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

**Dr. Edward W. Bork**

***Professor, Rangeland Ecology & Management***

**AFNS Dept., University of Alberta**

**Gateway Research**

**Feb. 24, 2016**

# 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.

# Canada Thistle Management - Background

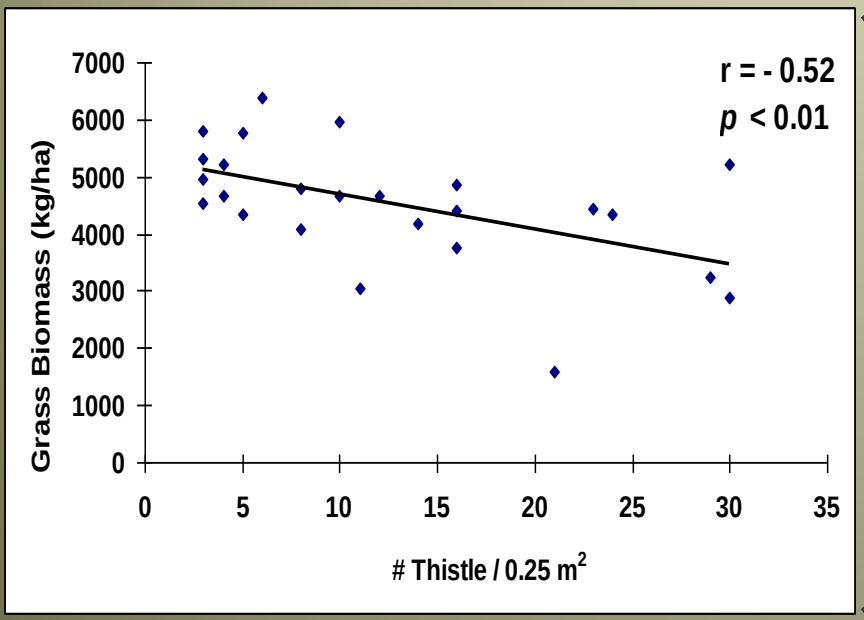
- Market surveys indicate CT ranks as the #1 weed among farmers on pasture land in western Canada

- CT is a “Noxious” weed, indicating that by law, it must be prevented from spreading

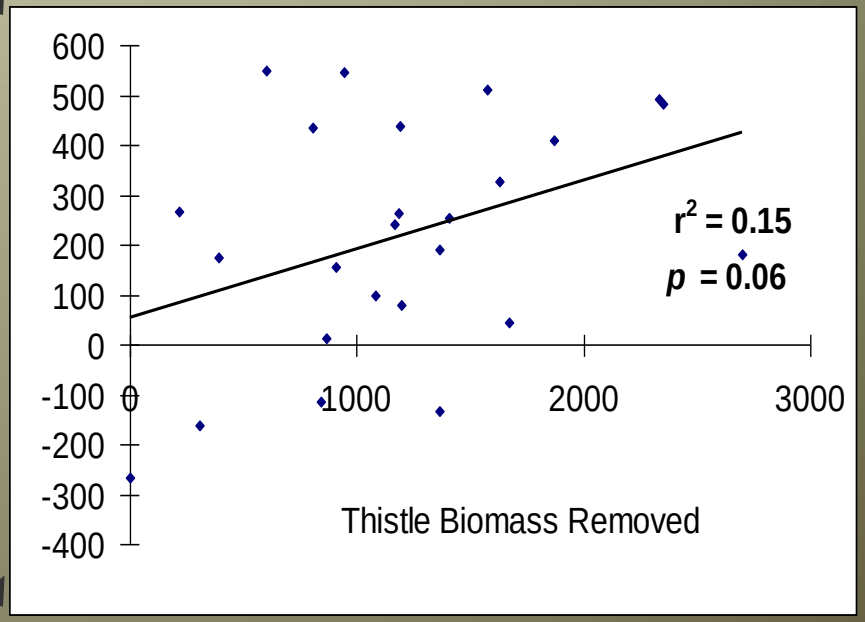
# Canada Thistle Impacts in Perennial Pastures

