Integrating Herbicides, Fertilization, and Rotational Grazing for Weed Management in Pastures

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Gateway Research
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Presentation Summary

- Integrated Canada thistle control in pasture
- Importance of rotational grazing in optimizing weed control and forage production
- Role of legumes in optimizing forage production in pastures
CASE STUDY:
Managing Canada Thistle in Pasture
Using Integrated Pest Management
Canada Thistle (*Cirsium arvense* L.)

- **Canada thistle (CT)** is a deep-rooted, long-lived perennial weed.

- Spreads primarily through an extensive creeping root system.

- Generally low palatability to livestock.

- Found across nearly 10,000,000 km2 in North America.
Market surveys indicate CT ranks as the #1 weed among farmers on pasture land in western Canada.

CT is a “Noxious” weed, indicating that by law, it must be prevented from spreading.
Canada Thistle Impacts in Perennial Pastures
Traditional Weed-Based Research: Yield Loss Assessments

Found significant negative relationships at 6 of 8 Yield Loss Assessment sites.

Removal of competition from CT led to subsequent forage yield gains.
Yield Loss Assessments

Yield losses peaked at a ratio of:
2 kg/ha forage lost for EACH 1 kg/ha CT
SEM Modelling Shed Unique Insight into Weed Impacts

A) Lake Isle

LI: High resources led to minimal competition “CT = passenger”

B) Parkland

PCF: Low resources led to high competition “CT = driver”
Appearances Can Be Deceiving …
(Initial CT Infestation Was Lower at Lake Isle!)
Traditional Weed-Based Research: Herbicide Efficacy Trials
Grazon – 3.7 L/ha
Herbicide Broadcast Spraying
(CT Biomass: 2 Months After Treatment)

- Treat ($p<0.001$)
- Fert ($p=0.60$)
- Treat*Fert ($p<0.001$)

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Biomass (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazon</td>
<td>Unfertilized</td>
</tr>
<tr>
<td>Lontrel</td>
<td>Fertilized</td>
</tr>
<tr>
<td>Dyvel DS</td>
<td>CD</td>
</tr>
<tr>
<td>2,4-D</td>
<td>BC</td>
</tr>
<tr>
<td>Mow</td>
<td>B</td>
</tr>
<tr>
<td>Check</td>
<td></td>
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</tbody>
</table>

A
Untreated Lontrel - 0.6 L/ha
Herbicide Broadcast Spraying
(CT Density: 2 Years After Treatment)

- Grazon
- Lontrel
- Dyvel DS
- 2,4-D
- Mow
- Check

# / m²

Fertilized
Unfertilized

Treat (p < 0.001)
Fert (p < 0.001)
Treat*Fert (p < 0.01)

C
C
B
B
A
A

* * * *
2,4-D ester – 2.5 L/ha

Fertilized

Unfertilized

Untreated
Herbicide Broadcast Spraying
(Forage Response: 1 Year After Treatment)

![Bar graph showing biomass response to herbicides with fertilization.](chart.png)

- **Biomass (kg/ha)**
  - **Fertilized**
  - **Unfertilized**

- Treatments: Grazon, Lontrel, Dyvel DS, 2,4-D, Mow, Check
- **Fertilized** (A, A, A, A)
- **Unfertilized** (B, B)

- Treat (p < 0.001)
- Fert (p < 0.001)
- Treat*Fert (p = 0.34)
What About Legume Sensitivity to Herbicide?
(Even very low levels impede legumes: <15% of RR)

** Similar effect of aminopyralid and aminocyclopyrachlor **

St. Albert Alfalfa Response

** Similar effect of aminopyralid and aminocyclopyrachlor **
Herbicide Effects on Legumes Evident up to 26 Months after Spraying in Long-Term Studies

A chart showing legume biomass (g m\(^{-2}\)) over time (MAT) from 2 MAT to 26 MAT. The legend indicates two treatments: 0x and 1x, with different symbols and letters (a, b, A, B, ab, B) indicating statistical significance.
Herbicide Wiping Trials
Herbicide Wiping Trials

33% Roundup Check
Wiping Trials
(Thistle Response: Treatment in 2000)

