Starter Fertilizer Nutrient Component Effects on Corn Yield on High Testing P and K Soils in a High Yield Environment

Carrie Laboski

Fluid Fertilizer Forum

Scottsdale, AZ

February 21, 2012

DEPARTMENT OF SOIL SCIENCE
University of Wisconsin-Madison

UW Extension

Background & Justification

- What is the value of starter fertilizer on high testing soils?
  - High fertilizer & corn prices create more risk
  - Not uncommon to see low K, but high P testing soils
- Past Wisconsin research with starters has been complete starter (N-P_2O_5-K_2O)
- Corn yield potential has increased
- Atmospheric S deposition has decreased

Objectives

1. Understand the effects of nutrient components in 2 x 2 placed starter fertilizer in a high yield environment with high soil test P and K levels
2. Understand the effects of nutrient components in pop-up placed starter fertilizer on soils with high P and K levels
3. Evaluate the efficacy of pop-up fertilizer containing lower rates of nutrients to increase yield and decrease grain moisture compared to 2 x 2 starter fertilizer
4. Evaluate the effect of cultural practices to "bump" yield levels
5. Collect new data on plant nutrient concentrations at various growth stages to improve our plant analysis interpretation database to more adequately reflect current high yield corn hybrids

Study design

Site characteristics

- Arlington Ag Research Station
  - Plano silt loam
- Soil test levels
  - pH: 6.2
  - OM: 4.1%
  - P: 59 ppm (EH)
  - K: 171 ppm (EH)
  - Ca: 1910 ppm (H)
  - Mg: 425 ppm (O)
  - Mn: 35 ppm (H)
  - Zn: 6 ppm (O)
  - S: 5 ppm; SAI: 35 (?)
- Cropping history
  - 2010: corn silage
  - 2009: soybean
  - 2008: corn
  - 2007: soybean
- Tillage
  - Soil finisher + cultimulcher
- Planting 5/10/11
  - Pioneer P0461XR
    - 104 d RM, HX, LL, RR2
  - 4.4 lb/a Force 3G in T-band

Weather

Month	Precipitation	Average air temperature
	inches	°F
April	3.53 (0.29) †	41.4 (-4.0)
May	1.56 (-1.87)	53.6 (-3.5)
June	4.08 (0.04)	64.7 (-1.9)
July	2.49 (-1.37)	72.9 (2.4)
August ‡	1.46 (-2.78)	67.9 (-0.6)
September	3.86 (0.22)	56.5 (-4.0)
October	1.58 (-0.85)	49.5 (0.1)

† Numbers in parentheses are the departure from the 30-year average (NOAA).

‡ Values for August to October are preliminary.

Treatments

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop
		lb/a							x1000
1	2x2	20	20	20	10	+	185	+	41
2	2x2	5	20	20	10	+	185	+	41
3	2x2	20		20	10	+	185	+	41
4	2x2	20	20		10	+	185	+	41
5	2x2	20	20	20		+	185	+	41
6	2x2	20	20	20	10		185	+	41
7	2x2	20			10	+	185	+	41
8	2x2	20	20	20			185	+	41
9	2x2	20					185	+	41
10	2x2						185	+	41
11	2x2	20	20	20	10	+	150	+	41
12	2x2	20	20	20	10	+	185		41
13	2x2	20	20	20	10	+	185	+	35
14	Pop	10	34				185	+	35
15	Pop	5	11	5			185	+	35
16	Pop	6	20	4	3		185	+	35

Micros
- 0.5 lb/a Zn EDTA +
- 0.5 lb Mn EDTA +
- 0.3 lb Cu/a EDTA

Sidedress N
- UAN
- 6/7/11

Fungicide
- At R1 on 7/26/11
- 5 fl. oz/a Stratego YLD

10-34-0

9-18-9

8-27-5-4S

Measurements

- Emergence and plant stand measured at four weeks after planting
- Plant height (extended leaf) will be recorded eight weeks after planting
- Total N and total mineral concentration and uptake in corn
  - 12-inches tall
  - V8 to V10
  - R6 (physiological maturity)
- Corn ear leaf nutrient concentration will be determined at the VT to R1 growth
- Chlorophyll measurements with Minolta SPAD-502 chlorophyll meter
  - 12-inch plant height
  - V8 to V10
  - VT to R1
- Corn grain will be harvested
  - Total N and total mineral concentration measured and used to calculate crop removal
  - Moisture & test weight determined

What did we learn?