# 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**

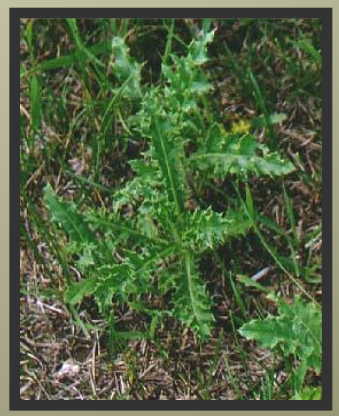


# Yield Loss Assessments

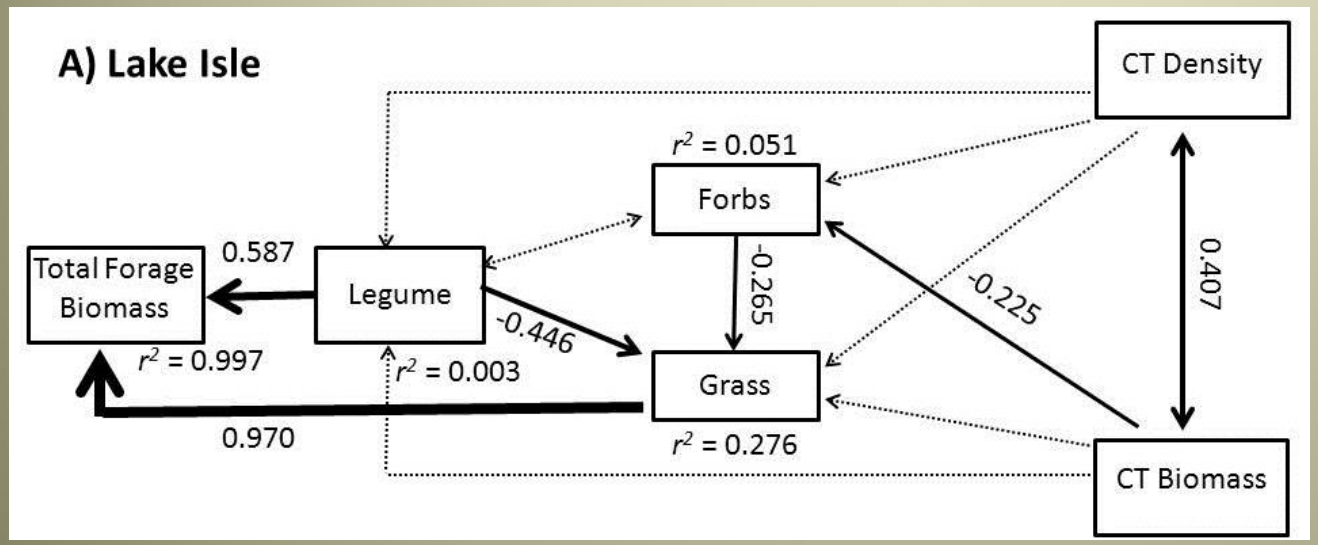
**Yield losses peaked at a ratio of:**

**2 kg/ha forage lost for *EACH* 1 kg/ha CT**



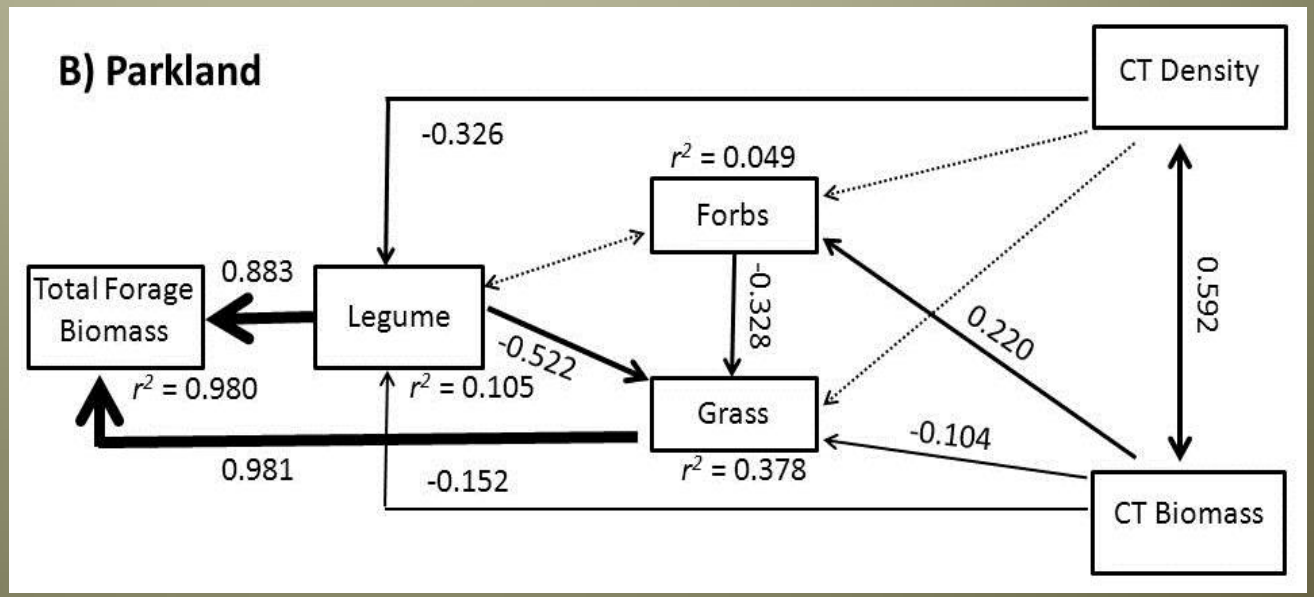


# SEM Modelling Shed Unique Insight into Weed Impacts



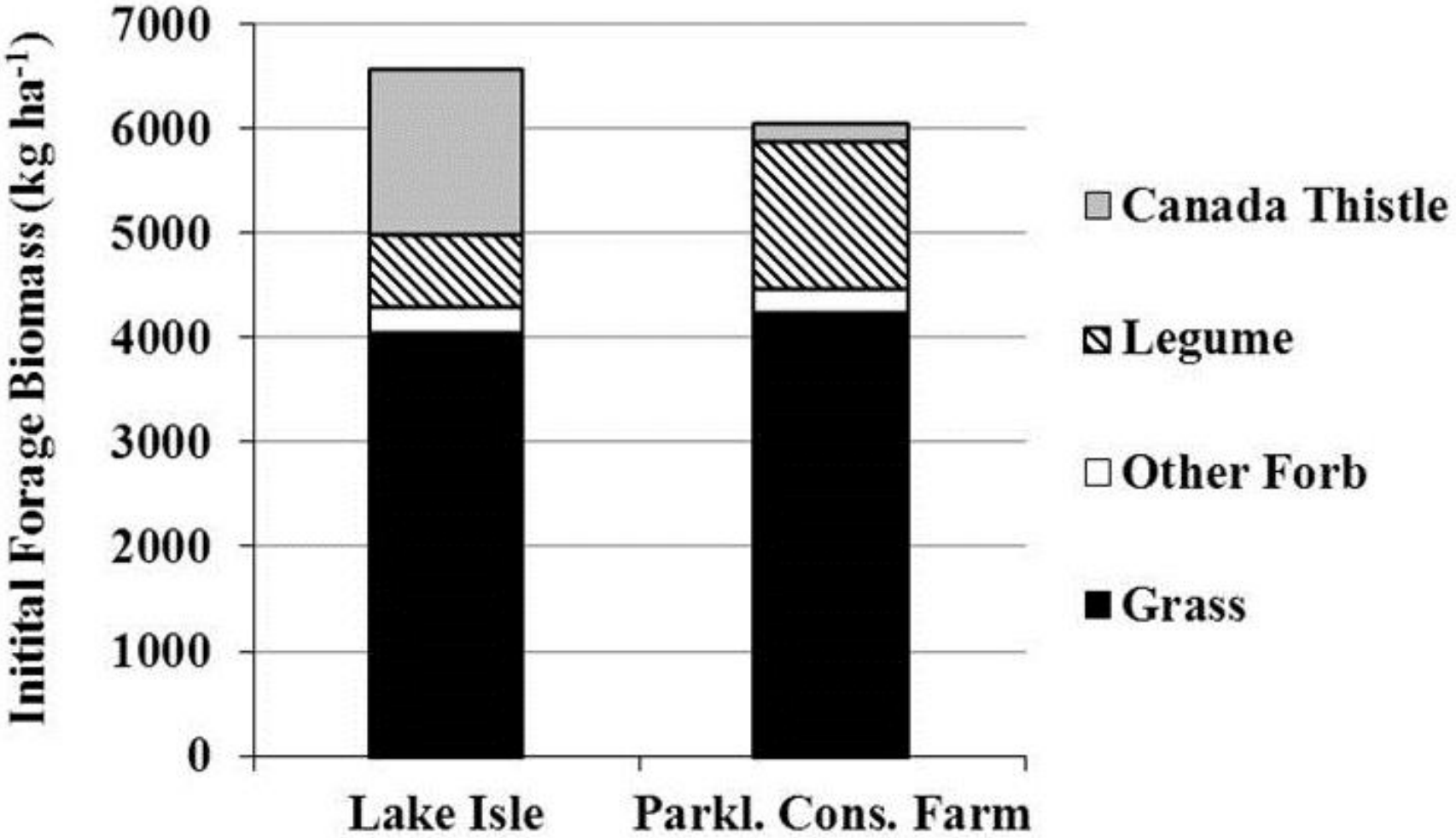

**LI: High resources led to minimal competition**
***"CT = passenger"***

**PCF: Low resources led to high competition**
***"CT = driver"***



# Appearances Can Be Deceiving …

## (Initial CT Infestation Was Lower at Lake Isle!)

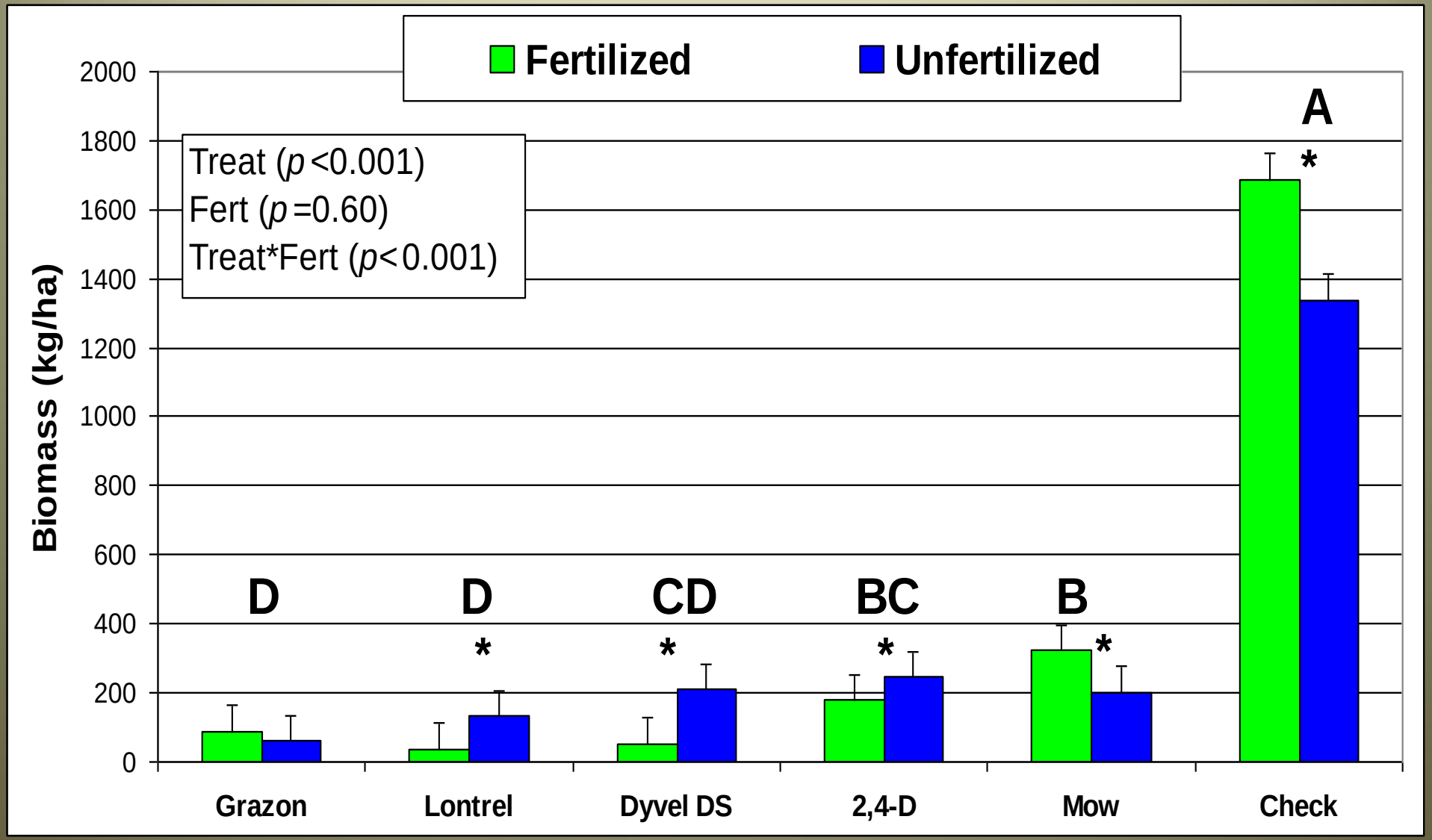


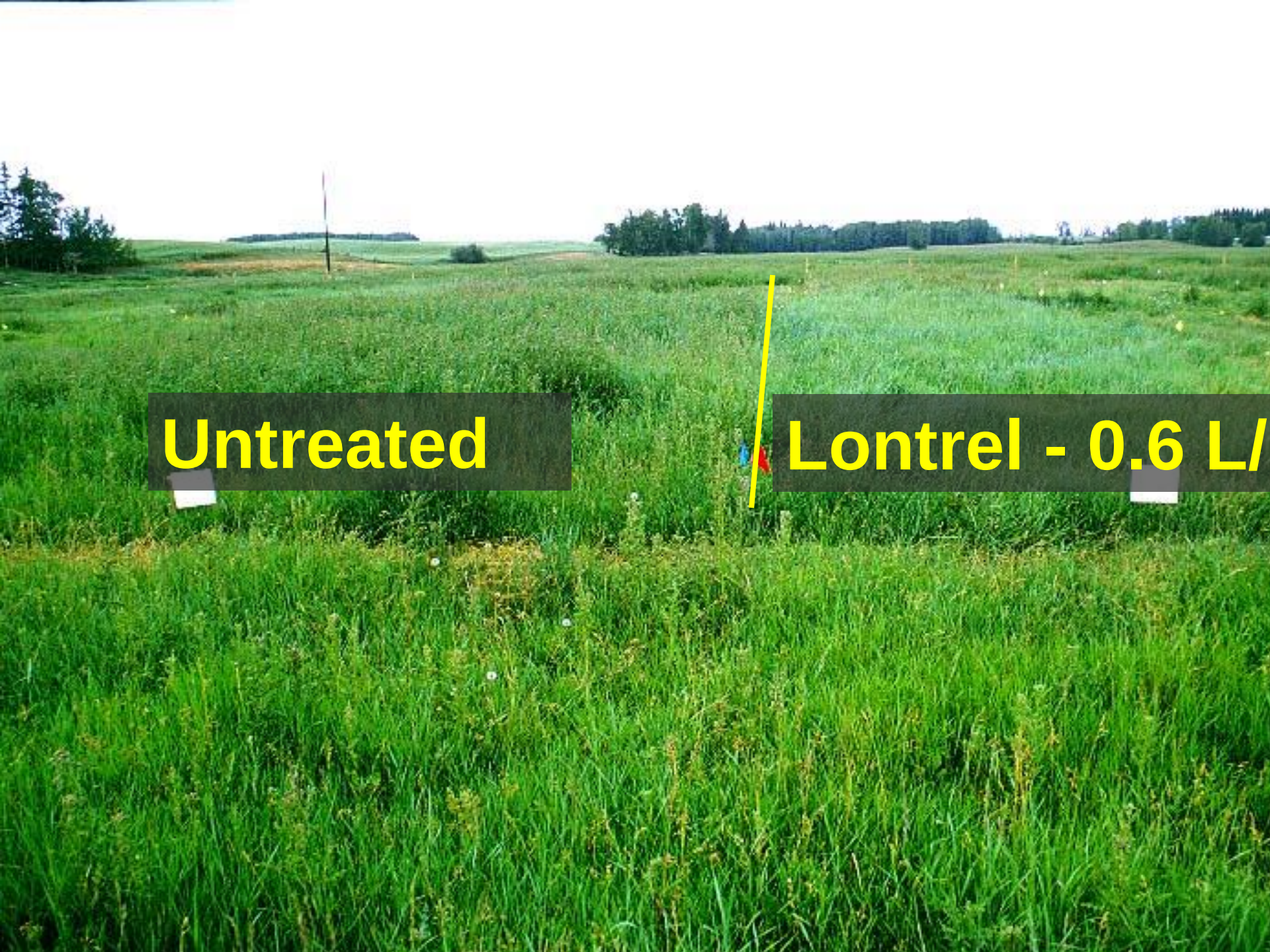
# Traditional Weed-Based Research: Herbicide Efficacy Trials


