to bud growth stages.

Cultural. Repeated mowing will reduce musk thistle infestations. Mow whenever the plants are in the early bud growth stage to prevent seed-set. Several mowings a year are needed because plant populations vary in maturity. Mow as close to the surface as possible. Plants should be cut below the terminal bud before the stem elongates or the weed will regrow. Mowing before the flowers start showing color is important because plants mowed after that likely will produce some viable seed. Mowing should be combined with a chemical control program for best results.

Biological. The seed weevil *Rhinocyllus conicus* was introduced from Eurasia to control musk thistle by

reducing seed production. Larvae develop in the flower head and consume the seed as it develops. The weevils can reduce seed production by nearly 80 percent, but they are attracted more to earlier blooming rather than to later blooming flowers. The late-season flowers produce seeds with little damage from the weevil, which sustains the musk thistle population. Building a high enough population of insects to greatly reduce seed production takes five to 10 years. These insects first were introduced into North Dakota in the early 1970s. *R. conicus* is not specific to musk thistle and has been found feeding on other invasive thistles, such as Canada thistle. However, this insect also feeds on native thistles, including several that are on the protected or endangered species list and interstate transport is not permitted.

The thistle crown weevil (*Trichosiromus horridus*) was introduced into North America from Europe in the mid-1970s. Larvae of this insect feed on the growing tip as the musk thistle rosette bolts. While seldom effective by itself, it does help control musk thistle when combined with *Rhinocyllus conicus*. Feeding by *T. horridus* larvae on musk thistle growing tips causes the plant to produce multiple shoots. The resulting flower heads are reduced in size and produce fewer seeds, and the increased number of flower heads results in an increased population of *R. conicus*. Interstate transport of *T. horridus* is no longer permitted.

The rust fungus *Puccinia carduorum* was released in the eastern U.S. in 1987 for Canada thistle control. The rust has moved westward by natural unaided spread and can reduce musk thistle, especially when in combination with the previously mentioned insects.

PLUMELESS THISTLE

(*Carduus acanthoides* L.)



PLUMELESS THISTLE

Not Listed by State or County

Plumeless thistle first was introduced into North America in the 1870s along the East Coast as a contaminant in ship ballast. Plumeless thistle is one of the most common invasive thistles in the mid-Atlantic and upper Midwestern states. Although found as far west as Washington state, it is less common than musk and bull thistle and is not listed on the North Dakota state noxious weed list.

Identification and growth form:

Plumeless thistle is a winter annual or biennial and generally is found only in eastern North Dakota. Plumeless thistle tends to be shorter than other noxious biennial thistles and generally reaches 1 to 4 feet tall. The stems are winged and very branched, giving the plant a candelabrum appearance. The wings are very spiny and are continuous along the stem and not interrupted as musk thistle. The leaves are deeply lobed, narrower than musk thistle and very pubescent underneath. Each lobe has one to three very sharp marginal spines. Flower heads are small (0.5 to 1 inch) but very numerous and pink to purple or very rarely white. The bracts are very narrow and resemble spines. The heads can be singular or in clusters of two to five. The achenes are small, gray to light brown with a distinct, light apical collar and slightly curved.

Rosettes of plumeless thistle resemble musk thistle rosettes, but are more deeply lobed and much more pubescent. Plumeless thistle rosettes have wavy leaves with yellow spines along the white leaf margins and resemble holly. The plant bolts and flowers in late April to early May.

Why is this plant a concern?

Plumeless thistle can become very weedy and form dense colonies, especially along waterways, ditches and roadsides in summers following wet falls. Plumeless thistle seldom is found in cultivated fields, even when infestations are nearby in roadsides or pastures. The numerous spiny branches make walking through infestations by people or grazing by animals very difficult.

How do I control this plant?

