Synchronizing nitrogen application with uptake using urease and nitrification inhibitors to maximize nitrogen use in forage seed stands in northeastern Saskatchewan

James Woodhouse, Dr. Fran Walley and Dr. Richard Farrell

Department of Soil Science, University of Saskatchewan
Saskatoon, Saskatchewan
Canada

Introduction

- Nitrogen management remains a challenge in perennial forage seed stands
- Ammonium-based fertilizers (e.g., urea) are widely used
- Urease activity and nitrification can lead to gaseous losses, including NH_3-volatilization and N_2O emissions
- Numerous products that act to inhibit or block the activity of both urease and nitrifying bacteria
  - products currently registered in Canada: Agrotain™ and Super U™
- Inhibitors may reduce GHG emissions, increase NUE and improve yield in a variety of crops

Study objective

- Assess the impact of urease and nitrification inhibitors on the seed yield of two forage crops
  - Timothy (*Phleum pratense*)
    - single induced forage grass (Heide, 1994)
    - timing of fertilizer application less important for tiller formation
  - Hybrid Brome (*Bromus riparius* Rehm and *Bromus inermis* Leyss)
    - dual induced forage grass (Heide, 1994)
    - responsive to fall application of fertilizer-N

Study design

- Assess two application strategies
  - fall *vs.* spring N application
  - environmental conditions typically dictate spring field operations
- Evaluate three enhanced efficiency urea fertilizers at a rate of 100 kg N ha^{-1} (~ 90 lbs N ac^{-1})
  - controls include both untreated urea and zero-N (unfertilized)
  - all treatments replicated four times at each of four field sites

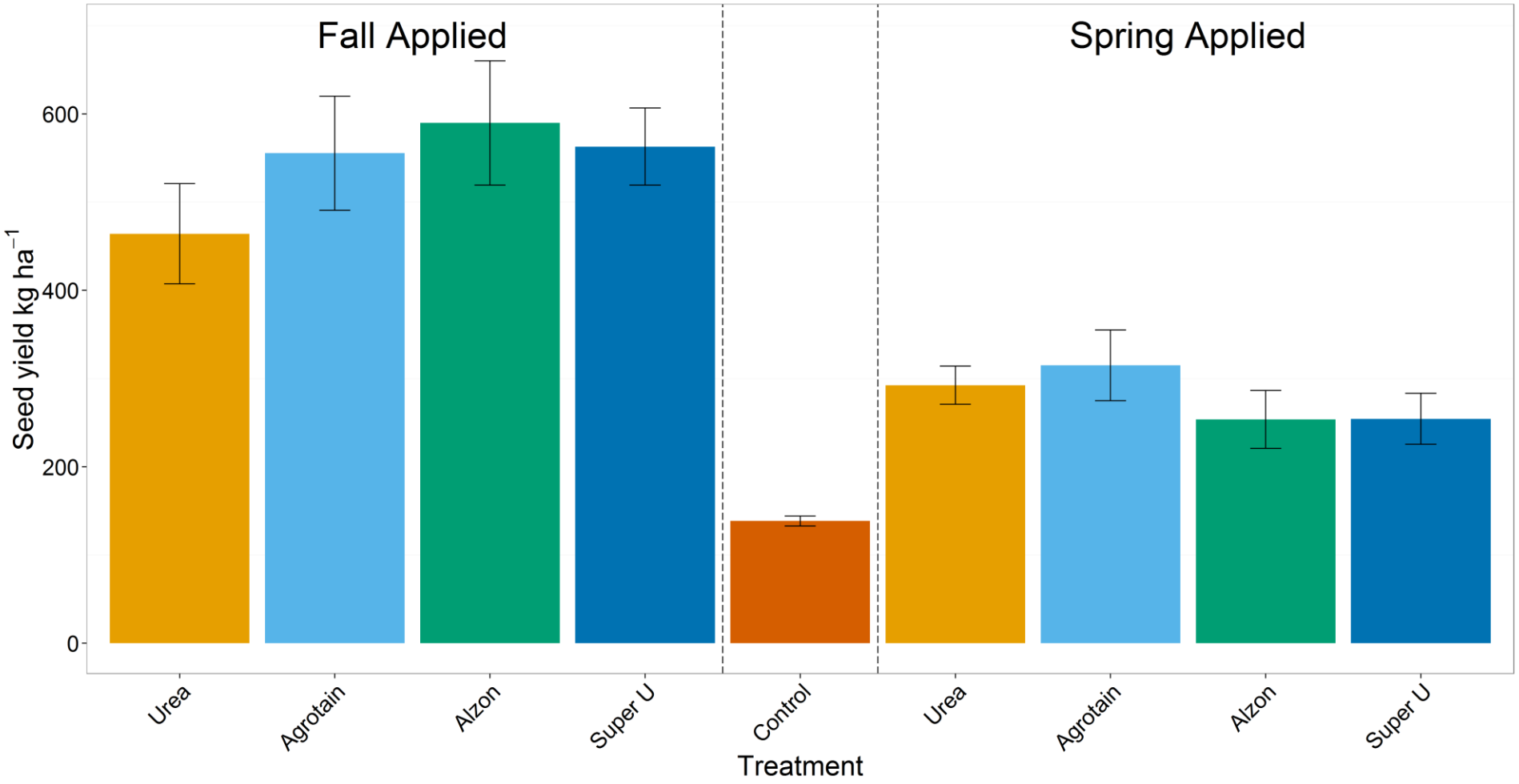
Treatment	Active Ingredient	Trade name
Urease Inhibitor	N-(n-butyl) thiophosphoric triamide (**NBPT**)	Agrotain™
Nitrification Inhibitor	Dicyandiamide (**DCD**) and Triazole (**ATC**)	Alzon™
Urease + Nitrification Inhibitor	NPBT and DCD	Super U™

