



TechLine

Sharing innovative research, success stories, and tips with invasive plant managers.

SPRING Newsletter 2011

Prairie & Grasslands Edition

OVERCOMING CHALLENGES TO RESTORE NATIVE TALLGRASS PRAIRIE

University and U.S. Fish and Wildlife Service Partner to Find Solutions



The Kufrin Waterfowl Production Area (WPA) is the heart of some of the best remaining waterfowl habitat in Minnesota. Located northeast of Ortonville, Minnesota near the South Dakota state line,

this 739-acre WPA is part of the Morris Wetland Management District. JB Bright, wildlife refuge specialist for the district is tasked with managing habitat to meet the needs of prairie wildlife. “The goal of the Morris Wetland Management District is to restore and protect wetland and grassland habitat and manage the lands to benefit breeding waterfowl and other wildlife,” explains

Bright. “Much of the land that we acquire is former cropland that we need to restore to native grassland species.” In an average year, the district may restore several hundred acres of tilled land back to native grassland species and restore numerous drained wetlands. Restoring these wetlands not only provides habitat for wildlife but also helps prevent downstream flooding and provides sites

for public recreation such as hunting and wildlife photography.

Invasive plants can be a serious problem when restoring native grasslands. “When we make a decision to restore a site, we often open up a ten-year ‘Pandora’s box’ of problems in the form of invasive plants such as Canada thistle (*Cirsium arvense*), plumeless thistle

by Celestine Duncan, Editor

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photo courtesy of JB Bright



photo courtesy of JB Bright

Forbs remaining in herbicide treated plots were larger and more robust across application timing compared to forbs in mowed or nontreated plots.

The level of sweet clover present in 2009 is visible in the border areas (foreground). There was a trend for cover of this and other exotic forbs including, perennial sowthistle, and dandelion to be higher with herbicide treatments applied in September compared to June.

(*Carduus acanthoides*), absinth wormwood (*Artemisia absinthium*), common mullein (*Verbascum thapsus*), yellow toadflax (*Linaria vulgaris*), sweetclover (*Melilotus* sp.) or sulfur cinquefoil (*Potentilla recta*)," says Bright. "Invasive plants present some real management challenges and can out-compete our desirable native species. During the first three years of these native seedings we needed to know how to proceed with our restoration program, whether we should mow or apply herbicides, and what impact our control methods were having on desirable plants."

"The herbicide treatments greatly reduced competition from Canada thistle and opened a niche for native forbs and grasses to thrive."

To answer some of these management questions, Bright teamed up with Dr. Roger Becker, weed scientist from the University of Minnesota to determine if selective herbicides could play a role in native prairie restoration. "We established field trials to compare the effectiveness of herbicide treatments applied in June and September for controlling Canada thistle, and to measure the impact of herbicide treatments on desirable forbs," explained Becker. Bright added, "We also wanted to determine if applying herbicides early in the restoration program would improve overall establishment of grasses and forbs."

Table 1. Canada thistle control and visual cover 12 to 15 months after treatment (MAT) in response to Milestone® and Transline applications in June compared to September on the Kufrrin Waterfowl Production Area.

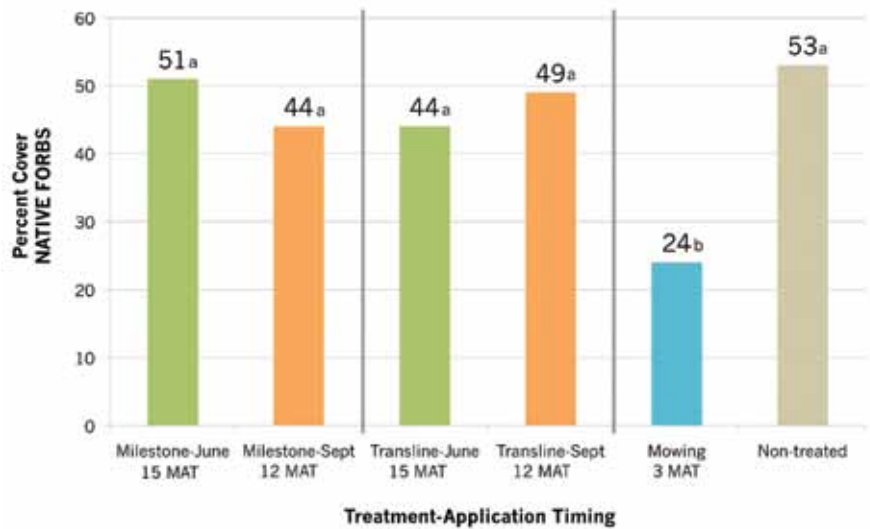
Treatment	Rate (fl oz/A)	Application Timing	Canada Thistle Rating: 9/21/2010 (12 or 15 MAT)	
			% Control*	% Cover*
Milestone	5	June	83 ab	4 bc
Transline	10.6	June	65 b	9 ab
Milestone	5	September	93 a	1 c
Transline®	10.6	September	90 a	2 bc
Non-treated	-		0	13 a