Chemical. Fall is the preferred time for applying herbicides for plumeless thistle control. Fall treatment allows more time for herbicide application than in the spring and thistle control is generally best with fall treatments. Seedlings that emerge in summer after tillage or previous herbicide applications will not bolt but remain in the rosette stage. Plumeless thistles are most susceptible to herbicides in the rosette form.

Plumeless thistles can be controlled effectively with Milestone (aminopyralid), Stinger, Transline or Curtail (clopyralid), Tordon (picloram), or dicamba (various) or dicamba plus diflufenzopyr (Overdrive). Products that contain metsulfuron (Escort, Cimarron Max, others) will control biennial thistles in the spring and will eliminate seed production when applied in the bolting to bud growth stages.

Cultural. Repeated mowing will reduce plumeless thistle population but must be done prior to flowering or viable seed will be produced. Plumeless thistle will not survive tillage operations used in cropland.

Biological. Both *Rhinocyllus conicus* and *Trichosirocalus horridus*, which were released for musk thistle control, attack plumeless thistle. Control from these agents has been minimal.

SCOTCH THISTLE

(*Onopordum acanthium* L.)



SCOTCH THISTLE

County Listed Noxious Weed

Scotch thistle is a native of Eurasia and has become naturalized in portions of western North America. Scotch thistle can thrive in well-drained, sandy or stony soils. The plant occurs in pastures, croplands, rangelands, roadsides and construction sites but prefers disturbed areas and sites near ditches. Scotch thistle has regal stature. During the reign of Malcolm I of Scotland, Norsemen attempted to capture the Staines Castle by wading across the moat in their bare feet, only to find the moat dry and overgrown with thistle. The painful cries by the warriors roused the castle guards and the Norsemen were defeated. To commemorate this victory, the flower became the emblem of Scotland.

Identification and growth form:

Scotch thistle is a biennial herb that can grow up to 12 feet tall. Stems of the plant are hairy or cottony, and have broad, spiny wings. Leaves are large, spiny and covered with fine, dense hairs that give Scotch thistle a grayish-green, cottony appearance. Upper leaves are alternate and have prominent triangular lobes that occur on the margins. Lobes of the leaf end with a prominent, sharp, green to white spines.

Flower heads are terminal, numerous and 1 to 2 inches in diameter. Flowers are pale purple to red and subtended with a series of overlapping bracts tipped with a spine. Seeds are oblong to obovate, four-angled, deep brown to black, about 3/16 of an inch long and wrinkled. Plants can produce 70 to more than 300 flower heads that can produce 100 to 200 seeds per head. Therefore, a single plant can produce 8,400 to 40,000 seeds. Seed viability can range from one to more than 16 years, depending on seed burial depth.

Why is this plant a concern?

Scotch thistle is an aggressive species that can out-compete and decrease desirable forage. The plant also can degrade wildlife habitats and recreational areas. Scotch thistle infestations can become impenetrable, thorny barriers that severely limit land use by wildlife, livestock and man.

How do I control this plant?

Scotch thistle reproduces solely through seed production. Seeds generally germinate in late fall but germination can occur anytime throughout the year.

Chemical. Scotch thistle can be controlled effectively with Milestone (aminopyralid), Stinger, Transline or Curtail (clopyralid), Tordon (picloram), Method (aminocyclopyrachlor), or dicamba (various) or Overdrive (dicamba plus diflufenzopyr). Products that contain metsulfuron (Escort, Cimarron Max, others) will control biennial thistles in the spring and will eliminate seed production when applied in the bolting to bud growth stages.

Mechanical. Hand-pulling small infestations of Scotch thistle can be an effective control method. Mowing prior to seed dispersal may limit the amount of seed available for germination. However, if the plant is cut after flowers begin to show color, viable seed may still be dispersed.

Biological. Both *Rhinocyllus conicus* and *Trichosirocalus horridus*, which were released for musk thistle control, attack Scotch thistle. Control from these agents has been minimal.

WAVYLEAF THISTLE

[*Cirsium undulatum* (Nutt.) Spreng.]



