Nitrogen Management of Winter Wheat in Kansas

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Objectives

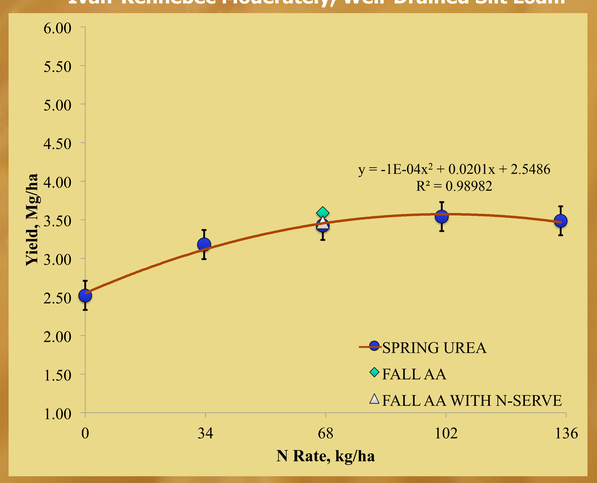
- Compare the practice of fall pre-plant application of anhydrous ammonia (AA) to spring top-dress application of urea at green-up (Feekes 4).
- Determine the effectiveness of a nitrification inhibitor (N-Serve) applied with AA for the improvement of nitrogen use efficiency (NUE) and yield.

Materials and Methods

- The study took place at the KSU Agronomy North Farm , Manhattan; Kansas River Valley Experiment Field, Rossville, Silver Lake; and East Central Experiment Field, Ottawa, during the 2011 – 2013 growing seasons.
- The plots were set up in a randomized complete block design with four replications.
- Treatments consisted of 0, 34, 67, 101, and 134 kg ha^{-1} N rates in the fall as AA and the spring as urea. N-Serve (nitrapyrin) was applied with the 67 kg ha^{-1} N rate at the recommended rate of 2.3 L ha^{-1}. N-Serve was injected directly into the AA stream prior to the manifold.
- For all locations, the previous crop was soybeans and the wheat was planted no-till. All AA applications were applied using a JD 2510 HSLD applicator on 50 cm spacing at a depth of 10 cm. N rates were adjusted by changing travel speeds. The unit was calibrated at 11.3 km hr^{-1} for a 67 kg ha^{-1} N rate.
- Soil samples were taken by block at each location to the following depths: 0-15 cm, 15-30 cm, 30-60 cm, and 60-91 cm. Soil pH, P, K, SOM, Zn, S, Cl, NH_4, and NO_3 were measured on the 0-15 cm samples, and NH_4, NO_3, S, and Cl were measured on all other samples
- Flag leaf samples were collected at Feekes 10.1 growth stage.
- Whole plant samples were collected at Feekes 11.1 growth stage.
- Grain samples were collected for the determination of yield, test weight, and protein content. Yields were adjusted to 125 g kg $^{-1}$ moisture.
- NUE by Recovery was calculated as NUE = (Total N Uptake Fertilized Treatment – Total N Uptake Unfertilized Check Plot) / Total N Applied

Results

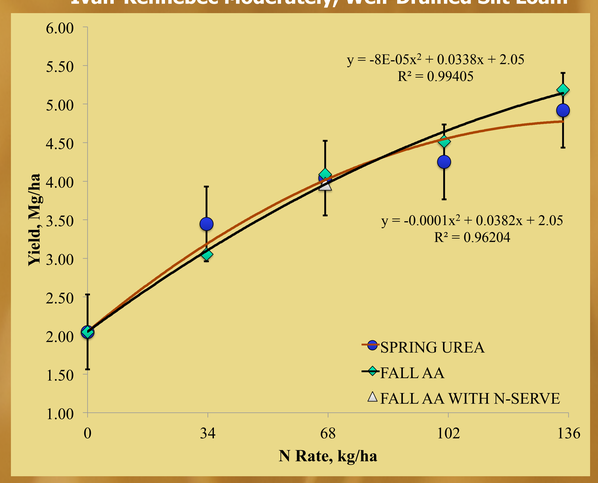
Grain Yield, Manhattan 2012
Ivan-Kennebec Moderately, Well-Drained Silt Loam



Manhattan 2012 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	(30.1)**	NA	(0.46)**
Fall 67 N vs Spring 67 N	4.5	5.3	0.08
Fall N with N-Serve vs Spring 67 N	(8.4)	(11.5)	0.02
Fall 67 N vs Fall N with N-Serve	13.0	16.8*	0.06

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

Grain Yield, Manhattan 2013
Ivan-Kennebec Moderately, Well-Drained Silt Loam



Manhattan 2013 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	(38.7)**	NA	(1.07)**
Fall N vs Spring N	9.4**	11.1**	0.02
Fall 67 N vs Spring 67 N	8.0	10.5	0.02
Fall N with N-Serve vs Spring 67 N	16.9*	21.3*	(0.03)
Fall 67 N vs Fall N with N-Serve	(8.9)	(10.9)	0.05

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

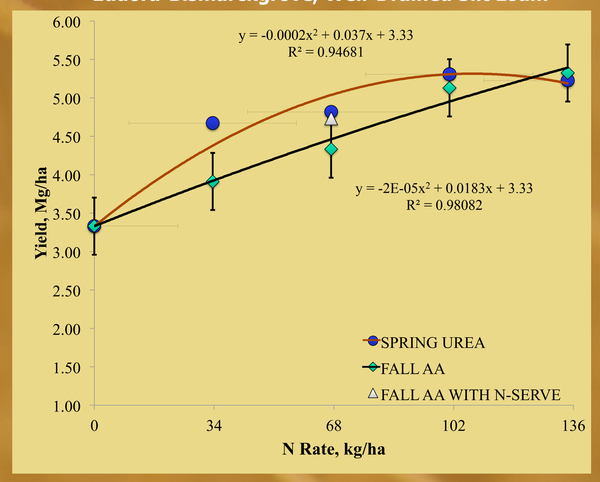
Results Cont.

