Exploring Varietal Response of Soft White Winter Wheat to Nitrogen and Seeding Rates in Northern Idaho

Cole Senefsky and Kurtis Schroeder, University of Idaho, Moscow

University of Idaho
College of Agricultural and Life Sciences

INTRODUCTION:

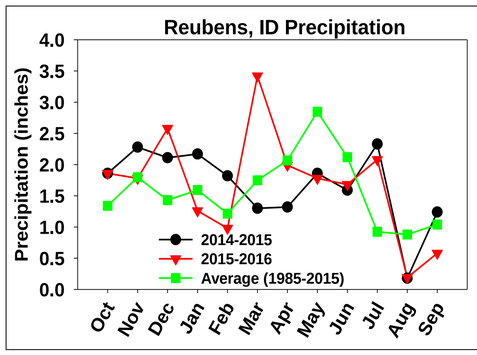
Soft white winter wheat is the largest class of wheat grown in the dryland, rainfed inland Pacific Northwest. New cultivars are continually released that provide superior yield, quality and disease resistance compared to older varieties. There has been an increased introduction of novel varieties by private companies and public entities. These cultivars may respond differently to the current recommended seeding and fertilizer rates. There is also some interest in tailoring nitrogen fertilizer and seeding rate recommendations to newly released cultivars. This study examines varietal response to different seeding and nitrogen rates for varieties from both the public and private sector.

MATERIALS AND METHODS:

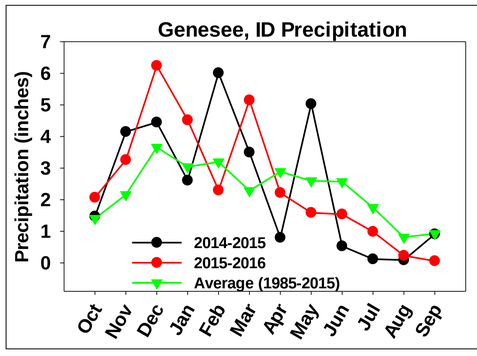
Two locations (Genesee and Reubens, ID) were selected to measure varietal response to nitrogen and seeding rates. Both locations are dryland, rainfed sites and direct seeded. The trials consisted of a split plot design with nitrogen rates as the main plots and cultivars and seeding rates as subplots. Fertilizer was banded below the seed at planting. The rates were determined using the *Northern Idaho Fertilizer Guide: Winter Wheat* (Mahler, 2015). A standard nitrogen rate of 2.5 lb N/bu expected yield was used throughout the study. For example, for the standard nitrogen rate for Genesee in 2015, a 100 bu/A yield goal was anticipated, requiring a total of 250 lb N/A. Soil sampling to a depth of 4 ft revealed a residual of 81 lb N/A, mineralizable nitrogen was calculated to be 51 lb N/A, and a 18 lb N/A credit for the residue from the previous spring pea crop. Therefore, 104 lb N/A was applied at planting. Yield potentials of 100 bu/A and 80 bu/A were used for Genesee and Reubens, respectively. All sites received an additional 30 lb/A phosphorus and 20 lb/A sulfur.

- 2015 nitrogen rates: 1.5, 2.0, 2.5 and 3.0 lb N/bu of expected yield.
- 2016 nitrogen rates: 0, 1.5, 2.0, 2.5, 3.0 and 3.5 lb N/bu of expected yield.
- Cultivars: IDN01-10704A, IDN02-29001A, UI-WSU Huffman, LCS Artdeco, LCS Drive and SY Ovation.
- Seeding rates: 0.6, 0.8 and 1 million seeds/acre.