Unfertilized
Fertilized
Grazon – 3.7 L/ha

# Herbicide Broadcast Spraying

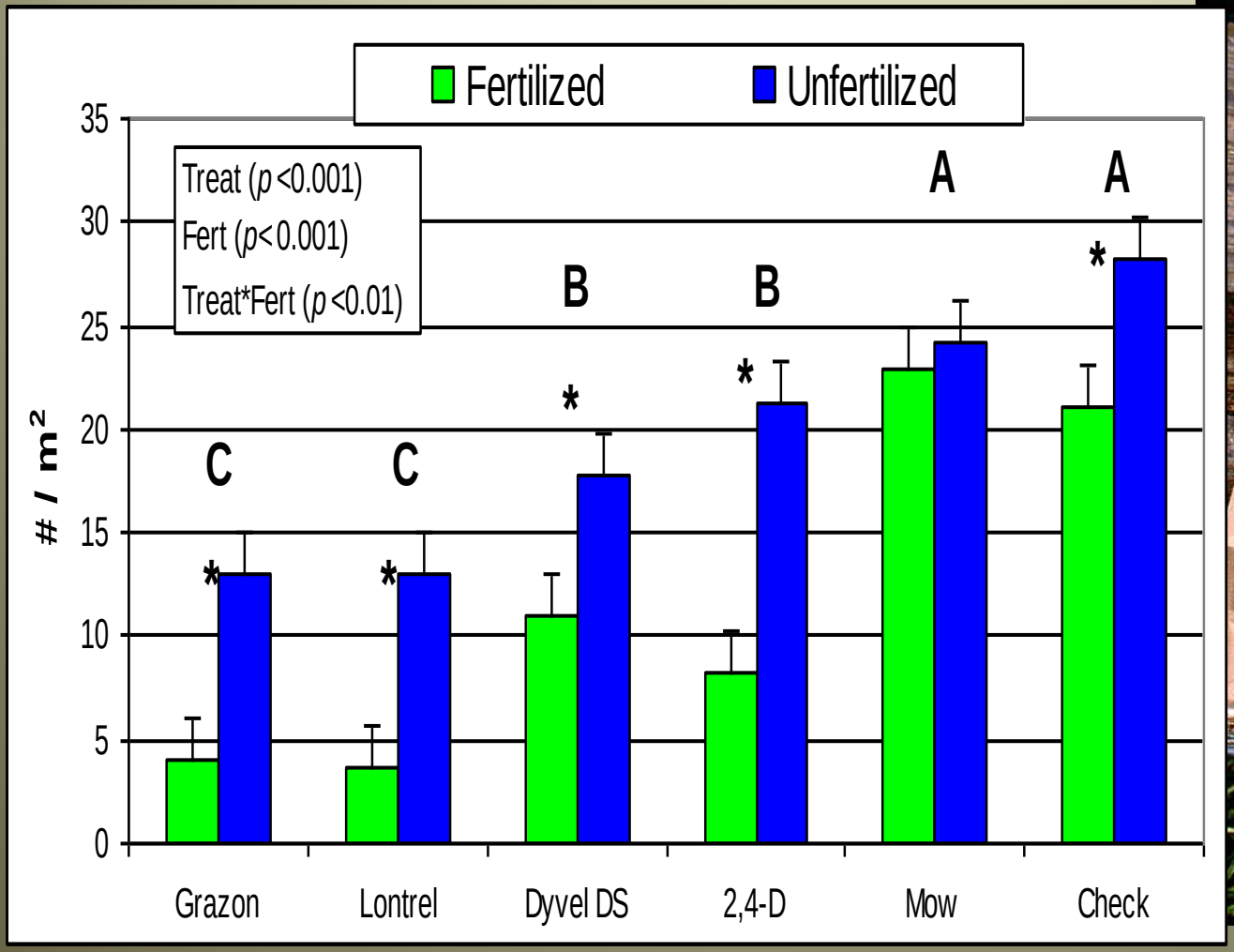
## (CT Biomass: 2 Months After Treatment)

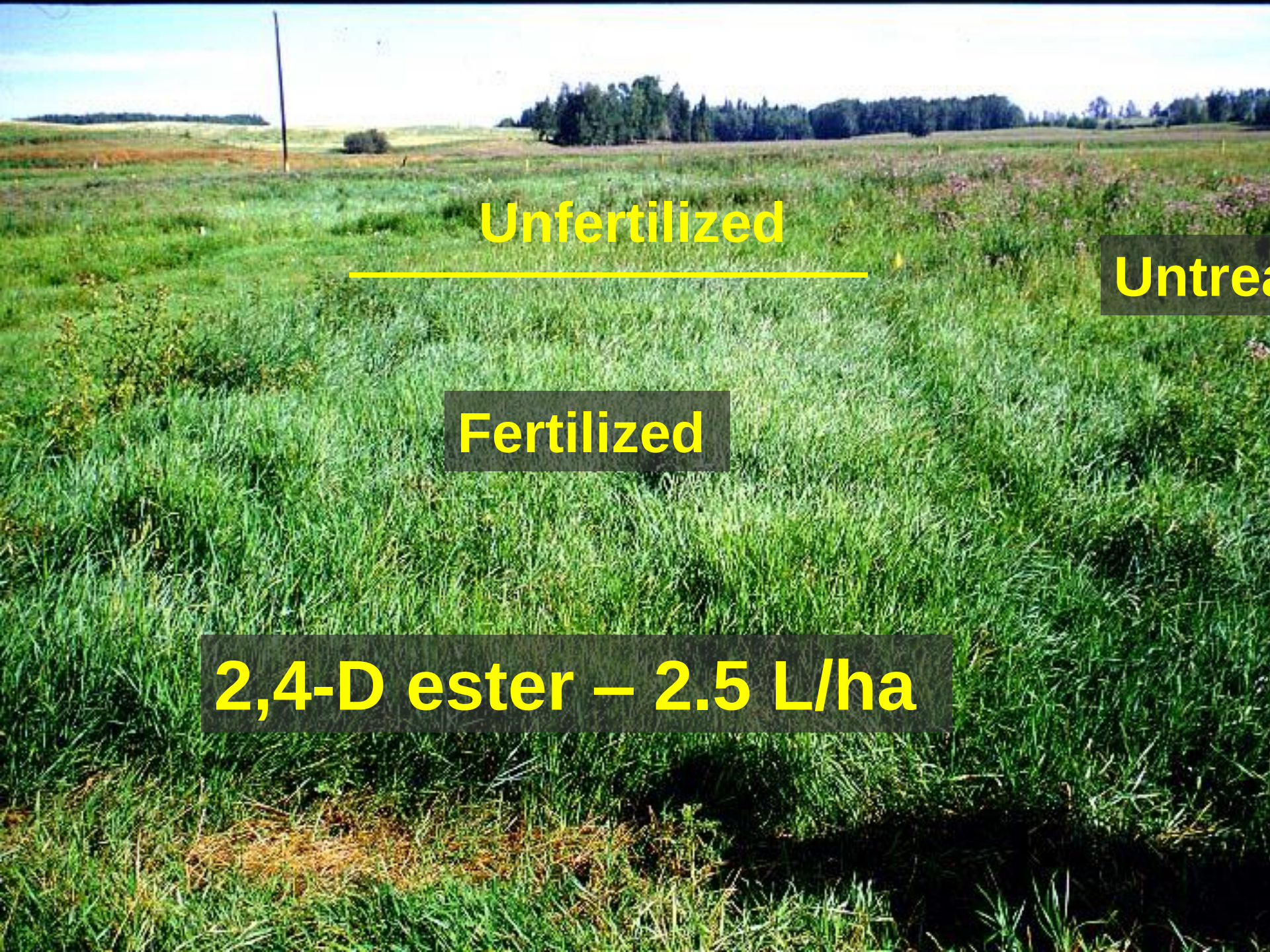



Untreated
Lontrel - 0.6 L/

# Herbicide Broadcast Spraying

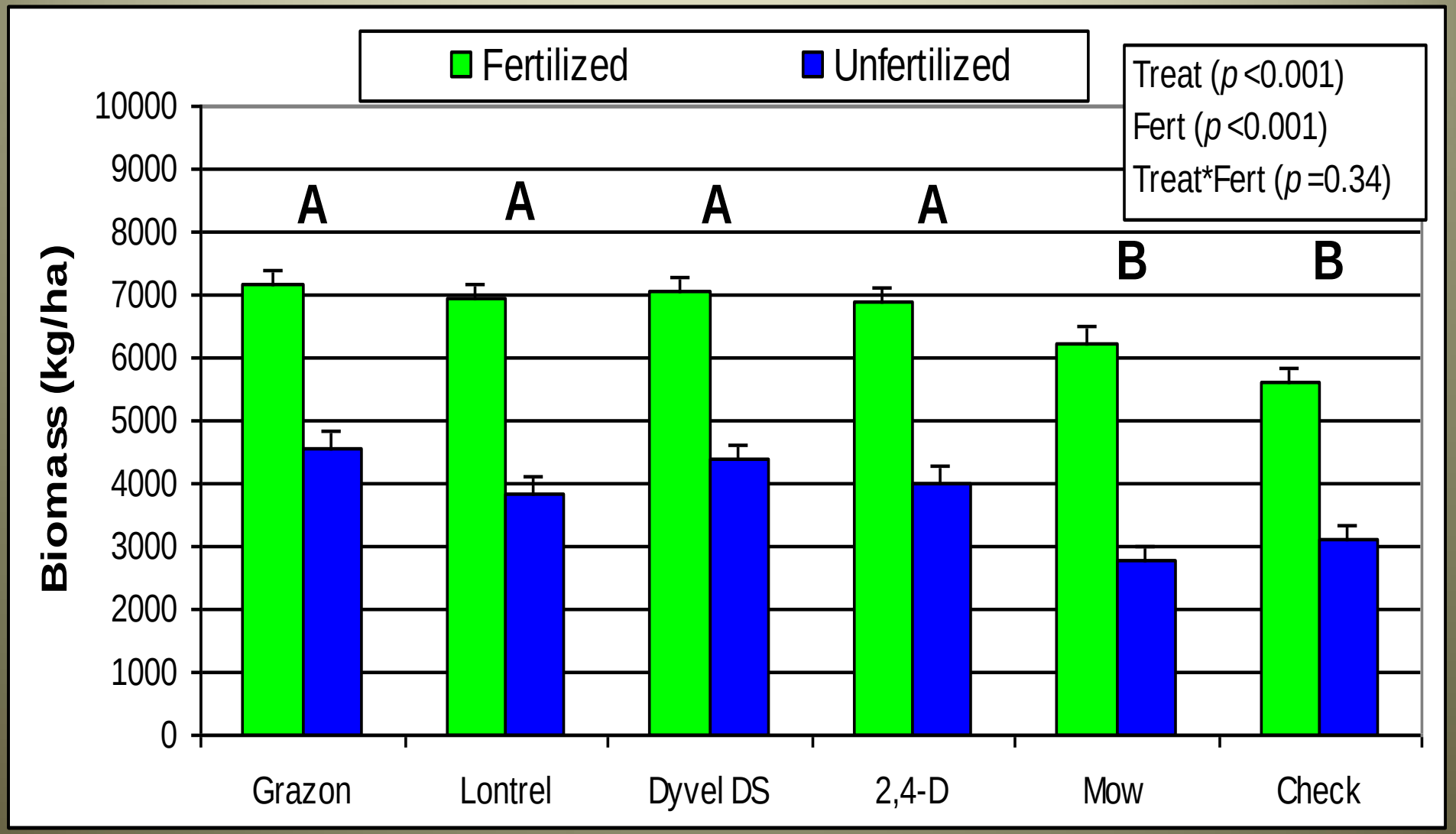
## (CT Density: 2 Years After Treatment)





