Canada Thistle Management
In Minnesota Native Prairies

Roger Becker, University of Minnesota
Milt Haar, Badlands National Park
Applied Weed Science Efforts

- **Natural Systems**
  - Purple loosestrife
  - Leafy spurge
  - Garlic Mustard
  - Buckthorn
  - Canada Thistle
  - Prickly Ash
- **Vegetable production**
- **Wild rice**
- **Pasture and Forages**
- **Herbicide x Water Quality Issues**
Ceutorhynchus scrobicollis larvae

Larval Tunnel
Exit plant to pupate

Photos and Slides by: Brian McCornack
Native Prairie Efforts

- **Canada Thistle Work**
  - Seed production/flight
  - Herbicide optimization
  - BMPs for waterfowl production areas
  - Functional Groups
  - Forb tolerance
  - Planned Sequential Program
  - Rotation intervals
    - forage species
    - native grasses and forbs

- **Brome Suppression in Warm Season Prairie**

- **Brush control**
  - (Cottonwood, Aspen, Buckthorn, Prickly Ash)
Brome suppression in warm grass prairies
Buckthorn and Prickly Ash Control

Cottonwood, Boxelder, and Aspen work with Litchfield USFWS
Native Prairie Efforts

- **Canada Thistle Work**
  - Seed production/flight ✓
  - Herbicide optimization
  - BMPs for waterfowl production areas ✓
  - Functional groups that resist invasion ✓
  - Forb tolerance ✓
  - Planned Sequential Program ✓
  - Plantback rotation intervals
    - forage species
    - native grasses and forbs

- **Brome Suppression in Warm Season Prairie**

- **Brush Control**
  - (Cottonwood, Aspen, Buckthorn, Prickly Ash)
The Elusive Holy Grail of Weed Management

- Eradication!
Rusts for biocontrol?
Thistle rust
(Puccinia punctiformis)

Bacteria for biocontrol?
*Pseudomonas syringae*

Check (top left) plus 4 degrees of control
Jurg Hilibrunner
Effect of Wind of direction and distance of Canada thistle dispersal

Elysian 2007

Seeds

Elysian 2007

Pappi

33 km

Achenes per square meter

- 0 - 37.73
- 37.73 - 75.46
- 75.46 - 113.19
- 113.19 - 150.91
- 150.91 - 188.64
- 188.64 - 226.37
- 226.37 - 264.10
- 264.10 - 301.83
- 301.83 - 339.55

Pappi per square meter

- 0 - 83.45
- 83.45 - 165.13
- 165.13 - 246.82
- 246.82 - 328.50
- 328.50 - 410.18
- 410.18 - 491.86
- 491.86 - 573.55
- 573.55 - 655.23
- 655.23 - 736.91
Open (spiral) trapping scheme
Avg. of 8 Site-Years

- Normal
- Shrunken
- Empty
- No seed

Pappus Percentage vs. Radius distance (ft)

- 5 ft
- 10 ft
- 15 ft
- 20 ft
Dilution of seed and pappi as area expands

\[ y = 308.64e^{-0.7998x} \]
\[ R^2 = 0.8926 \]
Put it in the bank

- Seed dispersal local

- Where already endemic or epidemic, avoid heroic control at dispersal time

- Where rare on a landscape scale, be heroic!
Best Management Practices for Canada Thistle in Native Prairies

Roger Becker, Milt Haar
University of Minnesota
Luke Skinner, Mark Gulick*,
Judy Markl, and Dennis Opdahl
Mn DNR. *Now Ia DNR
West Graham WMA

North
WMA BMP Strategies for Canada Thistle Control

BMP 7 - Prevention pre-renovation
BMP 6 - Seed Maturity Delayed Spray
BMP 5 - Nesting Delayed Spray
BMP 4 - Brd. Spray 4, 8, 12, 16 oz Spray/bud
BMP 3 - Spot Cue Delayed Spray
BMP 2 - Mow - Fall Herb.
BMP 1 - Mow - Mow

Herbicide
Non-herbicide

Scout-Spray
Viable Seed
Spot-spray mid-bloom
Post-nesting spray > July 15

Fall spray
Clip

April
July
October
Time of Season
Canada Thistle Carbohydrate Flow
BMP 7 Pre-restoration Management