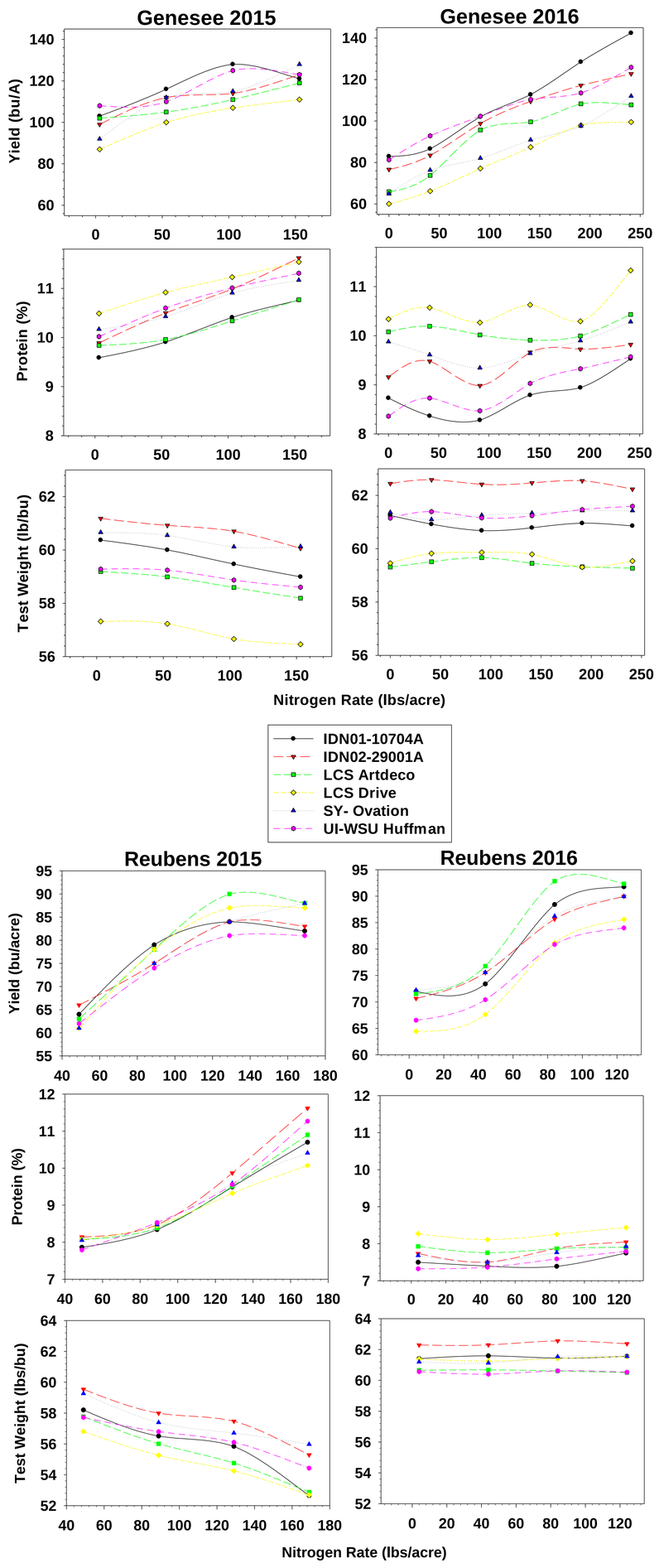
Plots were harvested using a Wintersteiger plot combine and total grain yield and test weights were measured. Grain protein was measured using a Foss Infratec.



- 2014 - 2015 Total: 20.1 in
- 2015 - 2016 Total: 20.2 in
- 30-Year Average: 19.0 in



- 2014 - 2015 Total: 29.7 in
- 2015 - 2016 Total: 30.2 in
- 30-Year Average: 27.3 in



RESULTS:

- Precipitation for 2015 was above average by 2.4 inches in Genesee and 1.1 inches in Reubens. Drought stress conditions were observed in 2015 due to lower than average precipitation in late spring (May though July). The rainfall in 2016 was higher than the 30-year average (2.9 inches in Genesee and 1.2 inches in Reubens). More optimal growing conditions occurred in 2016 with near normal precipitation from May through July. Average precipitation combined with mild temperatures in late June and early July extended the growing season for winter wheat.