Unfertilized
Untrea
Fertilized
2,4-D ester – 2.5 L/ha

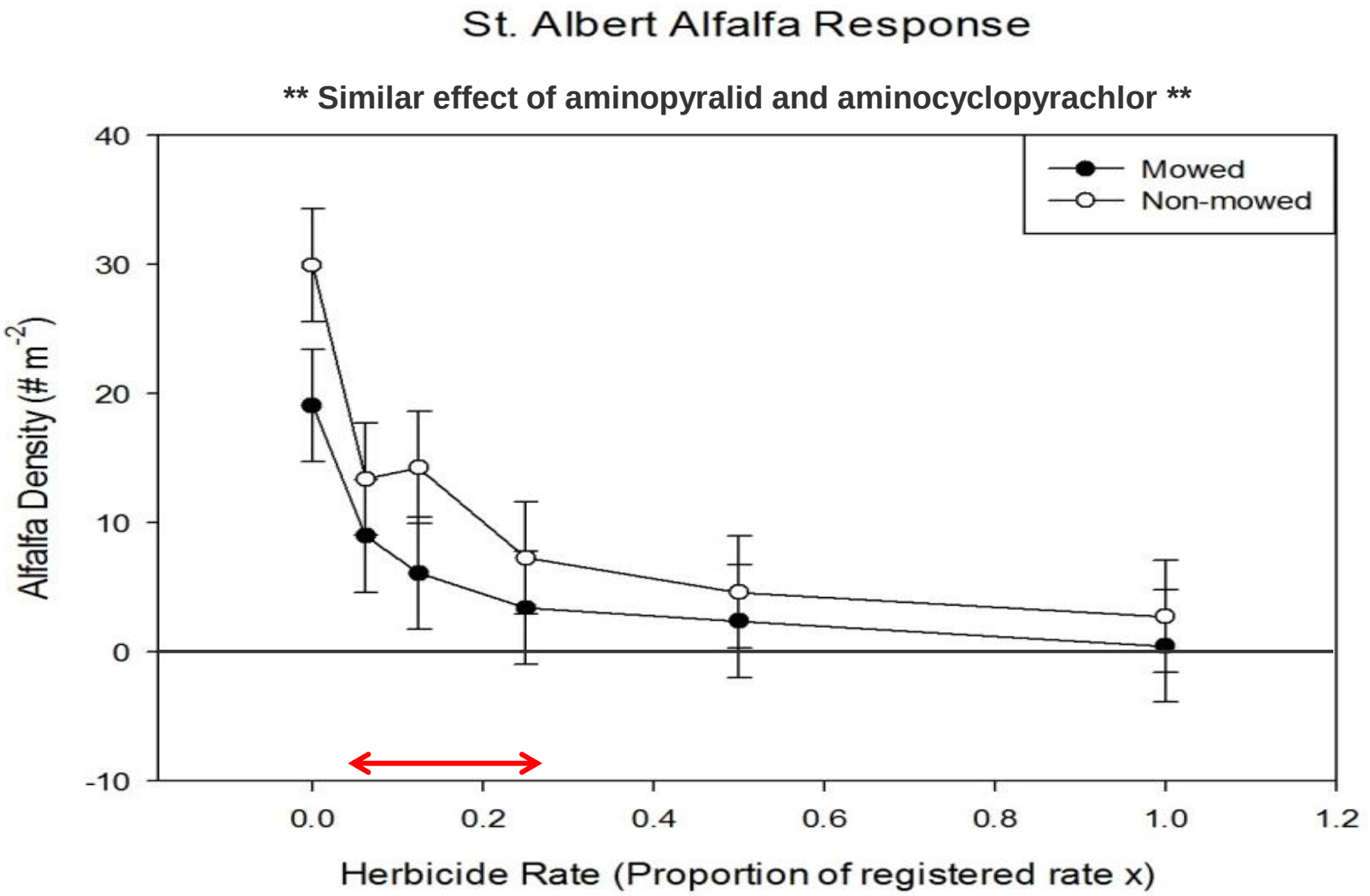
# Herbicide Broadcast Spraying

## (Forage Response: 1 Year After Treatment)

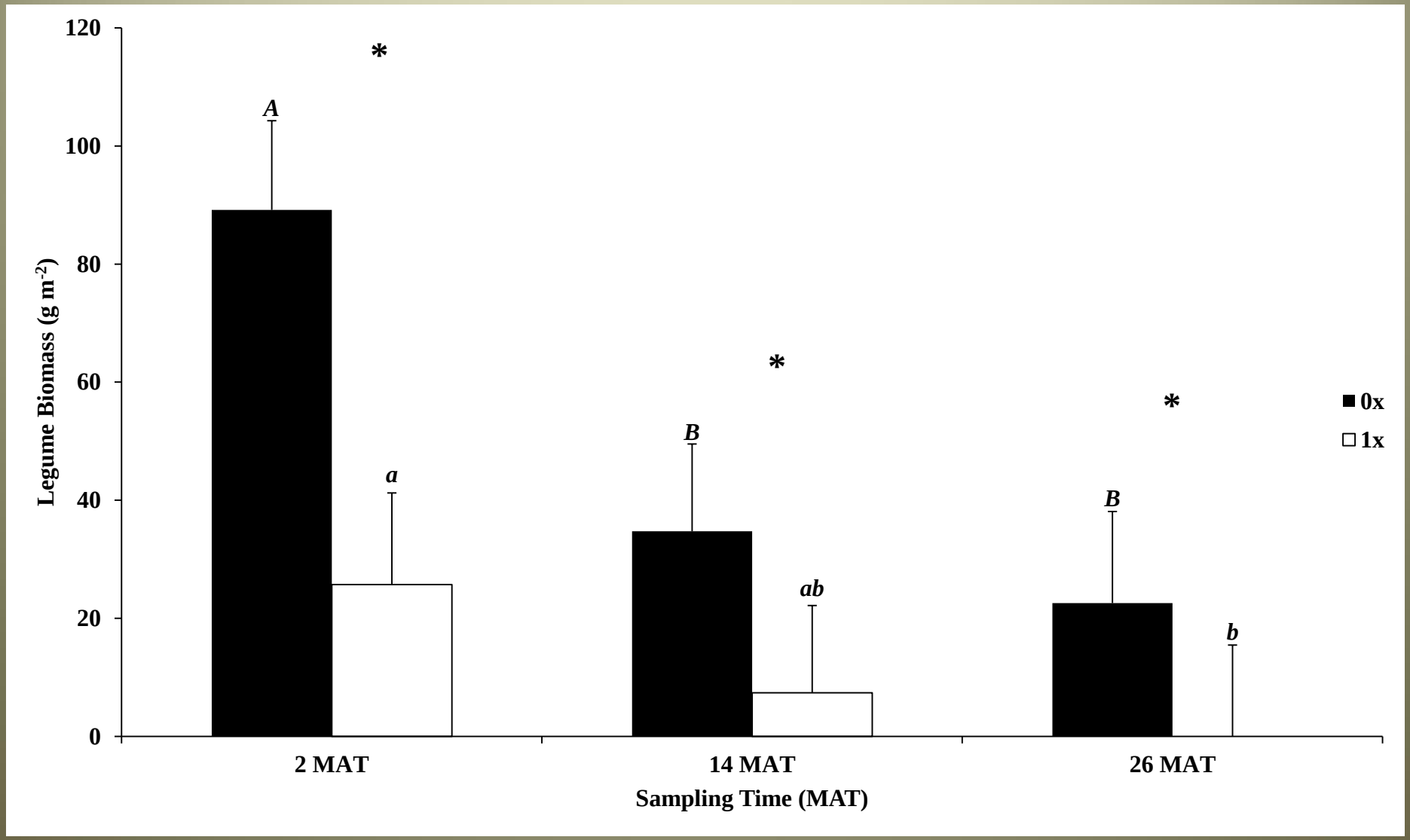


# What About Legume Sensitivity to Herbicide?

## (Even very low levels impede legumes: <15% of RR)

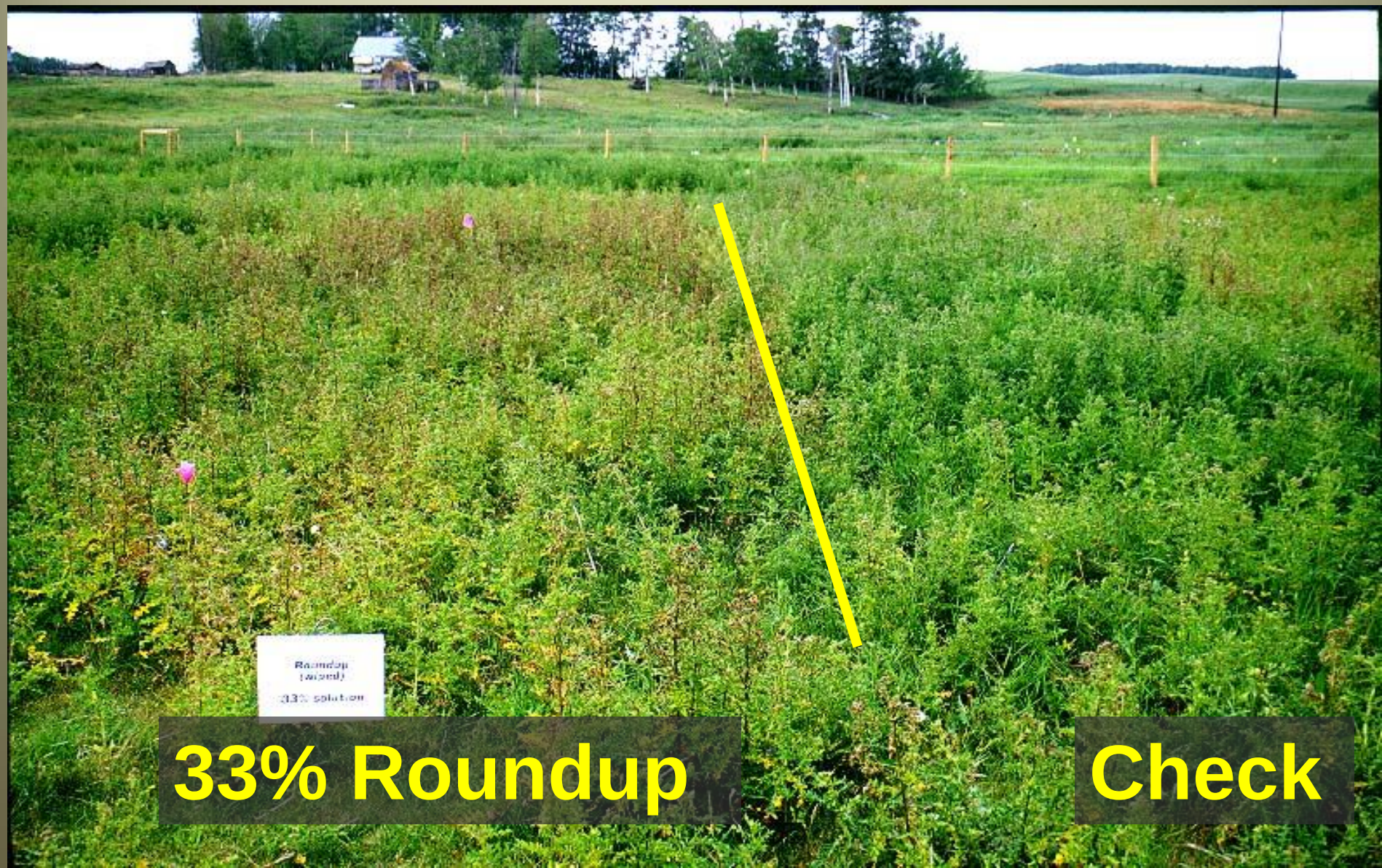


# Herbicide Effects on Legumes Evident up to 26 Months after Spraying in Long-Term Studies



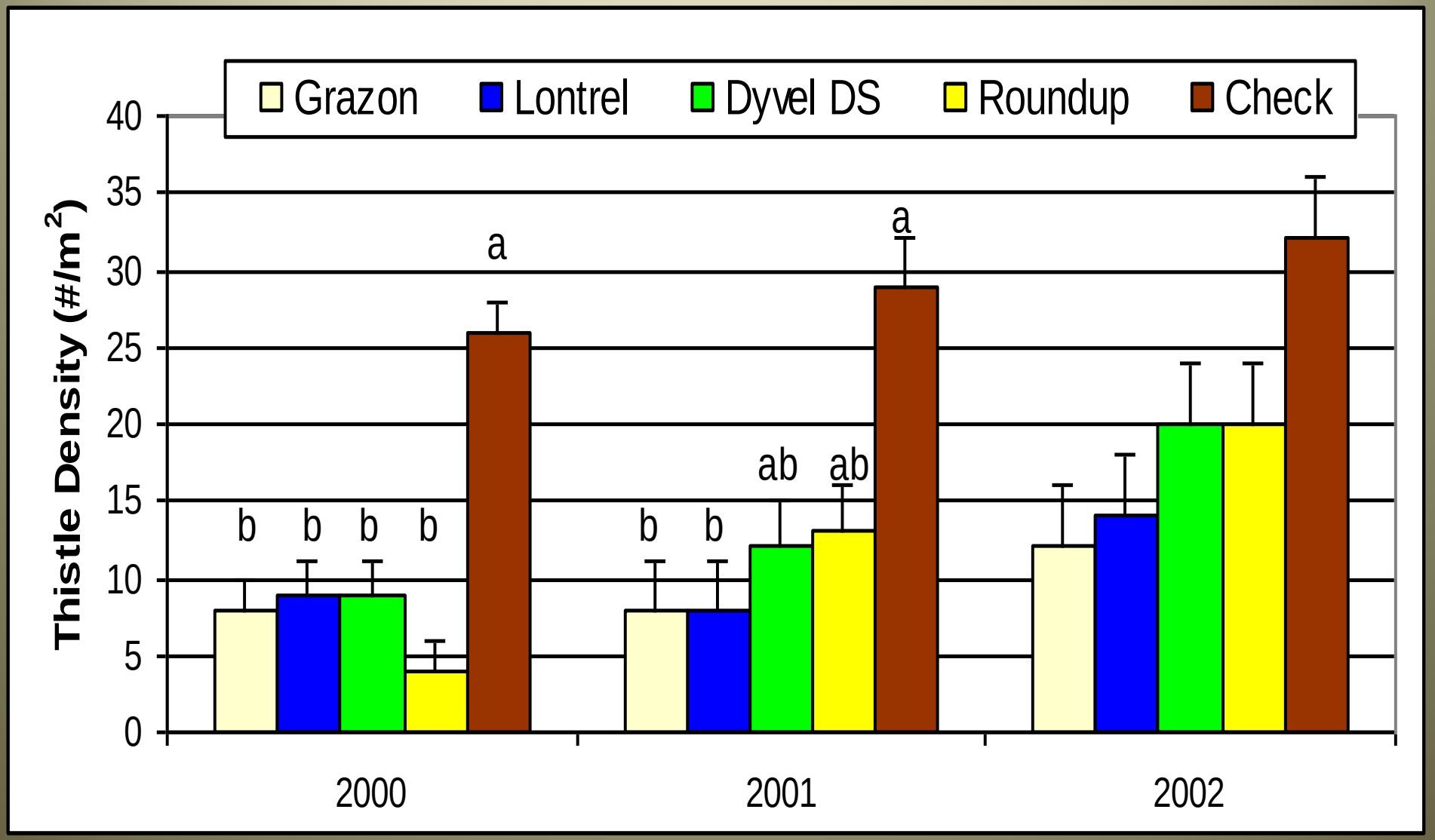
# Herbicide Wiping Trials

# Herbicide Wiping Trials



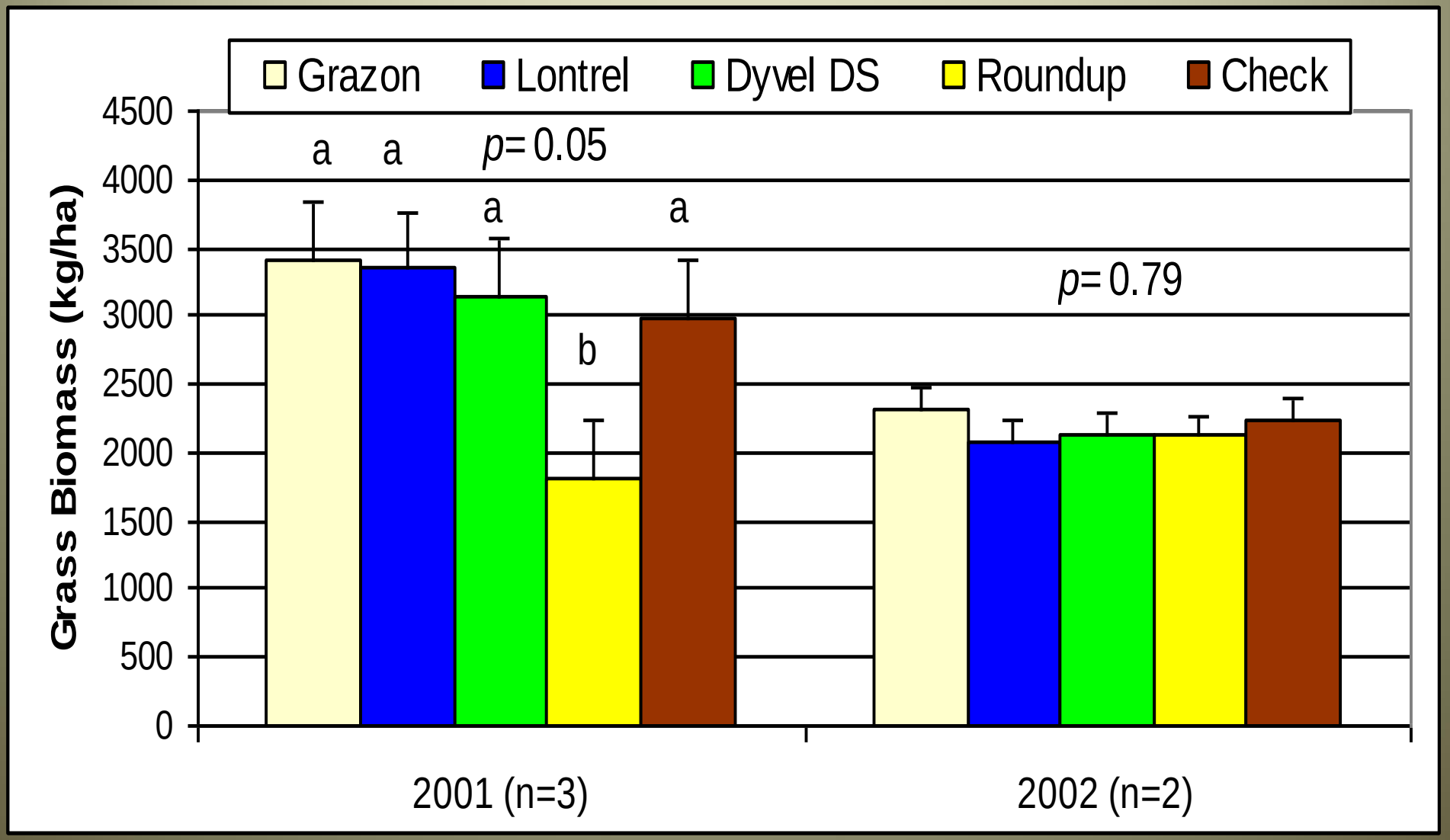