Effect of 2x2 starter composition on V3 pop., V10-11 plant height, 12" SPAD, & 12" biomass

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	V3 pop	V10 height	12" SPAD	12" biomass
		lb/a							x1000	plant/a	inch		lb/a
1	2x2	20	20	20	10	+	185	+	41	38,150	47	43	121
2	2x2	5	20	20	10	+	185	+	41	39,690	52	43	137
3	2x2	20		20	10	+	185	+	41	39,590	53	46	155
4	2x2	20	20		10	+	185	+	41	40,946	53	45	182
5	2x2	20	20	20		+	185	+	41	40,570	54	44	160
6	2x2	20	20	20	10		185	+	41	39,500	52	45	167
7	2x2	20			10	+	185	+	41	40,840	51	44	153
8	2x2	20	20	20			185	+	41	40,620	54	44	171
9	2x2	20					185	+	41	40,420	51	45	167
10	2x2						185	+	41	39,750	46	42	116

Treatments 2-10 were individually contrasted with treatment 1 and treatments 2-9 were individually contrasted with treatment 10. Numbers in red are significantly ($P \leq 0.10$) different than treatment 1.

Effect of 2x2 starter composition on N, P, K, and S concentration at 12" height

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	N	P	K	S
		lb/a							x1000	%	%	%	%
1	2x2	20	20	20	10	+	185	+	41	4.78	0.50	3.91	0.35
2	2x2	5	20	20	10	+	185	+	41	4.33	0.52	4.10	0.34
3	2x2	20		20	10	+	185	+	41	4.79	0.49	3.94	0.35
4	2x2	20	20		10	+	185	+	41	4.50	0.50	4.18	0.34
5	2x2	20	20	20		+	185	+	41	4.76	0.51	4.11	0.33
6	2x2	20	20	20	10		185	+	41	4.59	0.48	4.14	0.34
7	2x2	20			10	+	185	+	41	4.57	0.48	4.17	0.34
8	2x2	20	20	20			185	+	41	4.51	0.52	4.22	0.30
9	2x2	20					185	+	41	4.65	0.48	4.16	0.32
10	2x2						185	+	41	4.50	0.51	3.82	0.31

Treatments 2-10 were individually contrasted with treatment 1 and treatments 2-9 were individually contrasted with treatment 10. Numbers in red are significantly ($P \leq 0.10$) different than treatment 1.

Effect of 2x2 starter composition on yield, moisture, & test weight

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Silage Yield	Grain Yield	Moisture	Test Weight
		lb/a							x1000	T/a DM	bu/a	%	lb/bu
1	2x2	20	20	20	10	+	185	+	41	12.27	188	24.7	55.3
2	2x2	5	20	20	10	+	185	+	41	11.20	200	21.3	54.2
3	2x2	20		20	10	+	185	+	41	12.22	199	23.2	55.2
4	2x2	20	20		10	+	185	+	41	11.98	189	23.1	54.9
5	2x2	20	20	20		+	185	+	41	11.78	204	22.3	55.0
6	2x2	20	20	20	10		185	+	41	11.47	193	23.7	55.7
7	2x2	20			10	+	185	+	41	11.68	196	22.7	54.9
8	2x2	20	20	20			185	+	41	12.21	202	23.4	55.4
9	2x2	20					185	+	41	11.76	192	23.5	55.2
10	2x2						185	+	41	11.28	190	23.4	54.7

Treatments 2-10 were individually contrasted with treatment 1 and treatments 2-9 were individually contrasted with treatment 10. Numbers in red are significantly ($P \leq 0.10$) different than treatment 1. Numbers in purple are significantly different than treatment 10.