Study location

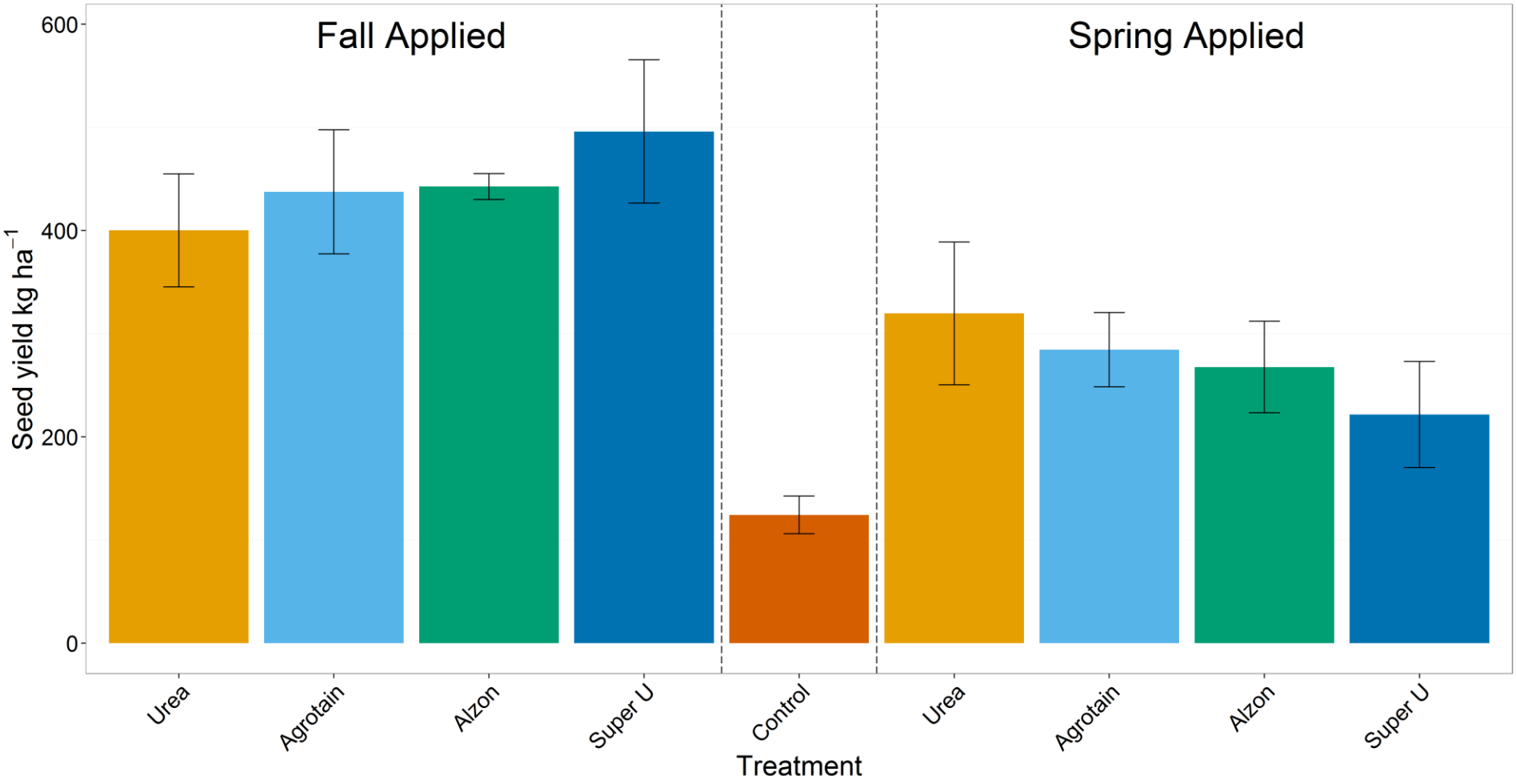
Seed Yield

- Seed harvested using 2 m^2 quadrat
  - 10 weeks in Hybrid Brome
  - 14 weeks Timothy