# Wiping Trials

## (Thistle Response: Treatment in 2000)



# Wiping Trials

## (Grass Response: 1 & 2 Years After Treatment)



# Can Rotational Grazing Influence Pasture Weeds?

# ***Basic Mechanisms of Herbivory Affecting Pasture Composition***

- **Direct: Loss of biomass and vigor in defoliated plants**

  **+**

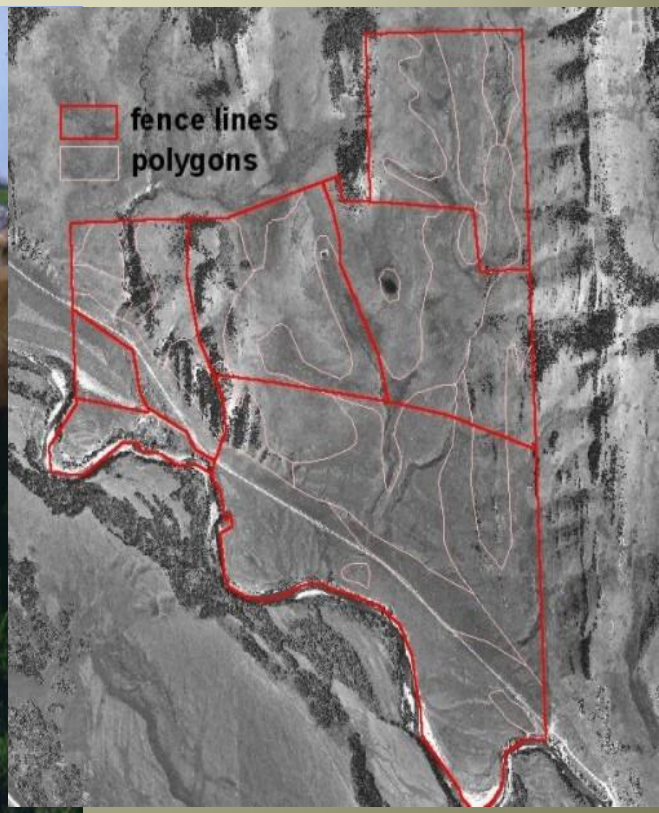
  **Associated environmental changes**

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

- **Actualized Vegetation Changes =**

  ***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:

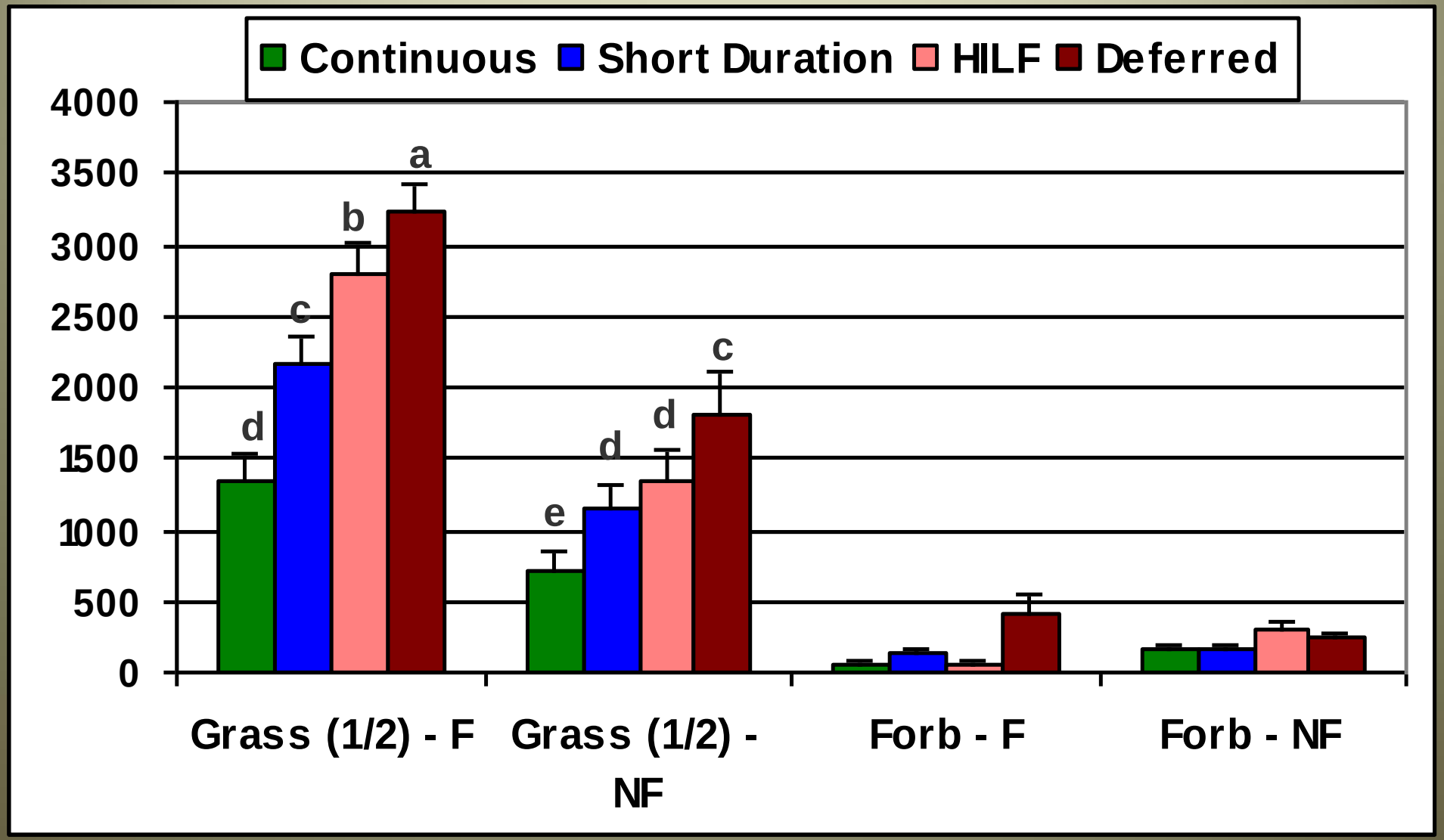
