UNIVERSITY OF MINNESOTA

Nitrogen Fertilizer Rates to Maximize Seed Yields from the Perennial Grain Crop Intermediate Wheatgrass

(*Thinopyrum Intermedium* L.)

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Abstract

Perennial crops have been proposed as a solution to a number of environmental issues related to agriculture including greenhouse gas (GHG) emissions, nitrogen (N) fertilizer pollution, and soil loss. Intermediate wheatgrass (Thinopyrum intermedium L.; IWG) is an introduced cool-season forage grass that has a dense, dynamic root system, that introduces new complexities for managing fertility to maximize grain yields. We tested the effect of various N fertilizer rates on IWG seed and vegetative biomass yields at four locations to identify the agronomically optimum nitrogen rate. This information is critical for determining the economic feasibility and broad-scale incorporation of IWG into Upper Midwest cropping systems.

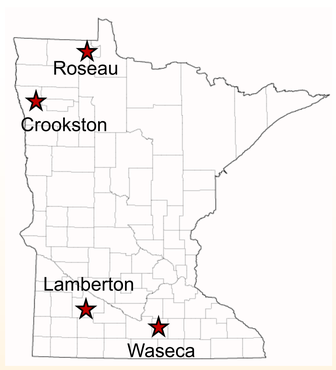

Figure 1 & 2. (Left) Annual wheat has a much smaller root system compared to IWG, leaving fields vulnerable to erosion and nutrient leaching below-ground. (Right) This experiment was carried out across 4 diverse MN locations: Roseau, Crookston, Lamberton, and Waseca.

Methods

- Seed used was improved IWG germplasm (TLI) as of 2011 for its performance in grain yield.
- One spring application per year of N (Urea) at rate: 0, 40, 80, 120, 160, and 200 kg N ha^{-1}.
- All plants within a 1.5m^2 were harvested, dried, and threshed.

Results

- Maximized grain yields were larger in 2013 compared to 2014 across all locations.
- Estimated (avg.) yields for 2013 were 880 kg ha^{-1} at an observed N rate of 79 kg N ha^{-1} for all sites.
- In 2013, grain yields peaked at 1101 kg ha^{-1} in Lamberton. In 2014, grain yields peaked at 791 kg ha^{-1} in Crookston.
- Optimum N rates were higher in 2014 compared to 2013 rates.

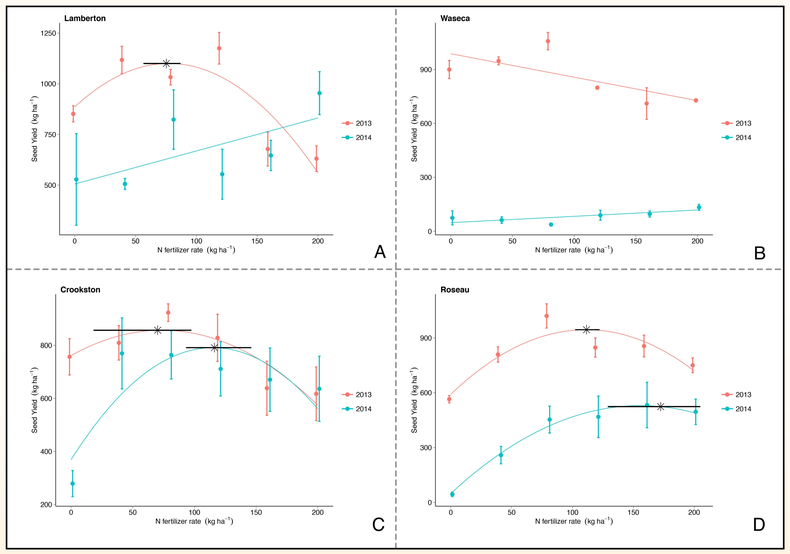

Figure 3: Grain yield was measured in response to N fertilizer rates across the four experimental sites in Minnesota.

	2013		2014	
Location	Optimum N rate (ONR)	Seed yield at ONR	Optimum N rate (ONR)	Seed yield at ONR
	kg N ha^{-1}	kg ha^{-1}	kg N ha^{-1}	kg ha^{-1}
Waseca	N/A*	N/A*	N/A*	N/A*
Lamberton	77	1101	N/A*	N/A*
Crookston	74	857	116	791
Roseau	111	945	170	523

Table 1: Optimum N rates (ONR) and estimated seed yields when fertilized at ONR. (N/A* indicated the data was linear, Optimum N-rate could not be determined).

Discussion

- More N fertilizer was needed to maximize grain yields in 2014 compared to 2013. Nutrient mining during biomass harvest may have limited yields in 2014.
- As stands mature, they become sod-bound and seed production declines.
- Yields declined at high N rates due to lodging. When N is not limiting, plants compete for sunlight with rapid vertical growth causing lodging.

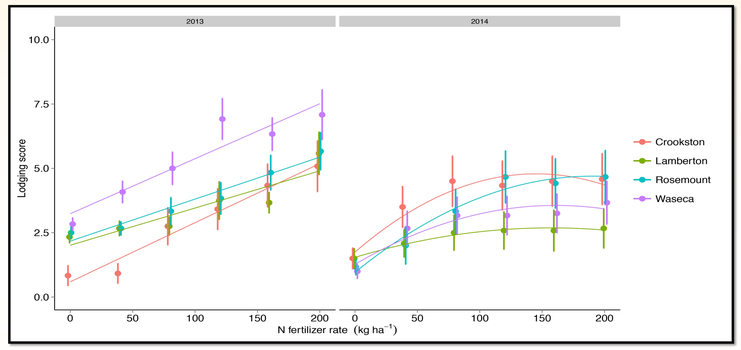

Figure 4: Trends indicate that high N rates are associated with greater likelihood of lodging and lower yields.

Future Research

There are still agronomic questions that need to be addressed involving the production of IWG:

- How can N fertilizer influence yield components of IWG including: seed mass, seeds per spikelet, spikelets per stem, and stems per plant (Carr et al., 2003)?
- Increasing N rates impacted lodging and yields. Can row spacing, or the use of plant growth regulators help control lodging to achieve production goals?

Acknowledgment

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Picture of annual wheat vs. perennial wheatgrass root system from: Glover, J. D. et al. 2010.