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

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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 information

Site Characteristics

Parameter	Arlington ARS	Lancaster ARS
Soil	Plano silt loam	Dubuque silt loam
pH	7.4	7.0
OM, %	3.1	2.6
P, ppm	118 (EH)	17 (O)
K, ppm	248 (EH)	136 (H)
Cropping history	Cgm-Am-A-Cg-**C**	A-Cg-**C**
Tillage	Fall chisel, sp field cultivator	Fall chisel, sp soil finisher
Planting, 30” rows	May 16	June 4
Hybrid	Pioneer P0407AMXT (104-day RM, HXX, LL,RR2)	Croplan 3737 SS/RIB (96-day RM, Genuity SmartStaz RIB Complete, LL, RR2
Sidedress 28% UAN	June 24	July 1
Foliar fungicide @ R1	July 31	August 8
Whole plant biomass at PM	October 2	October 10
Grain harvest	November 4	December 5

Weather

Month	Precipitation		Average air temperature	
	Arlington	Lancaster	Arlington	Lancaster
	inches		°F	
April	5.42 (1.92) †	6.05 (2.39)	39.4 (-5.3)	42.1 (-4.5)
May	6.04 (2.35)	5.67 (1.54)	56.0 (0.3)	59.3 (2.0)
June	7.51 (2.83)	7.90 (2.64)	64.3 (-1.3)	67.3 (0.4)
July	2.99 (-1.17)	1.91 (-2.41)	68.7 (-0.7)	71.2 (0.4)
August ‡	1.79	1.60	66.6	70.3
September	2.98	3.15	60.1	64.9
October	1.54	1.12	46.2	49.6

† 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
- 28 % UAN

Fungicide
- 5 fl. oz/a Stratego YLD

10-34-0

9-18-9

8-27-5-4S

Measurements

- Plant stand counted at V3-4
- Total N and total mineral concentration and uptake in corn
  - V5-6
  - V12
  - R6 (physiological maturity)
- Corn ear leaf nutrient concentration will be determined at R1
- Grain harvested
  - Total N and total mineral concentration measured and used to calculate crop removal
  - Moisture & test weight determined

What did we learn in 2014?

Effect of 2x2 starter composition on V3-4 population and biomass V4 at Arlington & V6 at Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop.	Pop. A	Pop. L	Biomass A	Biomass L
		lb/a							x1000	x1000	x1000	lb/a	lb/a
1	2x2	20	20	20	10	+	185	+	41	42.2	40.6	254	437
2	2x2	5	20	20	10	+	185	+	41	42.3	41.8	213	414
3	2x2	20		20	10	+	185	+	41	42.0	41.1	240	443
4	2x2	20	20		10	+	185	+	41	42.8	41.0	240	504
5	2x2	20	20	20		+	185	+	41	42.5	41.1	220	464
6	2x2	20	20	20	10		185	+	41	42.0	41.0	226	450
7	2x2	20			10	+	185	+	41	41.3	41.5	223	458
8	2x2	20	20	20			185	+	41	41.1	42.0	218	482
9	2x2	20					185	+	41	41.7	39.1	215	396
10	2x2						185	+	41	41.3	40.8	189	420

Treatments 2-10 were individually contrasted with treatment 1. Numbers in red are significantly (P≤0.10) different than treatment 1.

V11/12 biomass – no significant differences between treatments 2-10 and treatment 1.

Effect of 2x2 starter composition on silage & grain yield at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop.	Silage Yield A	Silage Yield L	Grain Yield A	Grain Yield L
		lb/a							x1000	T/a DM		bu/a	
1	2x2	20	20	20	10	+	185	+	41	12.53	11.92	238	225
2	2x2	5	20	20	10	+	185	+	41	11.22	11.04	230	220
3	2x2	20		20	10	+	185	+	41	12.10 *	10.42 *	252	235
4	2x2	20	20		10	+	185	+	41	10.94	11.46	230	222
5	2x2	20	20	20		+	185	+	41	11.88	10.10 *	236	223
6	2x2	20	20	20	10		185	+	41	12.33	11.98	253	233
7	2x2	20			10	+	185	+	41	12.58	10.44	253	229
8	2x2	20	20	20			185	+	41	12.60 *	11.30	249	237 *
9	2x2	20					185	+	41	10.72	10.41	236 *	215 *
10	2x2						185	+	41	12.42	11.43	262	228

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≤0.10) different than treatment 1. Numbers with an * are significantly different than treatment 10.

Effect of 2x2 starter composition on grain moisture & test weight at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop.	Grain Moist. A	Grain Moist. L	Test wt. A	Test wt. L
		lb/a							x1000	%		lb/bu	
1	2x2	20	20	20	10	+	185	+	41	21.9 *	18.3	53.4	53.0
2	2x2	5	20	20	10	+	185	+	41	21.7	18.3	53.3	52.9
3	2x2	20		20	10	+	185	+	41	23.9	18.3	53.2	52.6
4	2x2	20	20		10	+	185	+	41	22.5	18.3	53.0	52.8
5	2x2	20	20	20		+	185	+	41	24.4	18.0	52.6	52.1
6	2x2	20	20	20	10		185	+	41	24.4	17.9	52.9	53.4
7	2x2	20			10	+	185	+	41	24.4	18.7	53.2 *	53.0
8	2x2	20	20	20			185	+	41	23.6	18.4	53.0	52.6
9	2x2	20					185	+	41	22.6	18.2	53.6	51.6 *
10	2x2						185	+	41	25.4	18.0	51.9	52.5

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≤0.10) different than treatment 1. Numbers with an * are significantly different than treatment 10.