**Selective defoliation of non-thistle herbage at different intensities & frequencies.**

# Defoliation Regimes 'Simulated' Various Rotational Grazing Systems

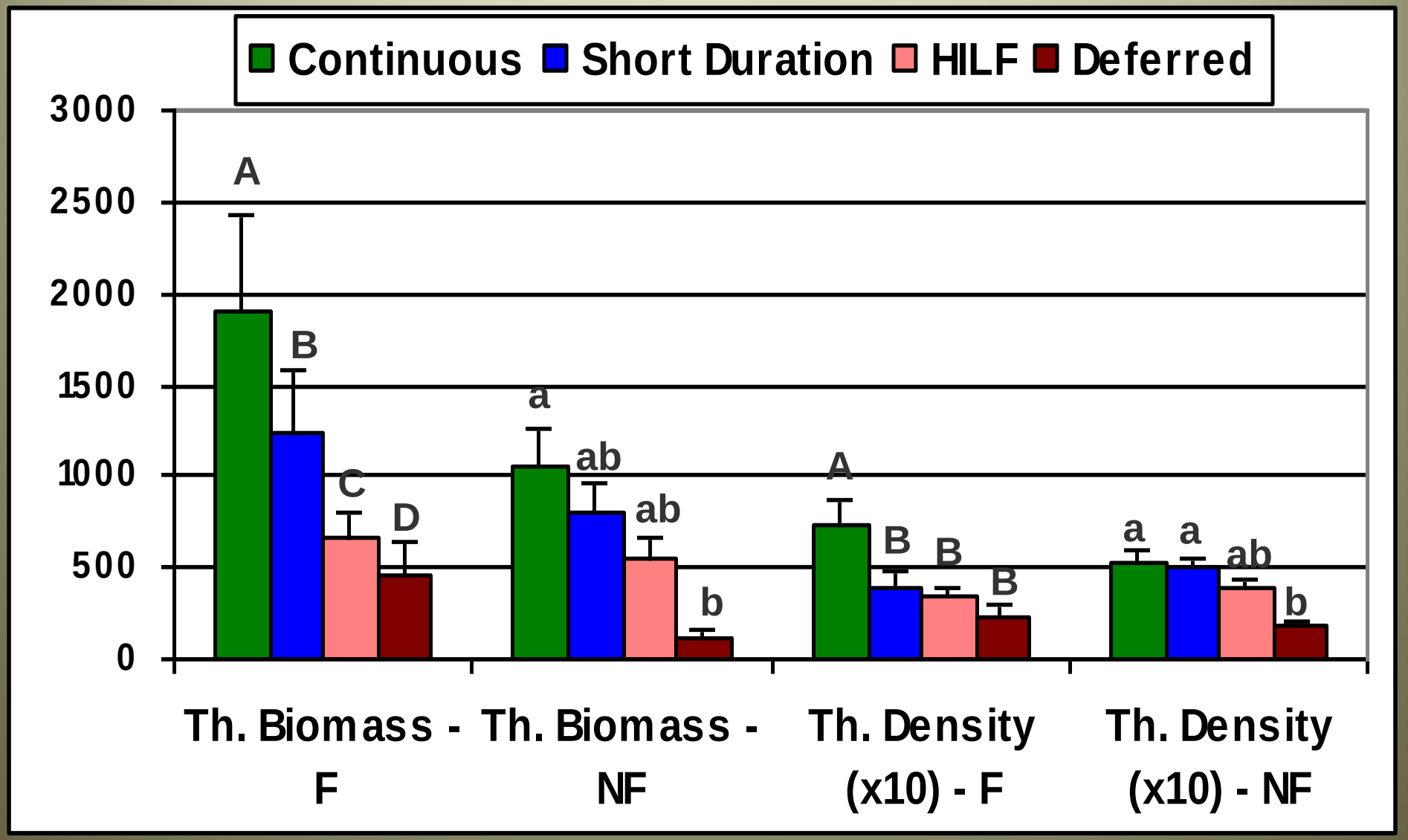
**Fertilized & Unfertilized Treatments - exposed to one of the following defoliation (i.e., simulated grazing) treatments:**

- **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**

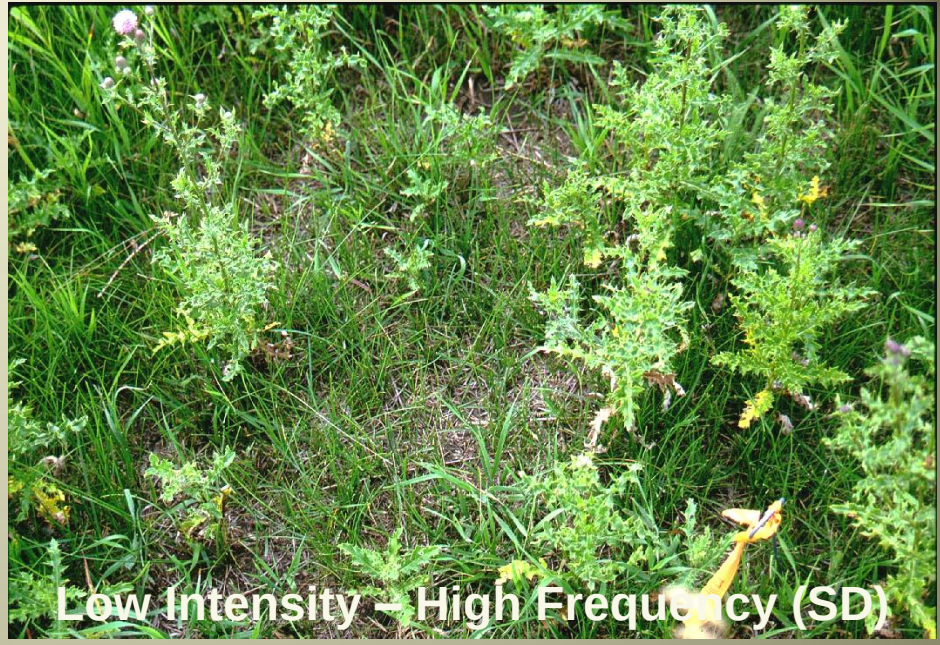
# Accumulated Forage Biomass (kg/ha) Harvested Under Various Defoliation Treatments (Intensity + Frequency)



# CT Biomass (kg/ha) & Shoot Density (#/m2 x 10) Under Various Defoliation Treatments (Intensity + Frequency)




High Intensity – High Frequency (Cont)


Low Intensity – High Frequency (SD)