Shoots emerge
Full bloom
Year 1
Year 2
Year 3
Year 4
Spray fall regrowth
Spray fall regrowth
Seed restoration

Root Carbohydrate Storage (%)

Canada Thistle Carbohydrate Flow
BMP 1 No Herbicide - Clipping

Shoots emerge
Bud stage
Full bloom
Clip @ Full Bloom
Clip Fall Regrowth
Senescence
Canada Thistle Carbohydrate Flow
BMP 4 Spray Pre-Bud (Current Label)

- Shoots emerge
- Bud stage
- Full bloom
- Escapes emerge after application?
- Regrowth via reduced translocation?
- Senescence

Root Carbohydrate Storage (%)
Canada Thistle BMPs in Native Prairies

June C. Thistle Shoots / Acre  Timber Lake USFWS WPA

Canada Thistle BMPs in Native Prairies
June C. Thistle Shoots / Acre West Graham MnDNR WMA

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness  Native Forbs  2004 - 2007  Timber Lake

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness  Exotic Forbs  2004 - 2007  Timber Lake BMP

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness Exotic Grasses 2004 - 2007 Timber Lake

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness Native Forbs 2004 - 2007 West Graham

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness  Exotic Forbs  2004 - 2007 West Graham

Canada Thistle BMPs in Native Prairies

Sept. - Species Richness Exotic Grasses 2004 - 2007 West Graham

Canada Thistle BMPs in Native Prairies

Sept. - Species Abundance    Exotic Forbs    2004 - 2007    Timber Lake

Species Abundance

Canada Thistle BMPs in Native Prairies

Sept. - Species Abundance  Exotic Grasses  2004 - 2007 Timber Lake

Species Abundance

Canada Thistle BMPs in Native Prairies

Sept. - Species Abundance Native Grasses 2004 - 2007 West Graham

Canada Thistle BMPs in Native Prairies

Sept. - Species Abundance  Exotic Forbs  2004 - 2007 West Graham

Canada Thistle Spring Emergence Control
Milestone Transline Sequential Trial, Rosemount MN 2007 - 2009

Product comparisons, oz per acre
All @ 20 GPA, No NIS unless indicated.

Sequential
Non-sequentials
Canada Thistle Fall Regrowth Control
Milestone Transline Sequential Trial, Rosemount MN 2007 - 2009

Product comparisons, oz per acre
All @ 20 GPA, No NIS except one M3 trt.

Sequentialss

Non-sequentials

% Visual Control

0 20 40 60 80 100

Jul-07 Sep-07 Nov-07 Jan-08 Mar-08 May-08 Jul-08 Sep-08 Nov-08 Jan-09 Mar-09 May-09 Jul-09 Sep-09
Lamberton MN Canada Thistle x Burn Study
May 29 2009. Shoot Counts, Heights
(Includes only plots used in trial)

<table>
<thead>
<tr>
<th></th>
<th>counts / 20X20 ft plot</th>
<th>Min ht (in)</th>
<th>Max ht (in)</th>
<th>Avg. Canth / sq yd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Burned</td>
<td>22.6</td>
<td>3.4</td>
<td>7.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Burned</td>
<td>42.5</td>
<td>1.0</td>
<td>3.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

- Spring burn resulted in more C. thistle shoots and delayed maturity
### Lamberton, MN Herbicide x Burn Canada Thistle Control

<table>
<thead>
<tr>
<th>Application Timing</th>
<th>Burn Trt.</th>
<th>n =</th>
<th>Native Grass</th>
<th>Native Forbs</th>
<th>Non Native Grasses</th>
<th>Non Native Forbs w/o CT</th>
<th>Non Native Forbs w/ CT</th>
<th>Canada thistle</th>
<th>Pre 09 dead litter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burned</td>
<td>AVG.</td>
<td>15</td>
<td>348.0</td>
<td>23.6</td>
<td>25.0</td>
<td>1.7</td>
<td>3.7</td>
<td>1.9</td>
<td>0.0</td>
</tr>
<tr>
<td>No Burn</td>
<td>AVG.</td>
<td>15</td>
<td>239.2</td>
<td>14.0</td>
<td>6.1</td>
<td>16.1</td>
<td>17.9</td>
<td>1.8</td>
<td>226.8</td>
</tr>
<tr>
<td>Herbicide Early</td>
<td>AVG.</td>
<td>12</td>
<td>337.6</td>
<td>15.5</td>
<td>12.0</td>
<td>0.7</td>
<td>1.4</td>
<td>0.7</td>
<td>107.8</td>
</tr>
<tr>
<td>Herbicide at Bud</td>
<td>AVG.</td>
<td>12</td>
<td>251.6</td>
<td>22.4</td>
<td>18.8</td>
<td>19.7</td>
<td>22.6</td>
<td>2.9</td>
<td>119.1</td>
</tr>
</tbody>
</table>