- Seed threshed using stationary thresher and hand cleaned

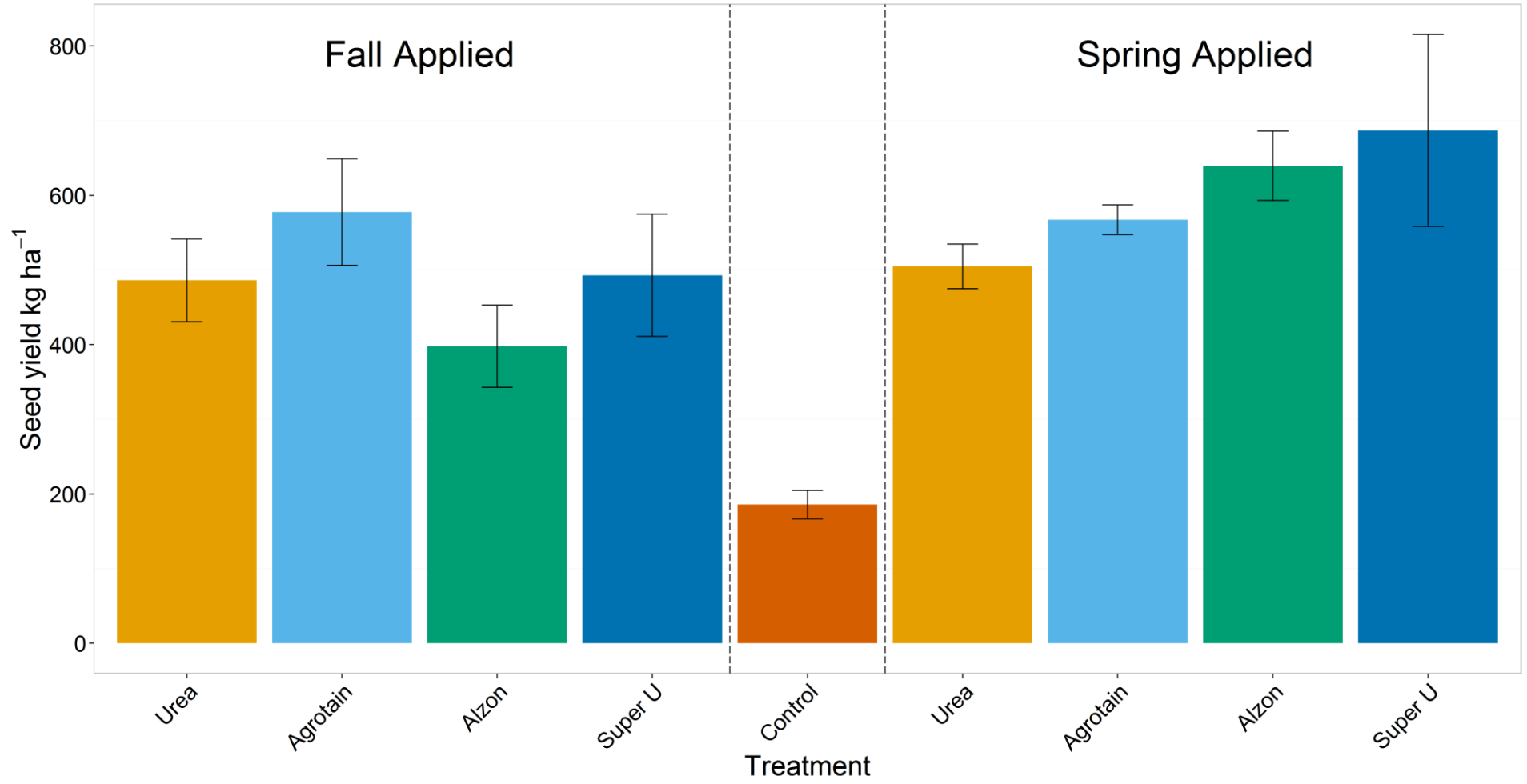
Carrot River 1 (Hybrid Brome) Seed Yield