*Numbers followed by the same letter are not significantly different at the 0.05 level

The study site was located in an 88-acre restoration project that was seeded to native species in June of 2007. When the trials were initiated native perennial grasses such as little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), indian grass (*Sorghastrum nutans*) and side oats grama (*Bouteloua curtipendula*) were established on the site. There were also many native forbs including golden Alexander (*Zizia aurea*), purple prairie clover (*Dalea purpurea*), wild bergamot (*Monarda fistulosa*), yarrow (*Achillea* spp.) and goldenrod (*Solidago canadensis* and *S. rigida*). The restored area was mowed in June of 2008 to stop Canada thistle seed production and the research study initiated the following year. Milestone® and Transline® were applied June 25, 2009 when Canada thistle was at the late bolt to bud growth stage. Fall treatments of these herbicides were applied September 23, 2009. The area outside of the herbicide treated and non-treated plots was mowed June 2009, August 2009 and June 2010 to prevent Canada thistle seed production and flight. Four quadrats were randomly established in September 2010 in this mowed area and data were collected to compare the effect of mowing to herbicide treated and non-treated plots.

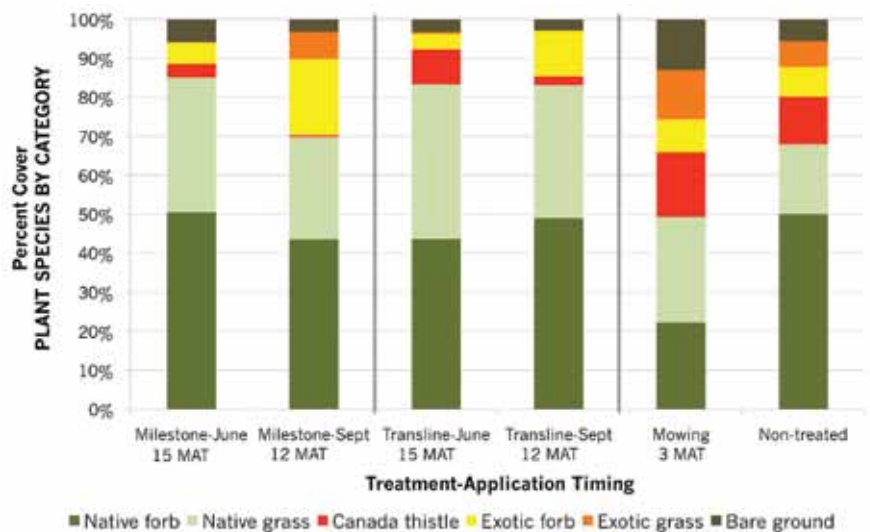
Results of the study to date show that Milestone at 5 fl oz/A and Transline at 10.6 fl oz/A (2/3 pints/acre) applied in September provided greater than 90% control of Canada thistle the season following treatment (Table 1). There was no significant difference in Canada thistle control between September and June applications of Milestone although control was slightly less in June (83%) compared to September (93%). There was a significant difference in control with Transline with the September application providing 90% Canada thistle control compared to 65% when applied in June.

Figure 1. Percent cover of native forbs in response to Milestone at 5 fl oz/A and Transline at 10.6 fl oz/A applied in June and September 2009 compared to mowing and non-treated plots. Data collected September 21, 2010.



*Cover values with the same letter are not significantly different at the 0.05 level [LSD= 13.63]

Figure 2. Percent cover of plant species by category in response to Milestone at 5 fl oz/A and Transline at 10.6 fl oz/A applied in June and September 2009 compared to mowing and non-treated plots. Data collected September 21, 2010.



Note: Exotic forbs include sweetclover, perennial sowthistle, and dandelion.