*Burn trt. Included checks, Herbicide timing trt. did not. Harvested Sept. 2, 2009

By fall, spring burning increased native grass and forb biomass, more exotic annual grass filling open niches. Canada thistle was not affected.
Put it in the bank

- Think sequentials

- Spring or fall?
  - Spray when fits your operation

- There are over-riding forces at work

- Burn for targets other than thistle
Defining Tolerance of Native Forbs to Herbicides
• Two locations, forb rich native prairies

• Replicated strip trials 30 x 150 ft to pick up less common forbs

• Sprayed in 2006
  • Spring vs. Fall
  • Milestone vs. Transline

• Visual presence-absence, transect counts
  • June and September 1 and 2 YAT
Two Rivers Control
Aug 7 ‘06

Species either missing or not flowering 1 year after treatment

Yellow Prairie Coneflower
Black-eyed Susan
Sunflowers
Native Forbs Tolerance to Milestone vs. Transline Hedquist and Two Rivers WMAs MN Species Richness 2007 Overall Averages

Milestone 2 SL 5 oz./A and Transline 3 SL 10.3 pts./A spring or fall 2006. 30 x 150 ' plots walked in June and Sept 2007 for presence absence ratings.
Native Forbs Tolerance to Milestone vs. Transline
Hedquist and Two Rivers WMAs MN Species Richness
2007 Overall Averages

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Native Forbs Tolerance to Milestone vs. Transline

Hedquist WMA MN  Native Forb Species Richness

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Native Forbs Tolerance to Milestone vs. Transline Two Rivers WMA MN Native Forb Species Richness

Milestone 2 SL 5 oz./A and Transline 3 SL 10.3 pts./A spring or fall 2006. Base plot 30 x 150' walked in 2007 for presence absence ratings.

Avg. No. Forb Species (Pres/Abs)
Native Forbs Tolerance to Milestone vs. Transline Two Rivers WMA MN Native Forb Species Richness

Milestone 2 SL 5 oz./A and Transline 3 SL 10.3 pts./A spring or fall 2006.
Base plot 30 x 150' walked in 2007 for presence absence ratings.
## Native Forbs Tolerance to Milestone vs. Transline

Two Rivers and Hedquist WMAs. MN  
Presence / Absence Data

Number of Observed Differences in Forb Response by Trt.

<table>
<thead>
<tr>
<th></th>
<th>June 20 07</th>
<th></th>
<th>Sept.26/27 07</th>
<th></th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two Rivers</td>
<td>Hedquist</td>
<td>Two Rivers</td>
<td>Hedquist</td>
<td></td>
</tr>
<tr>
<td>Milestone = Transline</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>5.2</td>
</tr>
<tr>
<td>Milestone safer</td>
<td>8</td>
<td>13</td>
<td>7</td>
<td>7</td>
<td>8.8</td>
</tr>
<tr>
<td>Transline Safer</td>
<td>7</td>
<td>13</td>
<td>11</td>
<td>8</td>
<td>9.8</td>
</tr>
<tr>
<td>No. of Species Observed</td>
<td>22</td>
<td>28</td>
<td>21</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

* Milestone 2SL 5 fl oz/A  Transline 3 SL 10.3 fl oz/A
## Native Forbs Tolerance to Milestone vs. Transline

Two Rivers and Hedquist WMAs. MN  
Presence / Absence Data  
Number of Observed Differences in Forb Response by Trt.

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<th>June 20 07</th>
<th>Sept.26/27 07</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two Rivers</td>
<td>Hedquist</td>
<td></td>
</tr>
<tr>
<td>Spring = Fall</td>
<td>6</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Spring safer</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Fall Safer</td>
<td>6</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>No. of Species Observed</td>
<td>22</td>
<td>28</td>
<td>21</td>
</tr>
</tbody>
</table>

* Milestone 2SL 5 fl oz/A  Transline 3 SL 10.3 fl oz/A
Two Rivers  June 26 '06
Transline Spring
Two Rivers  June 26 ’06
Transline Spring
Two Rivers  June 26 '06
Transline 10.3 oz Spring
Two Rivers Control
Aug 7 ‘06

Species either missing or not flowering from spring trt. most evident.