WAVYLEAF THISTLE

Not Listed by State or County

Wavyleaf thistle is a native species and is common in western North Dakota. Various Native American tribes used wavyleaf thistle to treat gonorrhea and syphilis. The remedy involved drinking a tea made from the plant and then elevating the body temperature to induce sweating. A tea also was made from the roots to treat diabetes and stomachache. The roots were boiled and used in soup.

Identification and growth form:

Wavyleaf thistle is a perennial native plant that often is confused with Flodman thistle. Wavyleaf thistle tends to flower from July to September, often a week or two earlier than Flodman thistle. Wavyleaf thistle tends to be more spiny and the leaves less deeply lobed than Flodman thistle. Also, wavyleaf thistle is found in well-drained soils, generally in drier locations than those occupied by Flodman thistle. Wavyleaf thistle grows 3 to 4 feet tall and often is associated with sagebrush communities and rangeland but is less common in moist meadows.

The leaves of wavyleaf are alternate and tipped with yellow spines. The leaves are very pubescent, giving the plant a gray cast, and are less deeply lobed than Flodman thistle. Leaves are strongly undulated or wavy, which gives the plant its common name. The stem of wavyleaf thistle is very pubescent and generally thicker than Flodman thistle. Rosette leaves are also very wavy and gray in appearance.

The flowers are most often pink or purple, but there is a white-flowered form, *f. album* Farwell. The flowers are usually more than 2 inches in diameter, with globe-shaped heads. The yellow spines on the heads lack the sticky secretion found on Flodman thistle. The achenes are brown without a lighter apical band or with only a very narrow lighter margin.

Wavyleaf thistle is a larger plant than Flodman thistle. Generally Flodman thistle is more common than wavyleaf in eastern North Dakota, but wavyleaf gradually becomes the predominant species in the central and western portions of the state.

Why is this plant a concern?

Generally wavyleaf thistle is kept in check by native insects and birds that feed on the plant as well as native pathogens that reduce plant vigor and growth. Wavyleaf has become a problem when the plant spreads beyond its normal range, such as the Pacific coast. Otherwise this plant does not warrant control efforts.

DALMATIAN TOADFLAX and YELLOW TOADFLAX

[*Linaria dalmatica* (L.) Mill.] and (*Linaria vulgaris* Mill.)



Dalmatian toadflax



Dalmatian toadflax has
broad heart-shaped leaves



DALMATIAN TOADFLAX and YELLOW TOADFLAX



Yellow toadflax



Yellow toadflax has narrow linear leaves



Yellow toadflax flowers have orange throats



DALMATIAN TOADFLAX and YELLOW TOADFLAX

State Listed Noxious Weed – both species

Both Dalmatian and yellow toadflax are escaped perennial ornamental plants that were introduced in the mid-1800s. Dalmatian toadflax is native to the Mediterranean region, specifically the Dalmatian Coast of Croatia, while yellow toadflax is from Eurasia. Yellow toadflax first was recorded in North Dakota by H.L. Bolley from a collection made in Fargo and described as “most abundant in Barnes County” in the 1940s by O.A. Stevens. The first record of Dalmatian toadflax is from Walhalla in Pembina County in 1937 by Stevens.

The toadflaxes are most likely to be found along highways, railroad tracks and other transportation or communication lines, or anywhere livestock is brought into the state. Often the origins of an infested area can be traced back to an escape from an ornamental planting. Dalmatian toadflax has been reported only as small patches in a few counties, generally in the western part of North Dakota. However, yellow toadflax has been found in many counties across the state and is on the verge of becoming a major problem for land managers in North Dakota.

