Fertilizer Placement Options Demonstration

-- UNL South Central Agricultural Laboratory --

Final Report, Jan. 2010

Glen P. Slater
Richard B. Ferguson

Rationale

Nebraska corn producers continually strive for good soil fertility management with the goal of achieving maximum returns. Sustained high fertilizer costs make it important to explore innovative options to manage nitrogen (N) and phosphorus (P) fertilizers more efficiently and effectively. This demonstration evaluated various nitrogen fertilizer application methods and their impact on crop health and yield for irrigated corn production.

Study Site and Treatments

An 18-acre demonstration site was used at the UNL South Central Agricultural Laboratory research farm in Clay County, Nebraska. The predominant soil type present was Hastings silt loam (see Figure 1). Agronomic activities included preplant and sidedress fertilizer application, ridge-till planting, and furrow irrigation. Other than fertilizer application, management practices (hybrid, pesticides, irrigation, etc.) remained uniform across the entire study with the intent to optimize yield potential. The soils of this location and the production system used are typical of irrigated corn production in the south central region of Nebraska.

The previous crop at this location was soybeans (65 bu/acre yield in 2008). Spring soil sampling took place February 25 (see Table 1). Preplant fertilizer treatment application took place March 19 in conjunction with a SCAL Crop Clinic. Corn was planted April 20 (Pioneer 33D47-RR). The field-length treatment strip dimensions were 8 rows (20 ft) wide by 1230 ft long. The study was a randomized complete block design with 9 treatments and 3 replications.

**no N credit from starter @ planting

TRT	Fertilizer Formulation	P Applied (lb P_2O_5/acre)	N Applied (lb N/acre)
1	NH_3 sidedress + Foliar Coron	32.5 (band)	98
2	NH_3 sidedress	32.5 (band)	133
3.	UAN/APP mix preplant	32.5 (band)	151
4.	Dual placed NH_3 + APP preplant	32.5 (band)	151
5.	Surface broadcast urea + MAP preplant	65 (broadcast)	151
6.	NH_3 preplant, starter APP in-row + MAP	32.5 (band + broadcast)	151
7.	NH_3 preplant, high rate starter APP in-row	32.5 (band)	151
8.	Strip-till NH_3 + MAP preplant	65 (broadcast)	151
9.	Surface broadcast ESN + MAP preplant	65 (broadcast)	151

Fertilizers used:

- Monammonium phosphate (MAP ,11-52-0)
- Urea (46-0-0)
- ESN (44-0-0)
- Anhydrous ammonia (82-0-0) 5.15 lbs/gal
- Ammonium polyphosphate (APP 10-34-0) 11.4 lbs/gal
- UAN (28-0-0) 10.67 lbs/gal