Yellow Prairie Coneflower
Black-eyed Susan
Sunflowers
Black-eyed Susan
Max. Sunflower

Two Rivers Control
Aug 7 ‘06
Sunflowers

False Sunflower (Heliopsis) damaged but not as much
Two Rivers  Sept 5 '06
Milestone 5 oz Spring

Some Max. sunflowers survived but injured
Two Rivers  Sept 5 '06
Milestone 5 oz Spring
West Newton Sand Prairie
Kurt Brownell US Army Corp
Louanne Brooks, Dow AgroSciences
West Newton Project
July 16 '08

• Multiple Spring vs. Fall treatments

• Commerical sprayer, strips across field

• Milestone vs Transline and T.M. of the two
Cow vetch, *Vicia cracca*
Hairy vetch, *Vicia villosa*
West Newton Project,
July 16 '08

Round-headed Bush Clover, M + T (3 + 5 oz) Fall
Fall trt. Sept. 25, 2009. Regrowth (larger) and remaining green shoot tips off orig. 09 shoot emergence (smaller).
June 29, 2010 Kufrin strip trial stage at application
Kufrin strip trial stage June 29, 2010 at application
Fall trt. applied 5 days before on Sept. 25, 2009.
C thistle shoots still with 30 to 45% green tissue.
Note apical areas of shoots / green tissue appear to suppress thistle regrowth shoot number vs. where sprayed or mowed in June
June 2, 2010 Kufrin WPA. Milestone 3 and 5 oz/A 1 YAT.
## Transplanted Forb Tolerance Study
Lamberton, MN  Est. 2007

<table>
<thead>
<tr>
<th>Trt Appl</th>
<th>Timing</th>
<th>Product</th>
<th>Rate/A</th>
<th>9.7.07</th>
<th>5.27.08</th>
<th>6.9.09</th>
<th>6.9.09 % Inj</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summer</td>
<td>Milestone 3 oz</td>
<td>3 oz</td>
<td>3.3</td>
<td>2.9</td>
<td>2.1</td>
<td>24.8</td>
</tr>
<tr>
<td>2</td>
<td>Summer</td>
<td>Milestone 5 oz</td>
<td>5 oz</td>
<td>3.2</td>
<td>2.9</td>
<td>2.1</td>
<td>30.9</td>
</tr>
<tr>
<td>3</td>
<td>Summer</td>
<td>Transline 4 oz</td>
<td>4 oz</td>
<td>3.1</td>
<td>2.8</td>
<td>2.4</td>
<td>16.2</td>
</tr>
<tr>
<td>4</td>
<td>Summer</td>
<td>Transline 10.6 oz</td>
<td></td>
<td>2.9</td>
<td>2.8</td>
<td>1.9</td>
<td>19.0</td>
</tr>
<tr>
<td>5</td>
<td>Summer</td>
<td>Milestone 3 oz+Transline 4 oz</td>
<td>3 oz+4 oz</td>
<td>2.7</td>
<td>2.9</td>
<td>2.0</td>
<td>38.7</td>
</tr>
<tr>
<td>6</td>
<td>Fall</td>
<td>Milestone 3 oz</td>
<td>3 oz</td>
<td>3.3</td>
<td>3.2</td>
<td>2.0</td>
<td>34.6</td>
</tr>
<tr>
<td>7</td>
<td>Fall</td>
<td>Milestone 5 oz</td>
<td>5 oz</td>
<td>3.2</td>
<td>3.1</td>
<td>1.9</td>
<td>38.3</td>
</tr>
<tr>
<td>8</td>
<td>Fall</td>
<td>Transline 4 oz</td>
<td>4 oz</td>
<td>3.0</td>
<td>2.7</td>
<td>2.0</td>
<td>33.7</td>
</tr>
<tr>
<td>9</td>
<td>Fall</td>
<td>Transline 10.6 oz</td>
<td>10.6 oz</td>
<td>2.7</td>
<td>2.7</td>
<td>2.0</td>
<td>40.8</td>
</tr>
<tr>
<td>10</td>
<td>Fall</td>
<td>Milestone 3 oz+Transline 4 oz</td>
<td>3 oz+4 oz</td>
<td>2.7</td>
<td>2.6</td>
<td>1.3</td>
<td>46.3</td>
</tr>
<tr>
<td>11</td>
<td>-</td>
<td>Untreated</td>
<td></td>
<td>3.0</td>
<td>3.0</td>
<td>2.5</td>
<td>14.4</td>
</tr>
</tbody>
</table>