Effect of starter placement and composition on V3 pop., V10-11 plant height, 12" SPAD, & 12" biomass

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	V3 pop	V10 height	12" SPAD	12" biomass
		lb/a							x1000	plant/a	inch		lb/a
13	2x2	20	20	20	10	+	185	+	35	33,430	55	47	148
14	Pop	10	34				185	+	35	35,070	49	44	113
15	Pop	5	11	5			185	+	35	34,360	48	44	121
16	Pop	6	20	4	3		185	+	35	33,000	46	44	108

Treatments 14-16 were individually contrasted with treatment 13. Numbers in red are significantly ($P \leq 0.10$) different than treatment 13.

- ✓ In general, 2x2 starter placement with higher N rate resulted is larger greener plants compared to pop-up.

Effect of starter placement and composition on N, P, K, and S concentration at 12" height

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	N	P	K	S
		lb/a							x1000	%	%	%	%
13	2x2	20	20	20	10	+	185	+	35	4.82	0.51	4.44	0.34
14	Pop	10	34				185	+	35	4.69	0.50	3.86	0.33
15	Pop	5	11	5			185	+	35	4.57	0.50	3.68	0.31
16	Pop	6	20	4	3		185	+	35	4.64	0.51	3.90	0.33

Treatments 14-16 were individually contrasted with treatment 13. Numbers in red are significantly ($P \leq 0.10$) different than treatment 13.

- ✓ In general, 2x2 starter placement with higher N rate resulted greater N concentration in the plants compared to pop-up.

Effect of starter placement and composition on yield, moisture, & test weight

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Silage Yield	Grain Yield	Moisture	Test Weight
		lb/a							x1000	T/a DM	bu/a	%	lb/bu
13	2x2	20	20	20	10	+	185	+	35	11.49	191	23.2	55.3
14	Pop	10	34				185	+	35	10.00	194	23.7	54.9
15	Pop	5	11	5			185	+	35	10.89	188	23.9	54.7
16	Pop	6	20	4	3		185	+	35	10.39	178	23.8	54.9

Treatments 14-16 were individually contrasted with treatment 13. Numbers in red are significantly ($P \leq 0.10$) different than treatment 13.

- ✓ 6-20-4-3 applied as a pop-up had a significantly lower grain yield compared to 20-20-20-10-micros

Effect of high yield management on yield, moisture, & test weight

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Silage Yield	Grain Yield	Moisture	Test Weight
		lb/a							x1000	T/a DM	bu/a	%	lb/bu
1	2x2	20	20	20	10	+	185	+	41	12.27	188	24.7	55.3
11	2x2	20	20	20	10	+	150	+	41	11.89	191	25.3	55.7
12	2x2	20	20	20	10	+	185		41	11.57	179	25.7	54.9
13	2x2	20	20	20	10	+	185	+	35	11.49	191	23.2	55.3

Treatments 11-13 were individually contrasted with treatment 1. Numbers in red are significantly ($P \leq 0.10$) different than treatment 1.

- ✓ N rate and population did not significantly effect yield, moisture or test weight.
- ✓ Fungicide application at R1 significantly increased silage yield.

First-year summary

- No consistent trends in early season effects with regard to 2x2 starter composition
- Sig. increase in silage yield and test weight for N-P-K-S-micros compared to no starter
  - No difference in grain yield or moisture
- Not many differences in silage or grain yield, moisture, or test weight with regard to 2x2 starter composition

First-year summary continued

- 2x2 placement of N-P-K-S-micros had higher N rate (20 lb N/a) compared to pop-up and generally resulted in larger, greener young plants
- N content in 12" tall corn was significantly less where pop-ups were applied compared to 2x2
- However, only 6-20-4-3 had significantly lower grain yield compared to 2x2
  - All other yield parameters were not different

First-year summary continued

- N rate and population did not significantly effect yield, moisture or test weight
  - Demonstrates that high N rates are not needed at higher populations
- Fungicide application at R1 significantly increased silage yield, but no other yield metric

Questions?

Thanks to:

- Todd Andraski
- Fluid Fertilizer Foundation
- Ward Laboratories
- Jay-Mar, Inc. Plover, WI
- WI Fertilizer Research Program
  - Funding 2nd location beginning 2012

Contact Info:

- Carrie Laboski
- laboski@wisc.edu
- 608-263-2795
- www.soils.wisc.edu/extension/
- Connect with me on LinkedIn