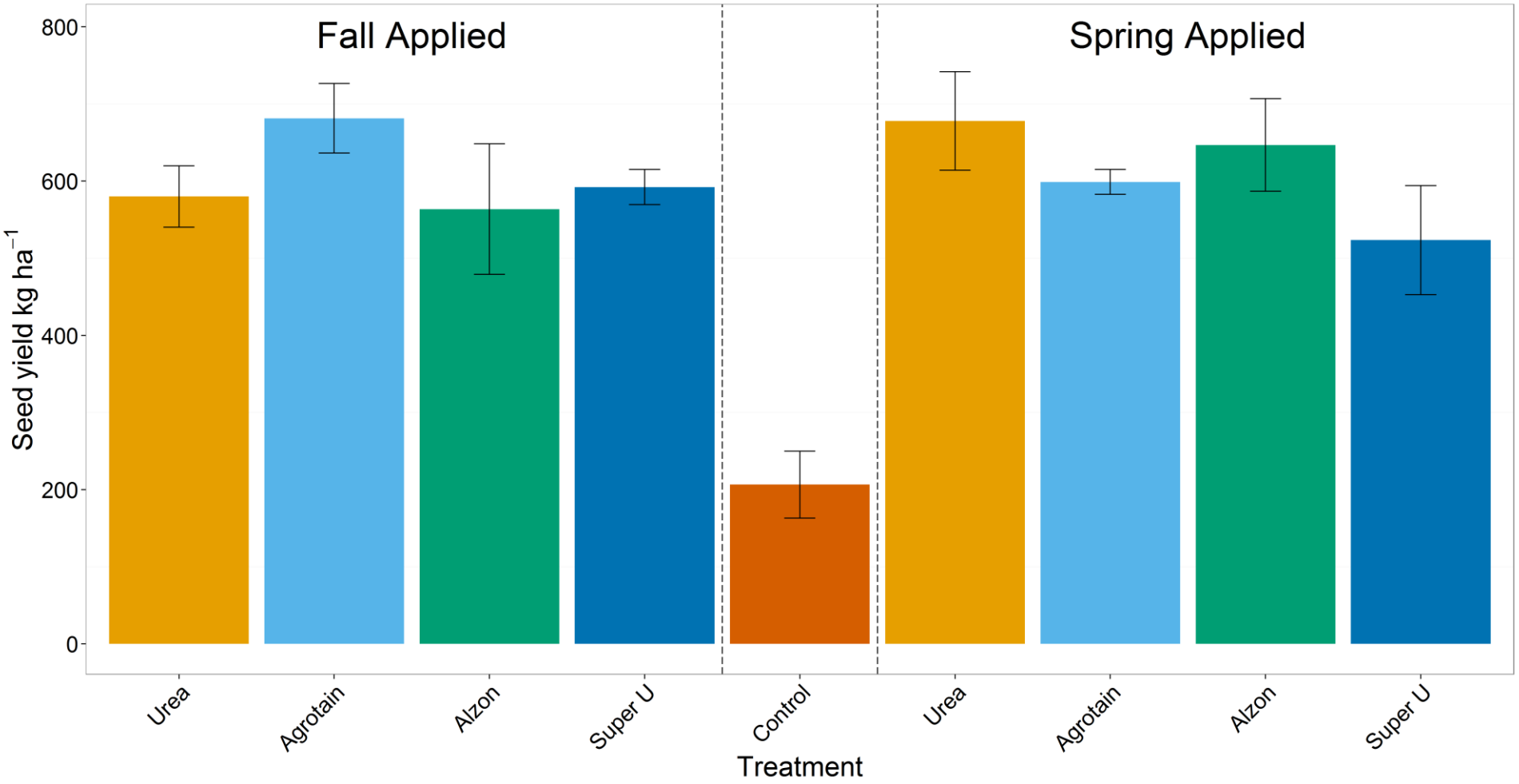
Carrot River 2 (Hybrid Brome) Seed Yield