Failed Location, Rossville 2012
Eudora, Well-Drained Silt Loam

Rossville 2012 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	No Data Analyzed		
Fall 67 N vs Spring 67 N			
Fall N with N-Serve vs Spring 67 N			
Fall 67 N vs Fall N with N-Serve			

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

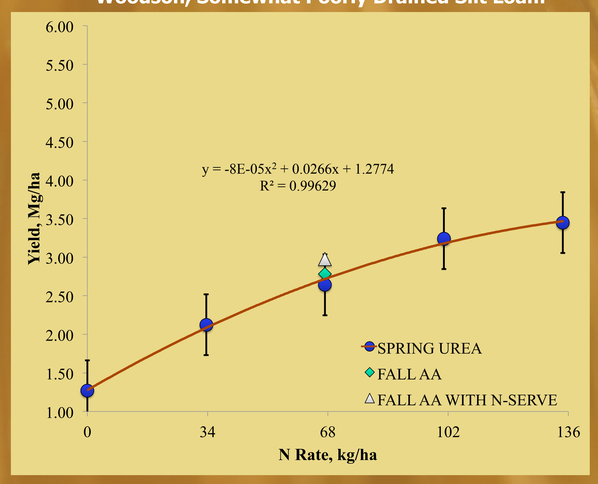
Grain Yield, Silver Lake 2013
Eudora-Bismarckgrove, Well-Drained Silt Loam



Silver Lake 2013 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	(36.7)**	NA	(0.75)**
Fall N vs Spring N	1.1	2.9	(0.17)**
Fall 67 N vs Spring 67 N	(1.8)	(2.0)	(0.24)**
Fall N with N-Serve vs Spring 67 N	(3.4)	(4.4)	0.04)
Fall 67 N vs Fall N with N-Serve	1.6	2.4	(0.20)*

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

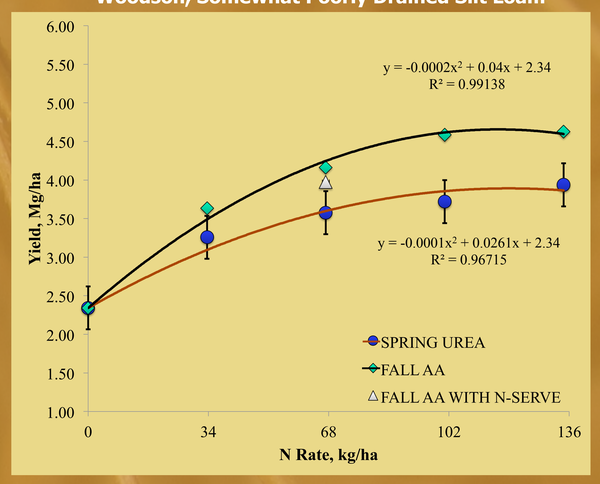
Grain Yield, Ottawa 2012
Woodson, Somewhat Poorly Drained Silt Loam



Ottawa 2012 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	(40.2)**	NA	(0.79)**
Fall 67 N vs Spring 67 N	5.7	7.5	0.07
Fall N with N-Serve vs Spring 67 N	11.7	14.8	0.17**
Fall 67 N vs Fall N with N-Serve	(5.3)	(7.2)	(0.09)

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

Grain Yield, Ottawa 2013
Woodson, Somewhat Poorly Drained Silt Loam



Ottawa 2013 Contrasts	N Uptake (kg/ha)	NUE (%)	Yield (Mg/ha)
Control vs N Applied	(38.5)**	NA	(0.80)**
Fall N vs Spring N	17.6**	18.6**	0.31**
Fall 67 N vs Spring 67 N	19.3**	25.0**	0.29**
Fall N with N-Serve vs Spring 67 N	17.0**	22.0**	0.19**
Fall 67 N vs Fall N with N-Serve	2.3	3.0	0.09

* indicates significance <0.10, ** indicates significance <0.01 — SAS 9.3 Proc Mixed

Conclusions

- Timing – Fall AA vs. Spring Urea
  - Variable based on soil properties and tillage history.
    - On well drained soils, prone to leaching, spring applications of urea appear to be more effective.
    - On medium textured soils, with limited potential for leaching or denitrification, no differences were observed between fall and spring applications in yield, however knifed AA increased N uptake and NUE.
    - On poorly drained soils with potential for N loss from denitrification and volatilization, fall knifed AA applications yielded higher than spring top-dressed urea, especially under long-term no-till.
- Use of a nitrification inhibitor with ammonia.
  - A good risk management tool for marginal sites.
  - Increases the range of opportunity for fall applications.