There was no significant difference in visual percent cover of forbs based on herbicide application timing. However, forb response in herbicide treated and non-treated plots was significantly different compared to mowed plots (Figure 1). Forbs remaining in herbicide treated plots were larger and more robust across application timing compared to forbs in

mowed or non-treated plots. There was a trend for cover of exotic forbs including sweetclover, perennial sowthistle (*Sonchus arvensis*), and dandelion (*Taraxacum* spp.) to be higher with herbicide treatments applied in September compared to June. Since most vegetation was removed with mowing, this treatment had a significantly higher negative impact

["KUFRRIN" continued on page 4]



JB Bright, wildlife refuge specialist for the Morris Wetland Management District

on native forb cover compared to herbicide treatments or non-treated plots when evaluated in September 2010 (Figures 1 and 2).

Although long term monitoring of the plant community is needed to understand impacts of the various

treatments, results of this evaluation indicate that mowing had a greater negative impact on the cover of native forbs than the herbicide treatments. Bright noted that, "Results were very enlightening because native forbs were visually more robust in herbicide treated plots compared to mowed plots. The herbicide treatments greatly reduced competition from Canada thistle and opened a niche for native forbs and grasses to thrive. In mowed plots, Canada thistle is still present and continues to compete with seeded species, impacting our desirable plant community." Current research results suggest that forb response may be similar with herbicide treatments applied in either June or September.

Plant counts were also taken in each of four replicates for each treatment in June using a square yard (yd²) frame. The only forb showing

STUDY SITE HISTORY: KUFRIN WPA

6/21 and 6/25/2007

Broadcast seeded (Vicon and culti-packer) into bean stubble with about 78% grass/22% forb mix, consisting of both purchased seed and remnant prairie harvest. At least 44 species were seeded at a rate of approximately 38 seeds per square foot.

6/20/2007

sprayed with Round-up and 2,4-D amine at 1 quart each product/acre

7/07/2008

mowed

6/30/2009

mowed outside plots (did not mow herbicide treated plots or non-herbicide treated plots within the study site)

8/12/2009

mowed outside plots (did not mow herbicide treated plots or non-herbicide treated plots within the study site)

6/23/2010

mowed outside plots (did not mow herbicide treated plots or non-herbicide treated plots within the study site)



WATERFOWL PRODUCTION AREAS

Waterfowl production areas (WPAs) are considered the prairie jewels of the U.S.

Fish and Wildlife Service National Wildlife Refuge System. These wetlands and the surrounding uplands provide breeding, resting and nesting habitat for millions of waterfowl, shorebirds, grassland birds and other wildlife. Waterfowl production areas also protect native plants, provide habitat for resident and migratory wildlife, help filter groundwater, control runoff and flooding, and capture carbon from the atmosphere. These lands are either acquired as public land, or protected through perpetual easement. With more than 36,000 separate fee and permanent easement tracts

covering nearly three million acres, waterfowl production areas account for 18 percent of National Wildlife Refuge System lands in the lower 48 states. Approximately 95 percent of these WPA lands are located within the Prairie Pothole states of North Dakota, South Dakota, Minnesota and Montana. The smallest is less than one acre (Ward County WPA in North Dakota) and the largest is 7,468 acres (Phillips County WPA in Montana).

By law, WPAs are open to hunting, fishing, trapping and other wildlife-dependent recreation including wildlife observation, photography, and environmental education.

The Kufrin WPA was dedicated in 2005 to Steve Kufrin, a life-long outdoorsman and former U.S. Fish and Wildlife Service partnership coordina-

tor, for his commitment to wetland conservation.

INTERESTING FACTS ABOUT WATERFOWL PRODUCTION AREAS:

- When you purchase a Federal Migratory Bird Hunting and Conservation Stamp (a.k.a. "Duck Stamp") 98 percent of your \$15 purchase goes toward creating waterfowl production areas.
- Dozens of threatened or endangered species, especially prairie plants such as the western prairie fringed orchid, rely heavily on WPA habitat for survival.
- WPAs protect a large portion of the remaining tallgrass prairie in the Midwest. For example, Helikson WPA in northwest Minnesota contains 1,373 acres of virgin prairie with grasses over 6 feet tall.

a significant response ($P=0.05$) to herbicide application timing was purple prairie clover. The June application of Milestone at 5 fl oz/A showed no significant impact on this forb (6 plants/yd² in treated versus 4 plants/yd² in non-treated) compared to complete removal of the plant with the September application. There was no significant impact to purple prairie clover with applications of Transline at 10.6 fl oz/A regardless of application timing. These plots will be monitored in 2011 to measure plant community response to various treatments.