Choiceland (Timothy) Seed Yield



Arborfield (Timothy) Seed Yield



Economic Analysis

Treatment	Trade Name	Cost (Dec 2013) per ha @ 100kg N ha^{-1}
Urea alone	46-0-0	104.35
Urease inhibitor	Agrotain™	121.09 (+16.74)
Nitrification inhibitor	Alzon™	N/A
Urease + Nitrification inhibitor	Super U™	136.74 (+31.39)

	$ kg^{-1} (2012-13)	Yield kg ha^{-1} urea	Yield kg ha^{-1} Agrotain	Yield kg ha^{-1} Super U
Timothy	1.85	533 ($ 986)	629 (+ $178)	542 (+ $16)
Hybrid brome	3.63	432 ($ 1568)	496 (+ $232)	529 (+ $362)

Summary

- Hybrid brome seed yield responsive to fall application of N-fertilizer
  - no clear trend in biomass production
- Timothy biomass and seed yield more responsive to spring application of N
- Although not conclusive, urease and nitrification inhibitors may have a potential role in forage seed production

Acknowledgements

- Supervisors: Richard Farrell and Fran Walley
- Committee Members: Bruce Coulman and Ken van Rees
- 5C29 and 5E19 Lab groups

Funding Agencies

- Agriculture and Agri-food Canada
- Agriculture Greenhouse Gases Program
- Saskatchewan Forage Seed Development Commission
- Saskatchewan Ministry of Agriculture

SFSDC

Saskatchewan Ministry of Agriculture

Agriculture et Agroalimentaire Canada

Agriculture and Agri-Food Canada

Canada

REFERENCES

- Heide O. 1994. Control of flowering and reproduction in temperate grasses. New Phytologist 128: 347-362

- Zaman, M., S. Sagger, J.D. Blennerhassett and J. Singh. 2009. Effect of urease and nitrification inhibitors on N transformations, gaseous emissions of ammonia and nitrous oxide, pasture yield and N uptake in grazed pasture systems. Soil Biology & Biochemistry. 41: 1270-1280.