CoRoN (25-0-0) 10.0 lbs/gal – controlled release fertilizer

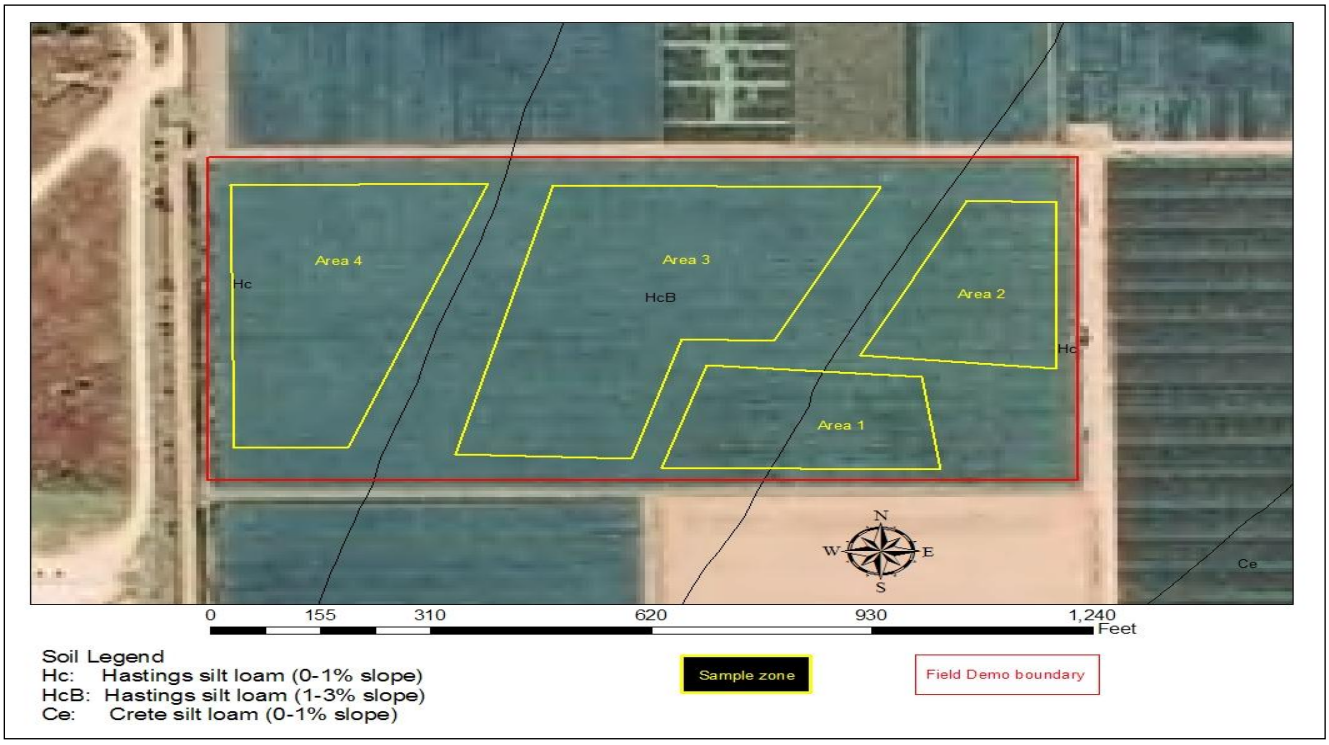

Figure 1. 2009 Study Location, SCAL farm, Clay Center, Nebraska (18 acre field)

Table 1. Spring Soil Sample Results (Feb. 25, 2009)

Sample Zone	pH	Buffer pH	OM (%)	Mehlich 2 P (ppm)	K (ppm)	DPTA Zn (ppm)	Sulfate S (ppm)	0-8 in. NO_3-N (ppm)	8-36 in. NO_3-N (ppm)
1	7.1	n/a	2.8	8	548	3.45	15	7.5	2.2
2	6.9	n/a	2.9	7	473	1.18	15	8.2	2.7
3	6.9	n/a	2.8	8	449	1.17	14	9.2	2.4
4	6.9	n/a	2.8	12	513	1.17	11	6.9	3.6
Avg.	6.9		2.83	8.8	496	1.17	13.75	7.95	2.73

Note: 42 lb N/acre residual N
UNL N recommendation for 230 bu. yield goal = 196 lb N/acre.
-45 lb N/acre credit for soybeans
=151 lb N/acre adjusted UNL N recommendation

UNL P recommendation:
64.8 lb P_2O_5/acre broadcast or 32.4 lb P_2O_5/acre row

Noteworthy Effect of Treatments

Field conditions were good for preplant fertilizer application Mar. 19 with dry surface conditions in the soybean stubble and abundant subsurface moisture. The corn emerged by May 1st with excellent stands (29,363 plants/acre average). Anhydrous ammonia burn became evident in the strip-till treatments by mid-May (plants @ V3-4), related to dry conditions after fertilizer application that were made more severe by the strip-till operation. At V3, growth of the seedling root system had essentially ceased and secondary (nodal) roots began elongating, forming root hairs, and becoming the major part of the root system. In the strip-tilled corn, stands were reduced by 5.4%, the corn was significantly stunted, and the crop remained uneven for several weeks (photos below). By later vegetative stages, the stunted corn appeared recovered, except for the loss in stand. Strip-till was the only fertilizer technique that caused this burn to occur. All other treatments had a healthy, uniform green appearance throughout vegetative stages.

May 22, 2009 – NH_3 burn (left) on strip-till treatments.

June 3, 2009 – Corn stunted and uneven stand (left 8 rows) on strip-till treatments.

Soil electrical conductivity was measured in the row on two separate dates for two treatments – Treatment 3, band-applied UAN between rows, and Treatment 8, strip-till applied NH_3 beneath rows. Figures 1 and 2 summarize the soil EC data. On June 4, soil EC was significantly higher for Trt. 8 to a depth of 6 inches. A couple of weeks later, soil EC was still elevated for Trt. 8 to a depth of 9 inches, but trends for higher EC with the strip-till treatment were noted at all depths. The conclusion from observations and data collected was that strip-till injection of NH_3 beneath the row in the spring reduced soil moisture and bulk density beneath the row location, allowing NH_3 to diffuse upward too close to the seed.