A secondary benefit of herbicide treatments is that there is less physical disturbance to upland bird habitat compared to mowing. "Our herbicide application equipment treats an area 52 feet wide compared to our mower which is 24 feet, so we have less disturbance and fewer tracks, both of which can impact upland bird habitat. Applying herbicides also saves time compared to mowing," says Bright.

"Our goal is to have diverse native plant communities that will include different levels of canopy cover and structural diversity to serve a wider array of birds, pollinator insects and other wildlife," explained Bright. Information from this research will help us select native forbs for seeding that are more tolerant to herbicide treatments, and time herbicide applications to achieve the best results." Restoring a diverse, healthy, native plant community will not only benefit wildlife but will be more resilient to invasion by non-native plants.

EDITOR'S NOTE: For a response to Milestone applied in spring and fall over five locations in four states, including the Kufirin WPA, is summarized in a power point presentation "The Effect of Application Timing on Forb Tolerance to Aminopyralid". The summary was presented at the Western Society of Weed Science annual meeting in March, 2011 and is available at www.techlinenews.com/wswstimingforbtolerance.pdf

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BRIEFS

TechLine Expands

Since our new production team signed on in spring 2010, TechLine has grown from a printed/mailed newsletter to an entire suite of print and electronic resources for invasive plant managers. We've expanded our audience, refined our message, and streamlined delivery so that we can send you—our reader—more of what you DO want and less of what you DON'T. Read on to learn more about how your TechLine subscription just got better.

NEW! Weed District TechAdvisor

This spring TechLine launched a new informational series specifically for county weed district professionals.

Weed District TechAdvisor provides timely resources to help ensure safe and effective field use of herbicides manufactured by Dow AgroSciences. The goal is to provide answers to technical questions and enhance education of weed district staff and the public about invasive plant management with herbicides. TechAdvisor is available online and delivered to subscribers in hardcopy and email formats.

IMPROVED! www.techlinenews.com

TechLine launched a new website to house our suite of resources for invasive plant managers. Use improved navigation and search features to quickly find issues of TechLine Newsletter, TechNotes, and much more.



Montana offers new invasive plant curriculum for K-12

The kNOweeds curriculum, developed by Missoula County Weed District in Montana, includes 46 hands-on, ecologically-based lessons for K-12 students. Lessons encourage student inquiry, incorporate a variety of learning styles, and are place-based to reflect the diversity of ecosystems, land values and users throughout the state.

The kNOweeds Curriculum is available for free at http://missoulaeduplace.org/weeds_curriculum.shtml or by writing Steffany at steffany@missoulaeduplace.org.

SPOTTED KNAPWEED MANAGEMENT POSSIBLE WITH PLANNING, PERSISTENCE, AND INTEGRATED APPROACH

Minnesota Department of Natural Resources protects resource values

Managing invasive plants is a challenge under the best circumstances, but when coupled with high recreational use, miles of trails and diverse ecosystems, it becomes even more complex.

by Celestine Duncan, Editor

Chris Weir-Koetter, Strategic Program Manager for the Minnesota Department of Natural Resources (MNDNR) Northwest Region Parks and Trails credits careful planning, persistence, and integrating the most effective and selective methods for her success in managing spotted knapweed (*Centaurea stoebe*).

“Our agency is charged with conserving and managing Minnesota’s natural resources,” Weir-Koetter explains. “We have very diverse vegetation in Minnesota with four of North America’s biomes converging in the Northwest Region.” The Region encompasses 16 state parks, recreation areas and wayside areas containing over 70,000 acres. There are 200 miles of state trails and 700 miles of state water trails along with hundreds of public water access points. Ecological diversity combined with invasion pathways and recreational use means plenty of suitable habitat for a variety of nonnative plants.

Spotted knapweed is among the top ten invasive plants prioritized for management by the Northwest MNDNR. First observed in the Northwest Region in Clearwater County in 1997, the weed spread rapidly along road corridors, trails, and in sand and gravel materials used in construction and maintenance activities. Currently all counties within the North-



west Region are infested with spotted knapweed including ten state parks.

The management strategy for spotted knapweed on state parks and trails lands followed a simple plan according to Weir-Koetter. “First we needed to become knowledgeable about the weed, its impacts, prevention and control. We then developed a map and plan of attack working from pioneering weeds to centers of infestations. Lands with high resource values were prioritized for management. We also targeted entry points

and travel routes to prevent spread to non-infested sites. And finally we used the most effective and selective combination of prevention and containment techniques for controlling spotted knapweed.”