Effect of starter placement and composition on V3-4 population and biomass V4 at Arlington & V6 at Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Pop. A	Pop. L	Biomass A	Biomass L
		lb/a							x1000	x1000		lb/a	
13	2x2	20	20	20	10	+	185	+	35	35.9	36.6	202	434
14	Pop	10	34				185	+	35	36.7	36.0	215	445
15	Pop	5	11	5			185	+	35	36.5	35.9	196	427
16	Pop	6	20	4	3		185	+	35	37.0	36.2	205	495

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

No significant differences in V11 biomass at Arlington.
At Lancaster, V11 biomass was significantly greater in treatments 14 and 15 compared to treatment 13.

Effect of starter placement and composition on silage & grain yield at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Silage Yield A	Silage Yield L	Grain Yield A	Grain Yield L
		lb/a							x1000	T/a DM		lb/a	
13	2x2	20	20	20	10	+	185	+	35	11.71	10.6	233	229
14	Pop	10	34				185	+	35	11.22	11.01	244	224
15	Pop	5	11	5			185	+	35	11.49	11.63	225	237
16	Pop	6	20	4	3		185	+	35	12.21	11.25	248	234

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

Effect of starter placement and composition on grain moisture & test weight at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Moisture A	Moisture L	Test Wt A	Test Wt L
		lb/a							x1000	%		lb/bu	
13	2x2	20	20	20	10	+	185	+	35	23.3	18.2	53.2	51.5
14	Pop	10	34				185	+	35	23.1	17.7	53.0	52.2
15	Pop	5	11	5			185	+	35	23.5	18.0	52.9	53.4
16	Pop	6	20	4	3		185	+	35	25.5	18.0	52.0	53.4

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

Effect of high yield management on V3-4 population and biomass V4 at Arlington & V6 at Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Pop. A	Pop. L	Biomass A	Biomass L
		lb/a							x1000	x1000		lb/a	
1	2x2	20	20	20	10	+	185	+	41	42.2	40.6	254	437
11	2x2	20	20	20	10	+	150	+	41	40.7	42.0	218	440
12	2x2	20	20	20	10	+	185		41	42.3	42.1	231	477
13	2x2	20	20	20	10	+	185	+	35	35.9	36.6	202	434

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

At these growth stages treatments 1, 11, and 12 are identical (sidedress N and fungicide had not been applied).

Biomass at V11 at Arlington was significantly lower in treatment 13 compared to treatment 1. No differences at Lancaster.

Effect of high yield management on silage & grain yield at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Silage Yield A	Silage Yield L	Grain Yield A	Grain Yield L
		lb/a							x1000	T/a DM		bu/a	
1	2x2	20	20	20	10	+	185	+	41	12.53	11.92	238	225
11	2x2	20	20	20	10	+	150	+	41	14.30	11.05	257	230
12	2x2	20	20	20	10	+	185		41	13.02	10.46	256	226
13	2x2	20	20	20	10	+	185	+	35	11.71	10.60	233	229

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

Effect of high yield management on grain moisture & test weight at Arlington & Lancaster

Trt	Place	N	P_2O_5	K_2O	S	micros	N Rate	Fungi	Pop	Moisture A	Moisture L	Test Wt A	Test Wt L
		lb/a							x1000	%		lb/bu	
1	2x2	20	20	20	10	+	185	+	41	21.9	18.3	53.4	53.0
11	2x2	20	20	20	10	+	150	+	41	25.5	18.4	52.4	52.8
12	2x2	20	20	20	10	+	185		41	23.8	18.1	52.4	52.3
13	2x2	20	20	20	10	+	185	+	35	23.3	18.2	53.2	51.5

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

Tissue and grain nutrient composition

- Data not available

Summary: Composition of 2x2 starter

- The composition of 2x2 starter produced few and inconsistent effects on V3-4 population, V4-6 biomass, and V11-12 biomass
- Significant effect of 2x2 starter composition on silage yield did not translate to grain yield
- Grain yield was significantly reduced where N only was applied 2x2 compared to no starter at both location

Summary: Composition of 2x2 starter

- NPK 2x2 starter produced significantly greater silage yield at Arlington and grain yield at Lancaster compared to NPKSmicros applied 2x2
- Application of NKSmicros 2x2 resulted in significantly lower silage yield compared to no starter or NPKSmicros at both locations

Summary: Starter placement (2x2 vs pop-up) and composition

- Starter placement had no effects on any parameter measured at Arlington
- 10-34-0 applied as a pop-up had significantly greater V6 & V11 biomass at Lancaster compared to 20-20-20-10S-micros 2x2, but yield was not effected
- 5-11-5 popup had significantly greater V11 biomass, silage & grain yield, and grain moisture & test weight compared to 20-20-20-10S-micros

Summary: High yield management

- Population
  - Reducing population to 35,000 resulted in lower V4 & V11 biomass at Arlington, but didn't effect yield
  - At Lancaster, lower population resulted in lower V6 biomass, silage yield, and grain moisture & test weight

Summary: High yield management

- Sidedress N
  - 150 lb N/a had significantly lower V4 biomass compared to 180 lb N/a at Arlington, but did not effect yield, moisture, or test weigh
- Fungicide @ R1
  - Fungicide application had no effect on yield, moisture, or test weight

Questions?

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Contact Info:

- Carrie Laboski
- laboski@wisc.edu
- 608-263-2795
- www.NPK.etc.info
- www.soils.wisc.edu/extension/