RESULTS:

- Genesee: IDN01-10704A was consistently the highest yielding variety at Genesee. The overall yield performance of each variety was similar in each year of the study with comparable responses to nitrogen rates. However, in 2015 IDN01-10704A and UI-WSU Huffman reached a maximum yield at 104 lb N/A (standard N rate) with reduced yields at the 120% rate. In 2016, mild temperatures and normal late spring rain lengthened the active growth of the wheat plants. As a result, most varieties continued to positively respond to increasing nitrogen rates, even at the 241 lb N/A (140% above standard rate). Only LCS Artdeco and LCS Drive reached a maximum yield prior to the highest applied rate.
- Reubens: LCS Artdeco produced the highest yields at Reubens for both years. The majority of varieties in Reubens achieved optimal yield in 2015 at 129 lb N/A (standard N rate) with reduced yields at 120% rate. Most of the varieties in 2016 continued to respond to added nitrogen rates of 124 lb N/A (140% rate) due to more precipitation in the spring. LCS Artdeco showed reduced yields at the highest rate both years. LCS Artdeco and SY-Ovation were better adapted to locations such as Ruebens with lower annual precipitation (20 inches annual).
- SY Ovation positively responded to increasing nitrogen rates at both locations in each year of the study.
- Weather patterns for 2015 dramatically influenced protein and test weights at both sites. Drought conditions in 2015 reduced test weight and increased protein content at the nitrogen rate increased. The lowest nitrogen rate (60%) resulted in the lowest protein and highest test weights at both locations. In 2016, proteins and test weights were not affected by nitrogen rates.
- For both years and both sites, there was not a significant interaction with seeding rates.

Optimal Nitrogen Rate and Net Return for Selected Varieties

Variety	Seed Rate (million seeds per acre)	Nitrogen Rate (%) (100%=2.5 lb N/bu of expected yield)	Final Net Return ($/A)
Genesee 2015			
IDN01-10704A	0.6	91	465.10
	0.8	95	425.80
	1.0	112	442.60
Ovation	0.6	108	467.50
	0.8	83	344.10
	1.0	99	404.10
Genesee 2016			
IDN01-10704A	0.6	140	486.00
	0.8	140	447.20
	1.0	140	494.90
Ovation	0.6	140	321.30
	0.8	140	288.90
	1.0	98	262.10

Variety	Seed Rate (million seeds per acre)	Nitrogen Rate (%) (100%=2.5 lb N/bu of expected yield)	Final Net Return ($/A)
Reubens 2015			
Artdeco	0.6	101	233.00
	0.8	104	230.90
	1.0	94	248.80
Ovation	0.6	111	216.30
	0.8	115	232.40
	1.0	104	218.30
Reubens 2016			
Artdeco	0.6	106	214.80
	0.8	100	212.10
	1.0	124	231.80
Ovation	0.6	98	215.40
	0.8	102	213.00
	1.0	128	226.50

Average bushel price – $5.10; Nitrogen – $0.42/lb; Phosphorus – $0.55lb; Sulfur – $0.74/lb; Seed – $0.24lb; Fuel, machinery, and pesticide cost – $118.38/acre; 2015 protein premium – $0.10 for every 0.1% below 10.5%)

- Economics analysis was performed on selected varieties. This analysis the optimal nitrogen rates at which the maximum return was realized. Seeding rate does change the net return. It is important to note, higher seeding rates provide more competition for weeds. In 2015, a premium was offered for lower protein wheat. As expected, the net returns in Genesee were higher due to yield potential being 20 bu/A greater than Reubens. More ideal growing conditions occurred in 2016, resulting in higher optimal nitrogen requirements. The net return may be lower in 2016 because there was not a premium offered for low protein.

CONCLUSION:

- Environment has a significant influence on nitrogen utilization, impacting yield, protein and test weight. Timing of rain during 2016 resulted in lower protein and test weight compared to 2015 where drought conditions existed after May. The 2015 protein dramatically increased with higher nitrogen rates while test weights decreased.
- Increasing nitrogen rates resulted in incremental increases in yield for most varieties at both locations, although the highest nitrogen rate was often not the most economical. For most varieties, only subtle differences exist in response to nitrogen.
- Seeding rate did not significantly impact yield, regardless of the variety.
- Environment, yield potential and economics each play a role in estimating how much nitrogen to apply. It is important to remember that the Law of Diminishing Returns plays into the net return.