Identification and growth form:

Dalmatian and yellow toadflax are members of the snapdragon family and thus easily recognizable by the bright yellow flowers, which have swollen corolla tubes that flare into two “lips” with an orange throat (yellow toadflax) and long spur. The flowers are 1 to 1.5 inches long with many flowers on a raceme. Both species have an extensive creeping rhizomatous root system that spreads like leafy spurge. The most distinctive difference between the species is that Dalmatian toadflax has broad, heart-shaped leaves that clasp a woody stem, whereas yellow toadflax has narrow, linear leaves with a narrow stem.

The plants begin regrowth from the roots as soon as the soil warms in early spring. Toadflax flowers from late June through August in North Dakota and single plants may produce more than 500,000 seeds that are dispersed by wind, rain, wildlife, and movement of forage and livestock. The seed is disk-shaped, 0.08 inch in diameter and dark brown to black, and often have irregular papery wings. Seed dispersal begins a few weeks after flowering and continues into winter. The roots of a single plant can extend 10 feet and give rise to daughter plants every few inches.

Why are these plants a concern?

The toadflax species are aggressive and will displace forage in pastureland and native species in wildland. Yellow toadflax can be mildly poisonous to livestock that graze it. Although the toadflaxes may be slow to establish, once plants take root, control is very difficult since most herbicides are ineffective.

Dalmatian toadflax seedlings are relatively poor competitors with grass species, but once established, the weed can become extremely invasive, especially on dryland sites, disturbed areas and roadsides. Yellow toadflax is adapted to more moist sites than Dalmatian toadflax and often is found in pasture, meadows and ditches.

DALMATIAN TOADFLAX and YELLOW TOADFLAX

How do I control these plants?

Prevention is the best method to keep Dalmatian and yellow toadflax from invading North Dakota pasture, rangeland and wildlands. Herbicides can be effective but require repeated treatments at high rates.

Chemical. Tordon (picloram), Plateau (imazapic) and Telar (chlorsulfuron) will control Dalmatian toadflax when applied at maximum use rates during flowering or late fall. No herbicide is labeled for yellow toadflax control, but research has found that a combination treatment of Tordon plus Overdrive (dicamba plus diflufenzopyr) applied from mid-June through mid-September will reduce yellow toadflax infestations for a least two years. See the latest edition of the “North Dakota Weed Control Guide” for application rate and timing recommendations.

Cultural. The long-term use of proper stocking rates to maintain competitive forage species has helped reduce the spread of toadflax into grazing lands. Burning is not effective because soil temperatures do not get high enough to kill the

roots. Burning even may have a detrimental effect and cause an increase in the number of stems due to reduced cover.

Biological. Several insects have been introduced for toadflax control. The stem-boring weevil *Mecinus janthiniformis* has been the most successful and can reduce Dalmatian toadflax stands relatively quickly. *M. janthiniformis* larvae mine in Dalmatian toadflax stems, which slowly causes the plants to wilt and die. Repeated attempts to establish *M. janthiniformis* on yellow toadflax in North Dakota have failed, likely because the larvae cannot survive in the much narrower diameter stem of yellow compared with Dalmatian toadflax. *Mecinus janthinus* is currently being evaluated for yellow toadflax control.

A foliage feeding moth, *Calophasie lunula*, was introduced in the U.S. in 1968 but has had little effect on controlling yellow toadflax. Several other insects have been introduced for biological control of both toadflax species but have not established or have not controlled the weeds

YELLOW STARHISTLE

(*Centaurea solstitialis* L.)

Not Listed by State or County

Yellow starthistle is an extremely invasive, fast-spreading member of the knapweed family and native of the Mediterranean region. Yellow starthistle first was collected in North Dakota in 1964 and was added to the state noxious weed list for a time beginning in 1999 after plants were observed in several newly seeded CRP fields. Successful control of these and other infestations led to the delisting of the weed, but yellow



YELLOW STARHISTLE

starthistle remains a threat and any infestation should be eradicated immediately. Yellow starthistle infests more than 15 million acres in California and has displaced leafy spurge as the most invasive weed found in Idaho. Yellow starthistle presently has been found in the neighboring states of Montana, South Dakota and Minnesota.