An integrated program to contain and control spotted knapweed was implemented in 1998. Methods included a combination of selective herbicides, mowing, biological control, hand pulling, and grazing. Different management strategies were customized for individual state parks based on the size and location

of weed infestations, operating budgets, and environmental constraints. A resource field crew trained for invasive plant management conducts most of the control efforts with support from parks and trails staff. Treated sites are monitored periodically to determine effectiveness of various management methods, and to locate and treat new infestations.

Selective herbicide treatments included dicamba applied at 32 fluid ounces per acre (fl oz/A), Milestone® at 5 to 7 fl oz/A, and Transline® at 10 to 16 fl oz/A. Herbicides were applied to spotted knapweed at the rosette to early bolt growth stage to remove plants and stop seed production. The higher herbicide rates were applied at later growth stages. Results of the herbicide treatments evaluated a year following application showed that dicamba gave less than 50% spotted knapweed control compared to Transline and Milestone with greater than 90% control. “Based on these results we adapted our program to use the most effective herbicide treatments,” explained Weir-Koetter.

On sites where common tansy (*Tanacetum vulgare*) and spotted knapweed are growing together, Opensight® at 2 to 3.3 ounces of product per acre is providing good control of both species. The combination of both herbicides on one granule makes it easier for applicators to mix spray solutions and broadens the weed control spectrum.

Although spotted knapweed seed remain viable in the soil for at least eight years, Weir-Koetter observed that growth of desirable vegetation increased following herbicide treatments and provided competition to germinating spotted knapweed. There are a few locations where desirable vegetation is not present prior to treatment. On these highly disturbed sites, the Northwest MNDNR Parks and Trails resource staff are restoring native and other desirable vegetation to help establish and promote a weed-resistant plant community.

In addition to herbicides, methods such as mowing, hand pulling, livestock grazing, and biological control were used. “We found that mowing, pulling and grazing didn’t fit our management goals and objectives on most



Mowing spotted knapweed plants does not prevent flower and seed production (above), and if not properly timed, mowing can actually spread seeds (right).



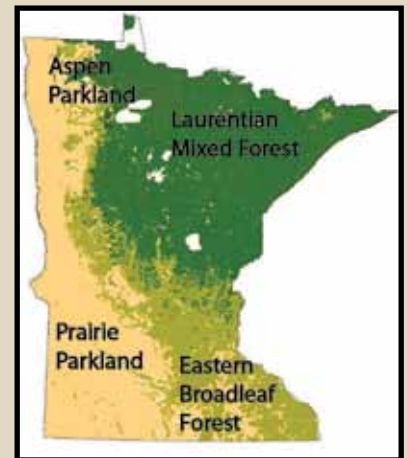
photos courtesy of C Weir-Koetter

of our sites,” explained Weir-Koetter. “Mowed plants can produce flowers and seed even with repeated mowing for more than 10 years. Because of the large number of sites and

acreage that needed treatment it was difficult to time all of our mowing operations prior to seed production, so mowing machines were actually spreading seed.”

MINNESOTA BIOMES

A biome is a broad, regional type of ecosystem characterized by distinctive climate and soil conditions and a distinctive biological community adapted to those conditions. There are four biomes that converge in Minnesota and different non-native plants are problematic in each biome. Invasive plants including leafy spurge (*Euphorbia esula*), spotted knapweed, birdsfoot trefoil (*Lotus corniculatus*), crown vetch (*Coronilla varia*) and Canada thistle (*Cirsium arvense*) are problematic in the Prairie Parkland and Tallgrass, Aspen Parkland biomes. In the Eastern Broadleaf (deciduous) Forest, wild parsnip (*Pastinaca sativa*), European buckthorn (*Rhamnus cathartica*), garlic mustard (*Alliaria petiolata*), and tartarian honeysuckle (*Lonicera tatarica*) are the most invasive species. The Laurentian Mixed Forest Biome is the most resilient to invasion by non-native plants with infestations of common tansy and orange hawkweed (*Hieracium aurantiacum*).



[“MNDNR” continued on page 8]



Selective herbicide treatments were applied to spotted knapweed at the rosette to early bolt growth stage.



Goats used to graze spotted knapweed attracted public interest to the invasive plant problem.