### Avg Across Summer Apps
- Avg. Across Fall Apps

### Untreated 3-Rep Avg.

9.7.09 is fall the year of transplanting, 5.27.09 is spring after overwintered. 6.9.09 is after overwintered after herbicide applied.
<table>
<thead>
<tr>
<th>Timing</th>
<th>Rate</th>
<th>Counts (4 max)</th>
<th>% GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer - Milestone n=6</td>
<td>3, 5 oz/ac</td>
<td>2.6</td>
<td>28.1</td>
</tr>
<tr>
<td>Fall - Milestone n=6</td>
<td>3, 5 oz/ac</td>
<td>2.1</td>
<td>44.8</td>
</tr>
<tr>
<td>Summer - Transline n=6</td>
<td>4, 10.6 fl oz/ac</td>
<td>2.8</td>
<td>20.3</td>
</tr>
<tr>
<td>Fall - Transline n=6</td>
<td>4, 10.6 fl oz/ac</td>
<td>2.9</td>
<td>22.3</td>
</tr>
<tr>
<td>Control n=3</td>
<td></td>
<td>2.9</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- Cnts (Counts) 4 transplant species per plot planted one foot apart
- Inj (Injury) is % Growth Reduction and growth regulator deformities
Minnesota Rankings for Native Forb Tolerance to Aminopyralid and Clopyralid Herbicides

This table reflects estimates of native forb tolerance to aminopyralid (Milestone VMP) and clopyralid (Transline®) based on field observations. Generally speaking, native forbs tolerated these herbicides better with spring applications compared to fall applications. If viable seed were present in the seedbank, neither herbicide prevented seedlings of susceptible species from establishing the growing season following herbicide application. These rankings reflect our experiences as of Fall 2006 and will be updated as more data becomes available.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Aminopyralid</th>
<th>Clopyralid</th>
<th>Family</th>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota Rankings for Native Forb Tolerance to Aminopyralid and Clopyralid Herbicides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key:
- **T = Tolerant:** Minimal symptoms - may result in slight cupping but less than 15% injury. Occasionally may inhibit flowering.
- **M = Moderate Tolerance:** Symptoms include cupping, yellowing, and twisted stems. Often will inhibit flowering. Plants may be stunted. May recover with recovery of surviving plants the following season after application.
- **M - S = Moderate to Susceptible:** Severity of response has been variable ranging from moderately tolerant to susceptible depending on environmental, plant age, and site characteristics.
- **S = Susceptible:** Injury greater than 75%. Injury can be severe. May kill established plants. Sensitive plants have been shown to reestablish from seedings if an adequate seedbank is present early in the growing season after application.

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September 2006  M. Decker and M. Miser, University of Minnesota
Canada Thistle - Tolerance Conclusions

• Many native forbs tolerate Transline (clopyralid) or Milestone VM (aminopyralid) applied spring or fall

• Spray at timings to fit most limiting factor which may be labor, etc. - things other than tolerance

• Transline an edge on forb tolerance, Milestone an edge on Canada thistle efficacy
Canada Thistle - Tolerance Conclusions

- Flowering and seed production may be reduced or eliminated during the treatment season(s) for many forbs.
- Notable exceptions - Helianthus, Rudbeckia, Ratibida are severely injured or killed.
- Seem to be re-establishing from the seed bank or from the few survivors.
Put it in the bank

- If need to spray, spray when it works for you

- Many species survive
  - Will interrupt flowering so looks can be deceiving

- They will come back
Special thanks to:

MnDNR: Luke Skinner and Laura Van Riper, (Mark Gulick), Judy and Randy Markl, Dennis Opdahl

USFWS: JB Bright

MnDOT: Bob Jacobson

Dow AgroSciences: Mary Halstvedt, Louanne Brooks