Identification and growth form:

Yellow starthistle is an annual that often grows 3 feet or more tall and is branched with winged stems. Each stem terminates in bright yellow flowers with needlelike straw-colored bracts often up to 2 inches long. Lower leaves are deeply lobed while upper leaves are entire. Both stems and leaves are covered with pubescent hairs that give the plant a grayish appearance. Yellow starthistle reproduces (and thus spreads) only by seed. A single plant can produce as many as 150,000 seeds, of which 90 percent or more are viable and can remain dormant in the soil for a few years. Most yellow starthistle seeds are plumed and disperse when mature. However, some seeds are plumeless and stay in the flower head until winter storms disperse them in blowing snow. Yellow starthistle has a long tap root similar to spotted knapweed or dandelion.

Yellow starthistle seeds can germinate either in the fall following cool rains and overwinter as a rosette or in the spring after snowmelt. Yellow starthistle begins to bolt in late May to early June. Flowering starts in early to mid-July, similar to Canada thistle. Yellow starthistle often can go unnoticed until the plant begins to flower, but once the bright yellow, dandelionlike flowers bloom, the plant is easily detected. Flowering continues until mid to late August, then the plant dries to a straw color, the seeds mature and the cycle repeats.

Why is this plant a concern?

Livestock and wildlife will not graze where yellow starthistle grows because of the sharp spines around the flower. Yellow starthistle is adapted to a wide variety of environments and will out-compete most native plants for nutrients and moisture, reducing both native wildlife and plant diversity. Yellow starthistle can cause “chewing

disease” in horses, which is a lethal neurological disorder. However, to present symptoms, such as the inability to eat or drink, stiff or trembling legs and a stiff, swollen, “frozen” face, a horse must eat an amount nearly equivalent to its body weight.

How do I control this plant?

Prevention is the best method to keep yellow starthistle from invading North Dakota cropland, rangeland and wildlands. Yellow starthistle is most likely to be found in recently seeded pastures or CRP fields; along highways, railroad tracks and other transportation or communication lines; or anywhere livestock is brought into the state. Previous infestations in the state can be traced to contaminated grass seed, including those used in CRP and contaminated hay, and from movement of out-of-state livestock and vehicles into North Dakota.

Chemical. The most effective herbicides for yellow starthistle control include Milestone (aminopyralid), Tordon (picloram) and dicamba (various). Treat an extra 10 to 15 feet around the infestations to control seedlings. A careful follow-up program is necessary to control missed plants and seedlings.

Cultural. Grazing, mowing, burning, cultivation and maintaining competitive forages can be used in conjunction with herbicides to keep yellow starthistle from establishing in North Dakota. Hand-pulling is also effective for control of this annual weed.

Biological. Several biological control agents have been introduced into states with large acreages of yellow starthistle such as California and Idaho. However, biological control is not recommended in North Dakota, and any new infestations should be eradicated using chemicals or by digging and removing by hand.

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Do You Have Noxious Weeds?

Noxious Weeds: It's Everyone's Job

By law, every person is required to do all things necessary and proper to control the spread of noxious weeds.

What should I do if I find a suspected noxious weed?

Contact your local county weed officer, NDSU local extension agent or the North Dakota Department of Agriculture at 1-800-242-7535. For a list of county weed officers, go to https://www.nd.gov/ndda/county_weed_officers.

If I do have noxious weeds on my property, is there any help available to control them?

Yes! Here are a couple of options:

Funding – You may be eligible for a cost-share program with your local county weed board. Contact your local county weed officer for more information.

Biological Control – There are biological control options available for certain weeds in certain populations. For example, the release of flea beetles can help control large populations of leafy spurge. Options are also available for yellow toadflax, Canada thistle, purple loosestrife and spotted knapweed. Visit <https://www.nd.gov/ndda/weeds> for more information on biological control options.



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