The root-feeding weevil *Cyphocleonus achates* was released to help manage spotted knapweed populations at Glendalough State Park.

photos courtesy of C Weir-Koetter

Persistent and careful hand pulling has been shown to control spotted knapweed if the entire crown portion of the plant is removed before the plant produces seed. Hand pulling spotted knapweed on MNDNR lands was effective on eliminating individual pioneer plants but had drawbacks when controlling larger infestations. Results of the MNDNR monitoring efforts showed that hand removal disturbed the ground and provided perfect conditions for spotted knapweed seeds to germinate. Pulling was also very labor intensive with high control costs. These observations were similar to hand removal projects evaluated in Montana that showed hand pulling well established infestations of spotted knapweed twice each year cost about \$14,000 per acre per year.

Cattle, sheep and goats are known to graze spotted knapweed at low to moderate levels. The Northwest Region MNDNR initiated a goat grazing project to control spotted knapweed infestations as part of their integrated efforts in Itasca State Park. "Our monitoring results showed that the goats had an impact on native vegetation and there was no decrease in spotted knapweed density two years after grazing," explained Weir-Koetter. "It was also expensive, our cost was \$2,069 for fencing and goats (with herder) plus about an equal amount of MNDNR labor to graze less than one acre for a year. However, the goat-grazing program likely reduced spotted knapweed seed production since goats consumed some flowers, and the animals were great for drawing public interest to the invasive plant problem."

Biological control can be an effective, long-term management tool for well-established infestations, but often requires many years before results are visible. At Glendalough State Park, the root-feeding weevil *Cyphocleonus achates* was released at multiple locations mainly along the edge of infested fields. The MNDNR is actively monitoring insect populations and is hopeful that biological control of spotted knapweed will play an important role in the management of spotted knapweed in northwestern Minnesota.

"Another important part of our invasive plant program is to insure that our management efforts weren't accelerating the problem," says Weir-Koetter. The Minnesota DNR developed guidelines for preventing spread of invasive plants within their own agency. This includes cleaning equipment to reduce spread, requiring weed-free materials (sand,

OPENSIGHT® FOR MIXED STANDS

Noxious weeds often occur as a complex or mixed stand of various species that may include knapweeds (*Centaurea* sp.) or thistles (*Cirsium* and others), mixed with other weeds such as wild parsnip (*Pastinaca sativa*),

wild carrot (*Daucus carota*), poison hemlock (*Conium maculatum*), or common tansy (*Tanacetum vulgare*). Growth regulator herbicides such as Milestone® (aminopyralid) provide excellent control of knapweeds and thistle, but have less activity on weeds such as wild parsnip and common tansy. In contrast, metsulfuron methyl provides

excellent control of wild carrot and parsnip, common tansy, and poison hemlock but poor control of knapweeds and thistle. Opensight® herbicide combines both aminopyralid and metsulfuron-methyl on a dry pellet formulation. The combination of these two active herbicide ingredients broadens the weed control spectrum and

allows applicators to control noxious weed complexes with one application. The maximum label use rate for Opensight is 3.3 oz product/A, which contains 1.7 oz acid equivalent (ae) of aminopyralid (equal to 7 fl oz Milestone) and 0.36 oz active ingredient of metsulfuron methyl.

gravel), requiring contractors to enter a site with clean equipment, and inspecting and controlling weeds on stockpiled materials.

The Minnesota DNR realizes that successful management of spotted knapweed and other invasive plants is a long-term effort involving the combined use of all available control methods and improved land management practices in an integrated approach. Weir-Koetter's says, "Be tenacious in your control efforts, and as control is achieved, move from a project approach to a maintenance program but never walk away."



Chris Weir-Koetter, Strategic Program Manager for the Minnesota Department of Natural Resources Northwest Region Parks and Trails

INTEGRATED WARFARE

poem by C.R. Weir-Koetter, 2005

*Do not despair
My comrade in arms.
For if we fall,
Bloodied and spent,
Before the Siege of Weeds.
We fall as
Warriors.
And if we prevail,
In a battle, or a war
or after years of conflicted toil,
We prevail still as
Warriors.
But if we do nothing,
Discard the beetles and tanks,
And grow fat and helpless,
Complacent of the advance,
We only despair.*

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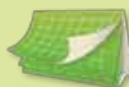
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BIENNIAL THISTLE MANAGEMENT



Left to right: bull thistle, musk thistle, Scotch thistle, plumeless thistle. (Photos by Steve Dewey)

Several biennial thistles are problematic in North America including bull thistle (*Cirsium vulgare*), musk thistle (*Carduus nutans*), plumeless thistle (*Carduus acanthoides*), and Scotch thistle (*Onopordum acanthium*).