Deferred to End of Summer


High Intensity – Low Frequency

## PHASE 2:

**TEST Direct Impact of Controlled Cattle Grazing in Regulating Weed Abundance**

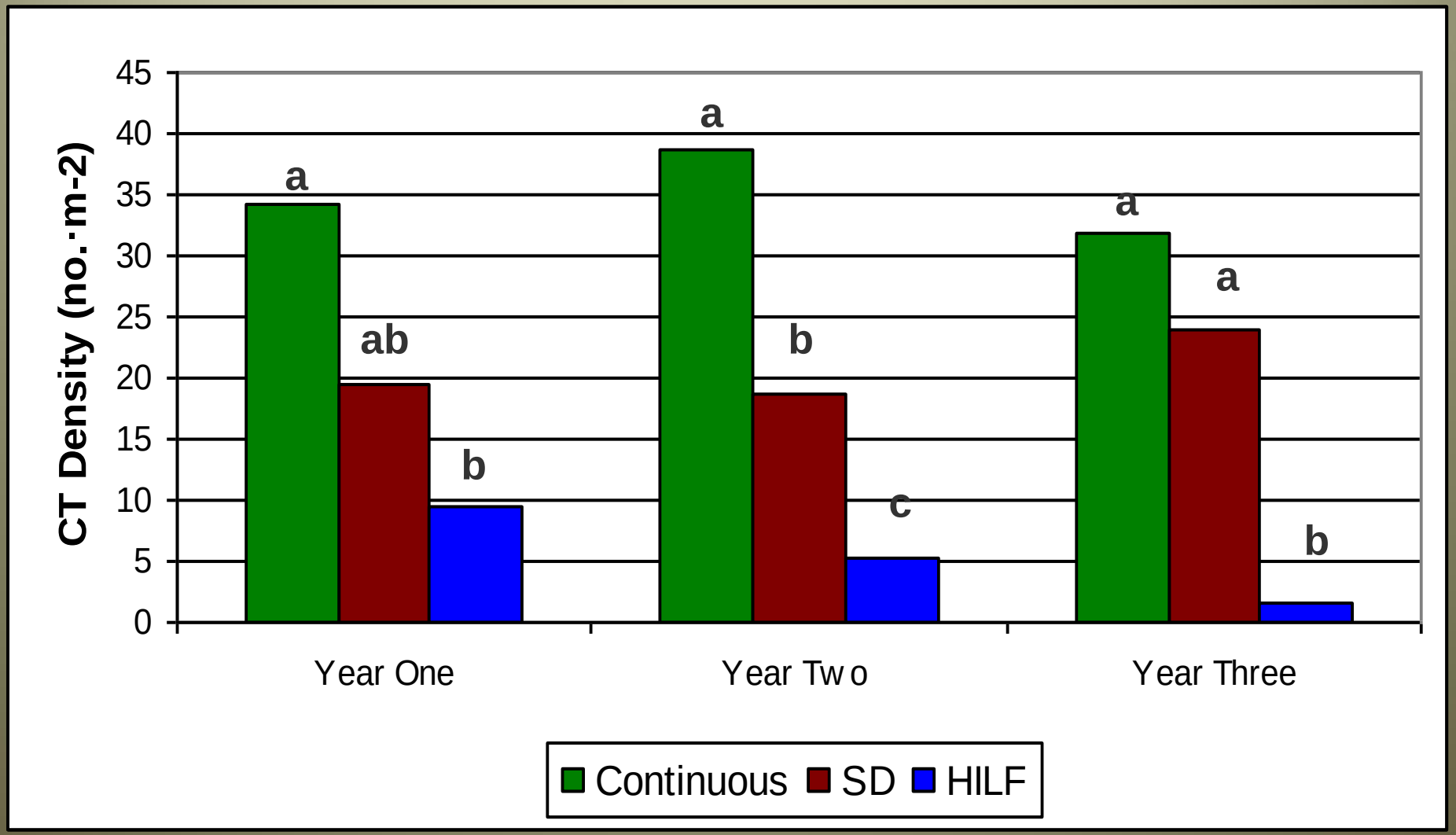
## Grazing Trials:

**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



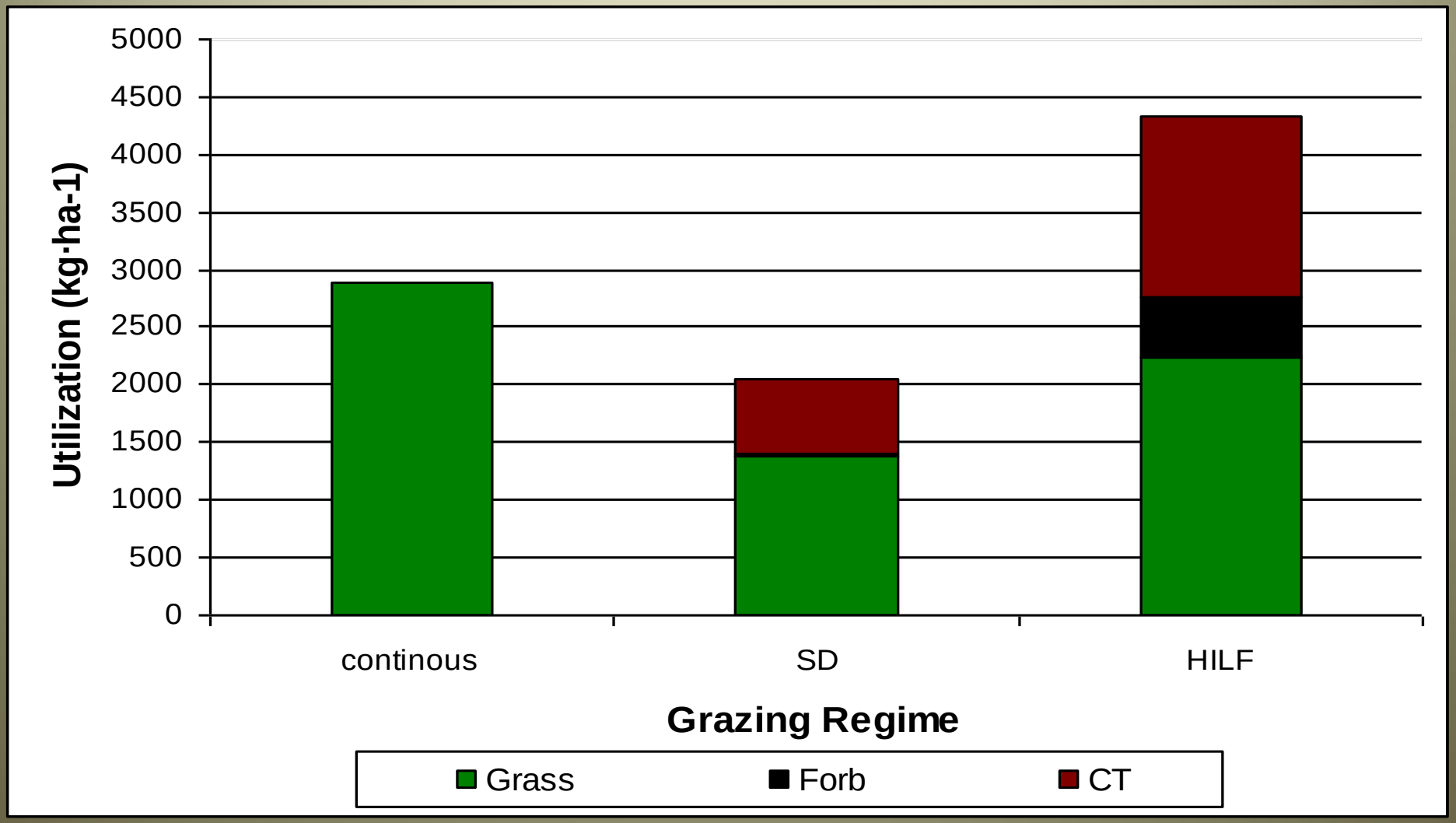
# Comparison of HILF (left) and SD (right) Grazing Treatments (Site 1)

# CT Declined, But Why?

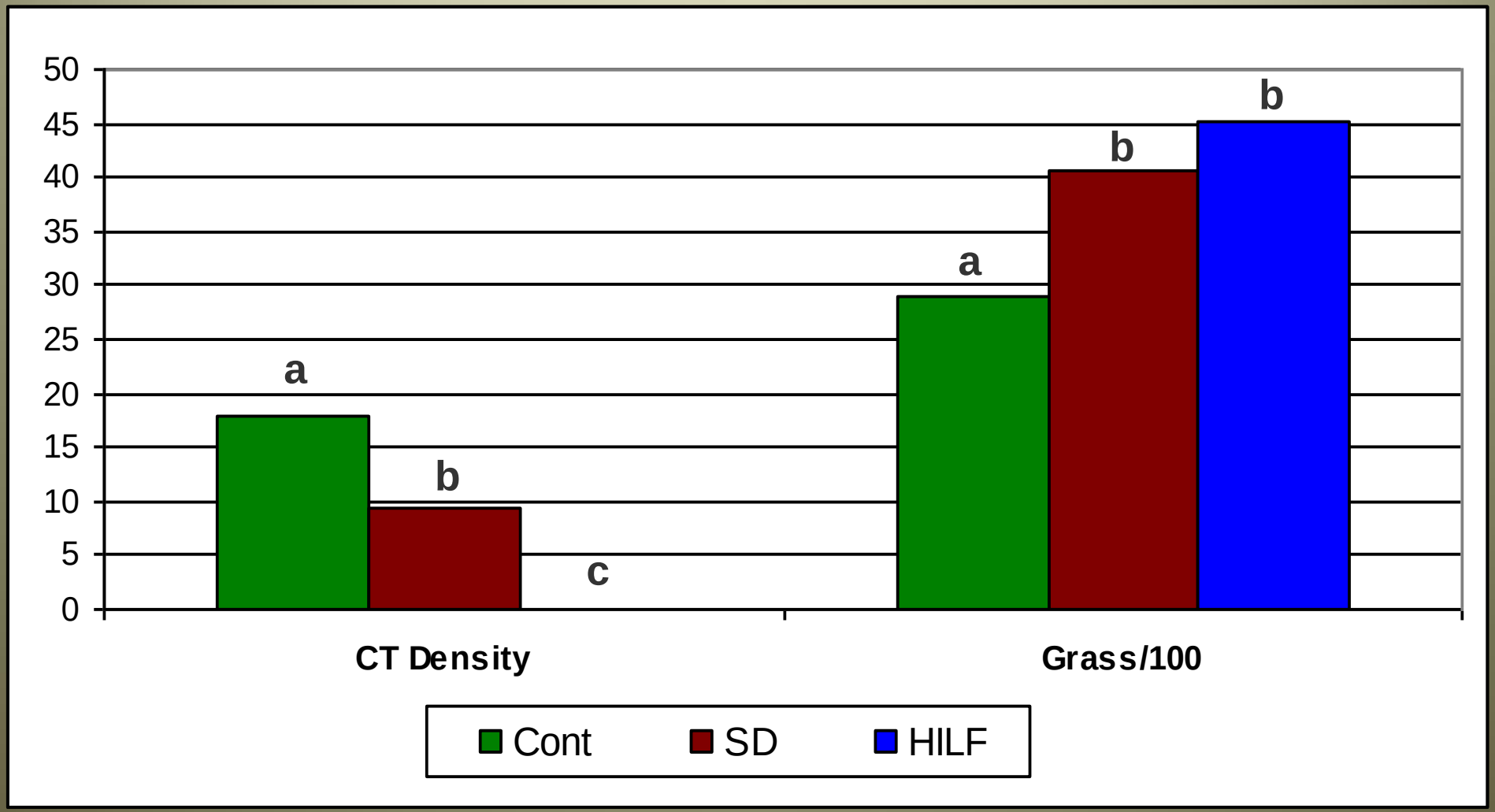
**Trampling ← (due to high cattle densities)**