Thistle Density (#/m²)

- Grazon
- Lontrel
- Dyvel DS
- Roundup
- Check

2000 2001 2002

2000

2001

2002

Thistle Density (#/m²)
Wiping Trials
(Grass Response: 1 & 2 Years After Treatment)

Grass Biomass (kg/ha)

- Grazon
- Lontrel
- Dyvel DS
- Roundup
- Check

2001 (n=3)

- a
- p=0.05

2002 (n=2)

- p=0.79

Note: a and b indicate significance levels for different treatments.
Can Rotational Grazing Influence Pasture Weeds?
Basic Mechanisms of Herbivory Affecting Pasture Composition

- **Direct:** Loss of biomass and vigor in defoliated plants + Associated environmental changes

- **Indirect:** Competitive shifts through time in favor of non-defoliated plants

- Actualized Vegetation Changes = \( \text{Direct + Indirect Effects} \)
“Management Intensive” Rotational Grazing

Are all rotational systems equal in balancing forage growth and pasture sustainability?
PHASE 1:

TEST Indirect Role of Defoliation in Regulating Weed Abundance (i.e. interspecific competition effects)

Clipping Study:
Selective defoliation of non-thistle herbage at different intensities & frequencies.
Defoliation Regimes ‘Simulated’ Various Rotational Grazing Systems

Fertilized & Unfertilized Treatments - exposed to one of the following defoliation (i.e., simulated grazing) treatments:

- **Continuous** – Defoliate forage all summer every 2 weeks at 2 cm stubble height, beginning mid-May
- **Short Duration** – Defoliate forage every 2 weeks at 10 cm stubble height
- **HILF** – Defoliate forage every 6 weeks at 2 cm height
- **Deferred** – Defoliate forage once at peak biomass (mid-August) after growing uninterrupted all year
Accumulated Forage Biomass (kg/ha) Harvested Under Various Defoliation Treatments (Intensity + Frequency)
CT Biomass (kg/ha) & Shoot Density (#/m² x 10) Under Various Defoliation Treatments (Intensity + Frequency)
PHASE 2:

TEST Direct Impact of Controlled Cattle Grazing in Regulating Weed Abundance

Grazing Trials:
Comparing continuous, HILF, and SD systems at 4 locations in central Alberta (2000-2002).
HILF Paddock Shortly After Grazing
(70-80% utilization / grazing period)
Year-End CT Density Among Treatments During 3 Successive Years

CT Density (no.∙m⁻²)

Year One
Year Two
Year Three

- Continuous
- SD
- HILF

Legend:

- a
- b
- c

Significant differences are indicated by different letters.
Comparison of HILF (left) and SD (right) Grazing Treatments (Site 1)
CT Declined, But Why?

Trampling ←
(due to high cattle densities)

Defoliation →
(forced consumption of CT)
Grass, Forb and CT Biomass Removed by Cattle Among Grazing Treatments
CT Shoot Density and Grass Biomass in 2003, One Year After Rotational Grazing Treatments Ceased

![Bar graph showing CT Density and Grass/100 for different treatments: Cont, SD, and HILF.](image)
Comparison of CT Growth Staging Among Grazing Treatments

Proportion of thistle in various growth stages in August 2002.

- Rosette
- Bolt to Bud
- Flowering to Fluff

Comparison of CT Growth Staging Among Grazing Treatments

Proportion of thistle in various growth stages in August 2002.
Grazing Provides Another Important CT Control Option
What Amount of Legume at Seeding Optimizes Protein Yield?

As little as 22% legume at seeding maximized CPY in grass-legume mixes.
Legume Retention in Mixed Forage Swards
(Contributions of legume converged to ~1/4 of stand)
General Conclusions

- Canada thistle reduces pasture yields, particularly in high resource competition environments.

- Combining herbicides with fertilization provided effective thistle control, while fertilization alone increased the weed.

- Residual herbicide effects can last up to 26 months.

- Specialized grazing systems can increase forage production while controlling Canada thistle.

- Although eradication is unlikely, integrated practices can keep thistle at tolerable levels.
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