Biennial thistles germinate and grow into rosettes in their first year and spend the winter as rosettes. In their second year, rosettes resume growth in early spring and bolt in mid-to late spring. Bolted plants then flower, set seed, and die by summer's end. Biennial thistles only reproduce from seeds, so the key to management is to prevent seed production.

Thistle species introduced from Europe often become weedy in part because the natural enemies that keep their populations in check in their native habitat are not found in North America. Disturbance, adequate moisture, and sunlight favors establishment of biennial thistles; thus degraded pastures and rangeland with bare soil or disturbed areas are most susceptible to invasion. Once established, biennial thistles compete with desirable vegetation, and sharp spines can deter livestock and possibly wildlife from grazing. Reductions in livestock carrying capacity have been reported when biennial thistles invade rangeland and pasture.

Management of biennial thistles includes herbicides, biological control agents, mechanical, and cultural control methods. The following information summarizes results of herbicide field trials conducted on non-native biennial thistles. The duration of biennial thistle control on any site is dependent on herbicide properties and environmental conditions such as soil type, rainfall, and presence of competitive desirable vegetation. In general, control with herbicides tends to

be shorter in duration on coarse textured soils and on sites with annual rather than perennial grasses.

Results of Herbicide Field Trials

MUSK, BULL, AND PLUMELESS THISTLES

Milestone® (aminopyralid) at 3 to 5 fluid ounces product per acre (fl oz/A) provides good to excellent control of musk, bull, and plumeless thistle (Table 1). Milestone can be applied from rosette (fall or spring) to early flower growth stages. Fall application timing on biennial thistle rosettes will provide control of rosettes and germinating seeds through the following growing season (Figure 1). Field studies have also been conducted when musk thistle is at

late bolt to early flower growth stage. In field trials conducted at two locations in the mid-west, Opensight® (aminopyralid plus metsulfuron) at 1.5 to 2 ounces of product per acre provided similar control as Milestone® (aminopyralid alone) when applied to musk thistle at late bud to early bloom growth stage (Figure 2).

SCOTCH THISTLE

Milestone® at 5 to 7 fluid ounces of product per acre should be applied to control Scotch thistle. Although lower rates may provide effective control on some sites, the 5 to 7 fl oz/A rate provides more consistent control across multiple locations. A field study conducted by Dr. Robert Wilson, University of Nebraska Weed Scientist at the Panhandle Research and Extension

Figure 1: Musk thistle control 200 to 236 days after herbicide treatments applied to rosettes in the fall (Iowa and Nebraska locations combined). Means with the same lower case letters do not differ ($P < 0.05$, LSD).

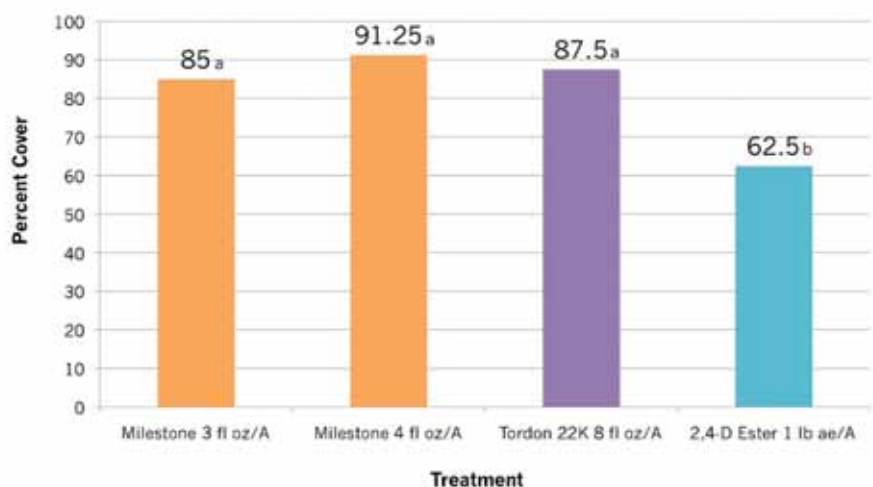


Table 1: Biennial thistle control with several herbicides evaluated 28 to 56 days after application (DAA) to bolting thistle in the spring.