Sidedress N was applied with the John Deere 2510 research NH_3 applicator May 27. Corn was cultivated June 5 to clean up emerged weeds. Coron N fertilizer was foliar-applied June 12 to Treatment 1, and the field was ridged June 12, 2009 for furrow irrigation. Four irrigation events took place from July 6 – Aug. 26 with 14.75 inches pumped (70% efficiency = 10.3 inches available for crop).

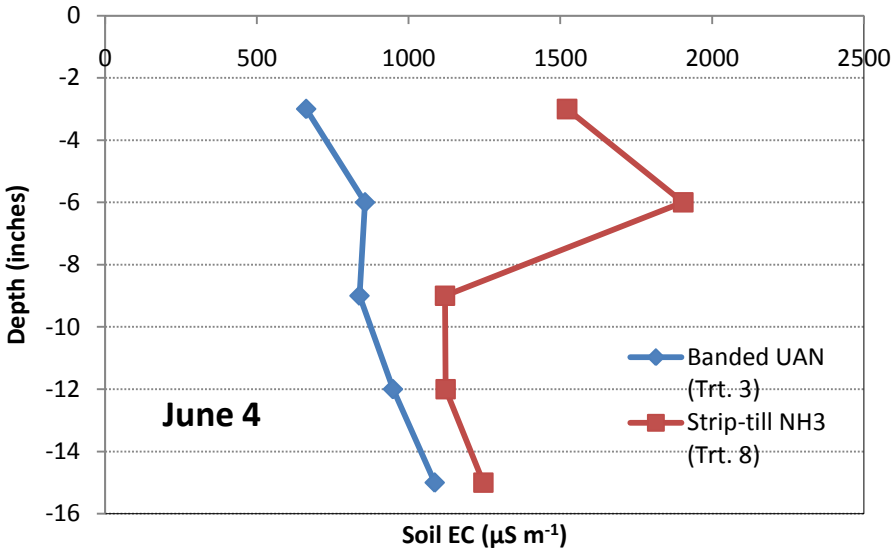

Figure 1. Soil EC measurement, June 4, 2009.

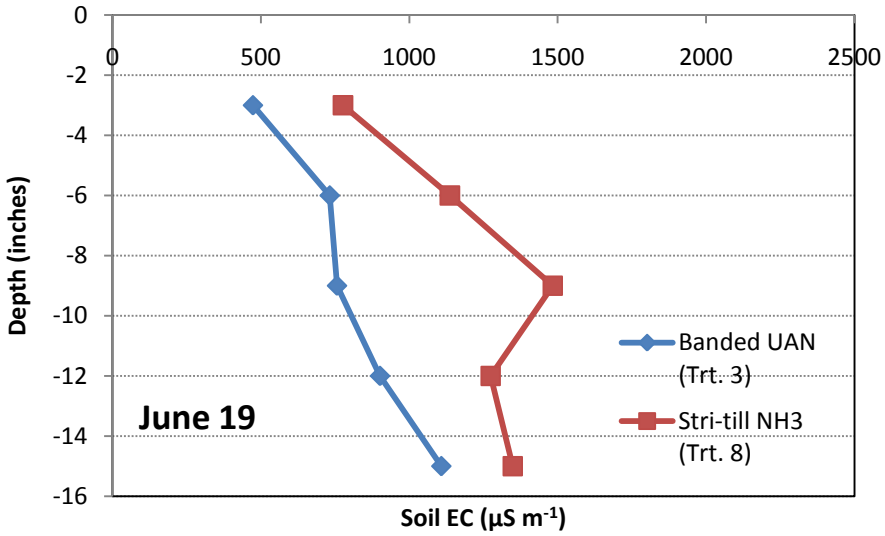

Figure 2. Soil EC measurement, June 19, 2009.

Yield Results

The study was harvested Nov. 10, 2009 with a John Deere 9600 combine with yield-mapping capabilities. Each treatment strip was weighed individually using a grain cart equipped with a scale. Grain samples were collected to determine moisture content and test weight. Except for treatment 8, treatments that received the full 151 lb N rate yielded similarly (236 avg). The strip-tilled treatment yielded 3.7% less, had the highest grain moisture content, and the lowest grain test weight.

Table 2. Yield results.