**→ Defoliation (forced consumption of CT)**

# Grass, Forb and CT Biomass Removed by Cattle Among Grazing Treatments

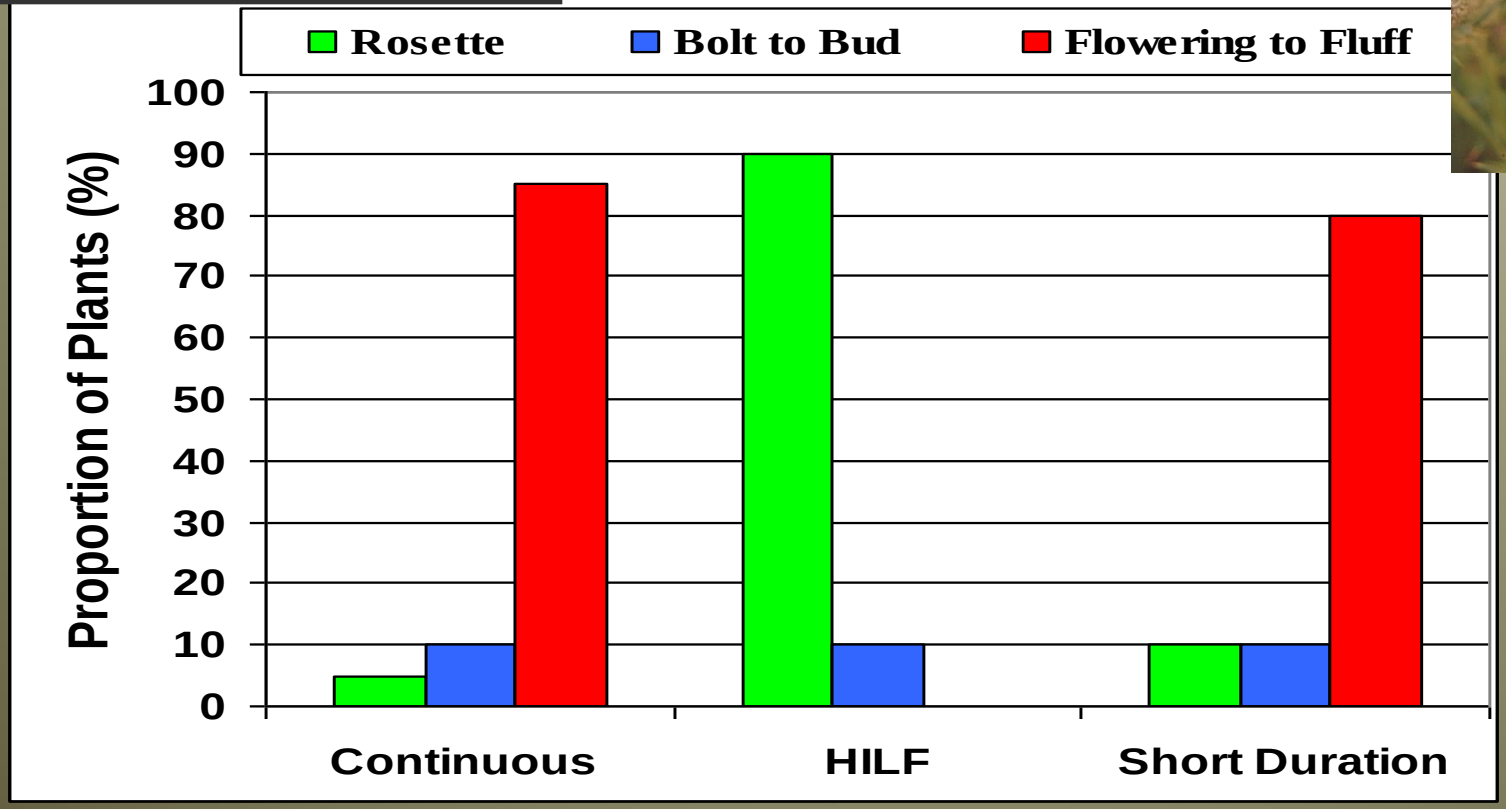


# CT Shoot Density and Grass Biomass in 2003, One Year *After* Rotational Grazing Treatments Ceased



# Comparison of CT Growth Staging Among Grazing Treatments

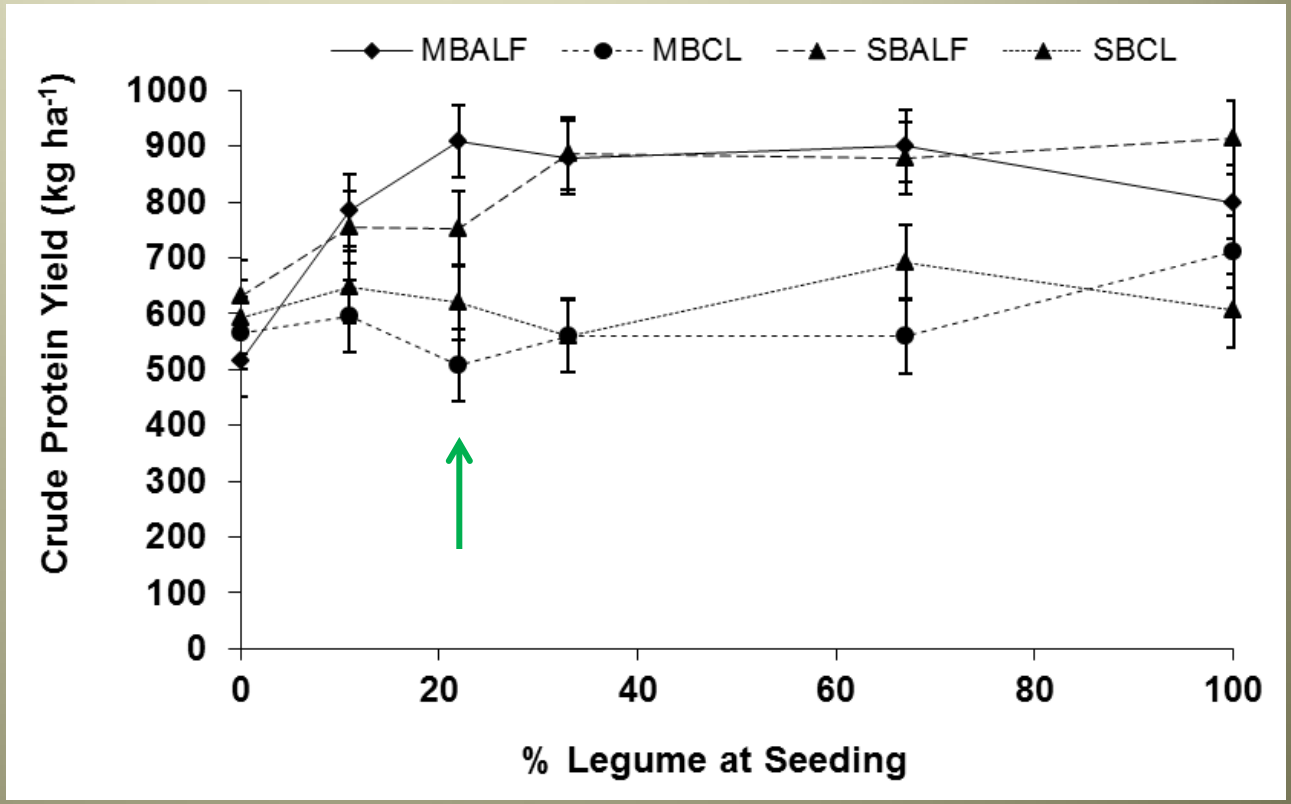
Proportion of thistle in various growth stages in August 2002.



# Grazing Provides Another Important CT Control Option

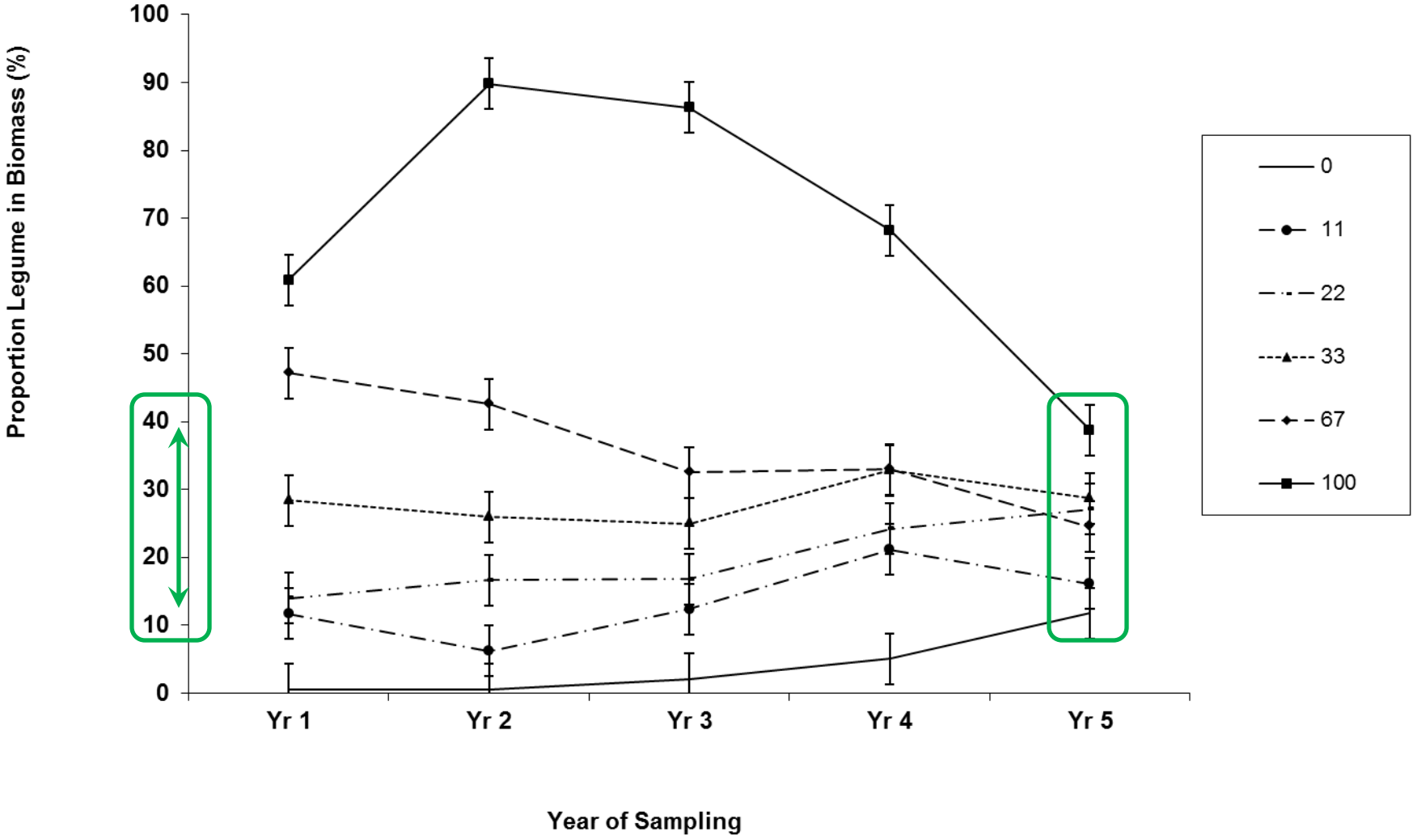
# What Amount of Legume at Seeding Optimizes Protein Yield?

**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

# Acknowledgements

**Colleagues: Dan Cole, Allan Macaulay (AAFRD), and Gerry Ehlert (SRD - Public Lands)**

**Sponsors: AARI, Dow AgroSciences, DuPont, BASF, MacEwens Fuel & Fertilizer, NSERC, Numerous Provincial Counties & MDs**

**Graduate Students:**

- **Chad Grekul**
- **Sue DeBruijn**
- **Danielle Gabruck**
- **Erin MacLeod**
- **Amanda Miller**