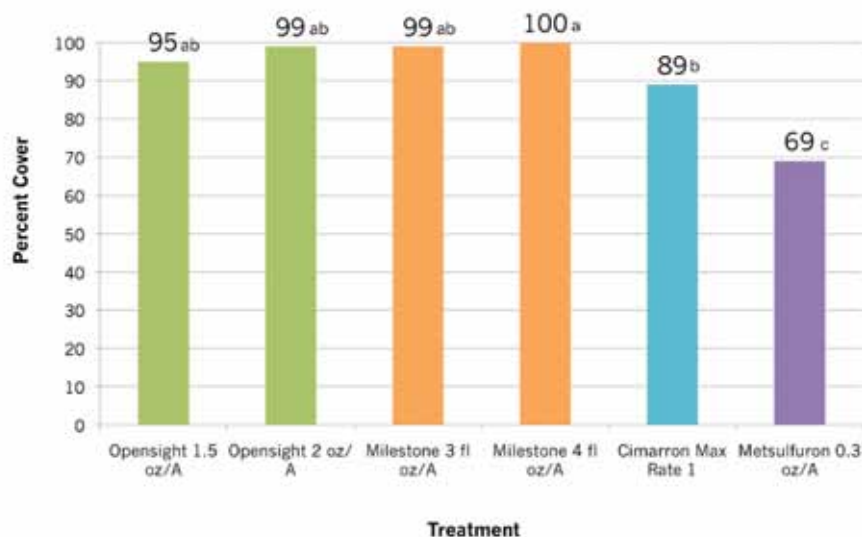
Herbicide Treatment	Application Rate/Acre	Visual Percent Control		
		Musk	Plumeless	Bull
Milestone®	3 fl oz	99 a	-	97 a
Milestone	4 fl oz	100 a	99 a	96 a
Milestone	5 fl oz	100 a	100 a	98 a
Tordon® 22K+2,4-D	1/2 pint+1.0 pint	100 a	97 a	100 a
2,4-D	1.0 quart	78 b	83 b	78 b
Non-treated	-	0 c	0 c	0 c

*Means with the same lower case letters do not differ (P=0.05, LSD)

Table 2: Scotch thistle control with various herbicides at Melbeta, NE evaluated May 30, July 1, and August 25 (25, 55, and 111 days after application).

Herbicide Treatment	Application Rate/Acre	Visual Percent Control		
		5/30	7/1	8/25
Milestone	4 fl oz	97	98	99
Milestone	6 fl oz	97	96	88
Milestone	7 fl oz	97	99	99
ForeFront R&P®	24 fl oz	93	99	98
Transline®	0.5 pint	96	97	94
Tordon 22K+2,4-D	1.0 pint+1.0 pint	97	99	84
Dicamba+2,4-D	1.0 pint+1.0 pint	94	89	66
Non-treated	-	0	0	0
LSD 5%	-	3	9	53

Figure 2: Musk thistle control with various herbicides applied at late bolt to early flower growth stage 90 days after application (2 locations). Means with the same lower case letters do not differ (P<0.05, LSD).



Center in Scottsbluff compared the effectiveness of various herbicides applied post-emergence in the spring for Scotch thistle control. Herbicide treatments were applied on May 5 to Scotch thistle plants at the rosette growth stage. Visual evaluations of Scotch thistle were made following application. In late May and early July, Scotch thistle control with all herbicides was excellent. By late August, Scotch thistle seedlings were emerging in some of the herbicide-treated plots. Results of the data are summarized below and a full report is available in TechLine, Spring 2007 (<http://www.techlinenews.net/ScotchThistle.pdf>).

Integrated Management

Improving the desirable plant community by seeding with competitive grasses or implementing grazing management practices that favor desirable vegetation may be necessary to provide long-term control of biennial thistles. On disturbed sites, integrating the use of herbicides with reseeding and/or with insect biological control agents is likely to decrease biennial thistle populations more effectively than any control method used alone.

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Always read and follow label directions.

Some states require an individual be licensed if involved in the recommendation, handling or application of any pesticide. Consult your local Extension office for information regarding licensing requirements.

ForeFront R&P and Milestone are not registered for sale or use in all states. Contact your state pesticide regulatory agency to determine if a product is registered for sale or use in your state.

State restriction on the sale and use of Opensight and Transline apply. Consult the label before purchase of use for full details. Tordon 22K is a federally Restricted Use Pesticide.

Label precautions apply to forage treated with ForeFront R&P and Milestone and to manure from animals that have consumed treated forage within the last three days. Consult the label for full details. When using Opensight to treat areas in and around roadside or utility rights-of-way that are or will be grazed or planted to forage, important label precautions apply regarding harvesting hay from treated sites, using manure from animals grazing on treated areas or rotating the treated area to sensitive crops. See the product label for details.



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