TRT	Fertilizer Strategy	Dry Yield (bu/acre)	Grain Moist.(%)	Test Wt. (lb/bu)
1	NH_3 sidedress + Foliar Coron	228.3 cd	19.3	59.0
2	NH_3 sidedress	233.8 abc	19.2	59.1
3	UAN/APP mix preplant	233.6 abc	18.8	59.7
4	Dual placed NH_3 + APP preplant	232.5 bcd	19.3	59.1
5	Surface broadcast urea + MAP preplant	236.5 ab	18.9	60.1
6	NH_3 preplant, starter APP in-row + MAP	235.4 ab	18.9	59.7
7	NH_3 preplant, high rate starter APP in-row	238.6 a	18.9	60.2
8	Strip-till NH_3 + MAP preplant	227.2 d	19.8	58.4
9	Surface broadcast ESN + MAP preplant	238.8 a	18.8	60.0

Yields with the same letter are not significantly different.

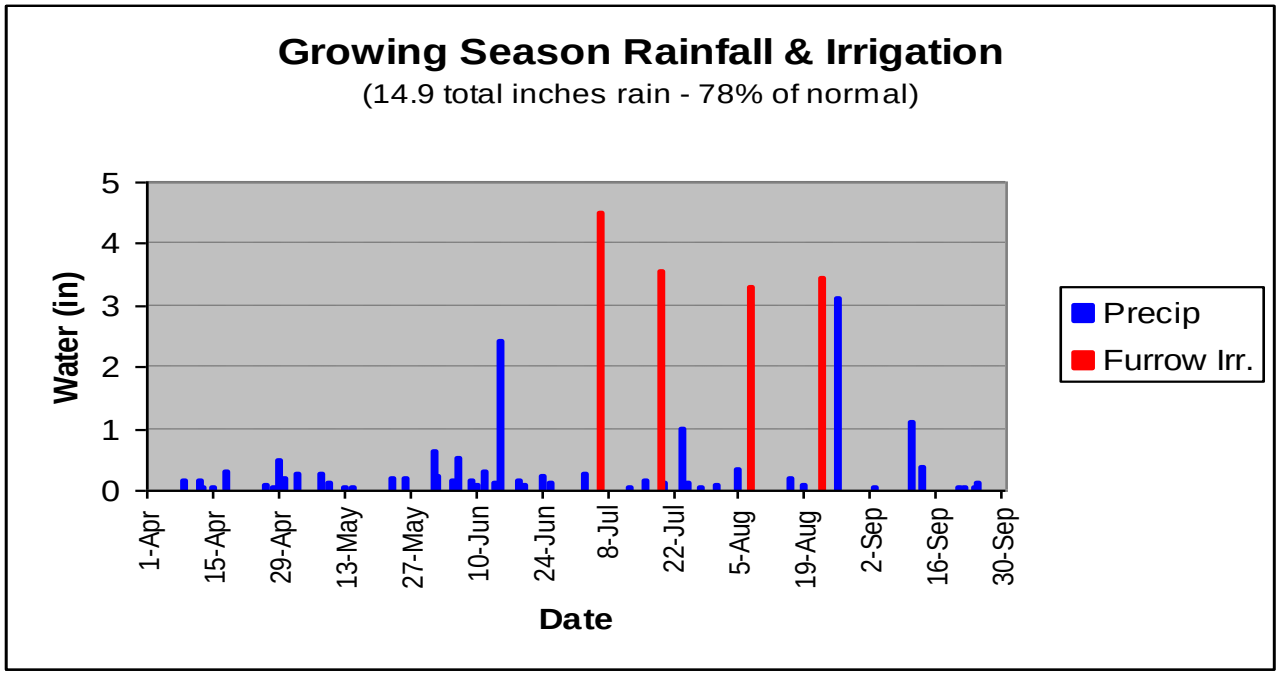

Figure 3. Rainfall and irrigation, April 1 – October 1, 2009.

Summary

Grain yields were excellent from this demonstration in 2009, a year with outstanding growing conditions. Yields were generally similar for most treatments, with the exception of the strip-till applied N (treatment 8) which was influenced by NH_3 damage early in the season, and treatment 1 (NH_3 sidedress + Coron), which had less total N than other treatments. There was little evidence that foliarly-applied Coron was able to replace N which was not supplied by NH_3 at V6. Treatment 2 also – inadvertently – received a somewhat lower total N rate than other treatments, but yield was not reduced significantly.