Starter Fertilizer and High Yield Management Impacts on Corn Production

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Questions Growers Are Asking

- What is the value of starter fertilizer to high yield potential corn grown on soils testing high in P &K?
- Are low rates of starter fertilizer applied with the seed as beneficial as 2 x 2 applications?
- High crop input prices create more financial risk, can starter fertilizer reduce risk?
- Does reduced atmospheric deposition of S, create a need for S in starter fertilizer?
- Does high yield crop management practices increase the need for starter fertilizer?

Objectives

Understand how early season growth and yield are impacted by:

1. Nutrient composition of starter fertilizer
2. Placement of starter fertilizer (2 x 2 or in-furrow)
3. High yield management and starter fertilizer use

Methods & Materials

- Six site-years in southern Wisconsin
  - Arlington Ag Research Station 2011-2013, Plano sil
  - Lancaster Ag Research Station 2012-2014, Fayette sil in 2012 & 2014, Dubuque sil in 2013
- Previous crop was corn grain for all site years except, Arlington 2011 (corn silage) and Lancaster 2014 (winter wheat)
- Soil test and corn hybrid information in Table 1.
- Treatments consisted of liquid 2 x 2 or in-furrow starter fertilizer which varied in the composition of nutrients (Table 2).
- High yield management was also evaluated by varying:
  - Rate of sidedress N (207 vs 168 kg N ha^{-1} following corn or 179 vs 134 kg N ha-1 following wheat)
  - Foliar fungicide applied at VT (0 vs 365 mL ha^{-1} Stratego YLD)
  - Seeding rate (101,270 vs 86,450 seeds ha^{-1})
- Treatments were statistically analyzed using the Dunnett's test for pairwise comparisons at the α=0.10 level. Comparisions made between:
  - The complete 2 x 2 starter with all high yield management practices and all other treatments with 2 x 2 placement (treatment 1 vs 2 – 13)
  - The complete 2 x 2 starter with 207 kg N ha^{-1}, fungicide, and the lower seeding rate (86,450 seeds ha^{-1}) with all in-furrow applications at the same seeding rate (treatment 13 vs 14 – 16)

Table 1. Soil test values, corn hybrid, and growing season information.

	Arlington			Lancaster		
	2011	2012	2013	2012	2013	2014
Soil test, 0-15 cm						
pH	6.2	6.6	7.4	7.1	7.0	6.9
OM, %	4.1	3.7	3.1	2.0	2.6	2.5
P, ppm	59 (EH)	101 (EH)	118 (EH)	46 (EH)	17 (O)	17 (O)
K, ppm	171 (VH)	186 (VH)	248 (EH)	150 (H)	136 (H)	119 (O)
Ca, ppm	1910 (H)	2028 (H)	2175 (H)	1318 (H)	1751 (H)	1258 (H)
Mg, ppm	425 (O)	580 (H)	550 (H)	400 (O)	525 (H)	377 (O)
Mn, ppm	35 (H)	16 (O)	16 (O)	22 (H)	21 (H)	18 (O)
Zn, ppm	6 (O)	8 (O)	4 (O)	3 (O)	2 (O)	3 (O)
SO_4-S, ppm	5 (L)	6 (L)	5 (O)	6 (L)	6 (L)	5 (L)
Hybrid	P0461XR	936V53	P0407AMXT	P36V53	Croplan 3737	P0407AMXT
Rel. Maturity	104 day	102 day	104 day	102 day	96 day	104 day
Planting Date	10 May	18 May	16 May	21 May	4 June	21 May
GDD to R1	1376	1773	1382	1669	1686	1454
GDD to 1 Oct.	2448	2773	2468	2654	2347	2407
R6 harvest	21 Sept.	24 Sept.	2 Oct.	25 Sept.	10 Oct.	30 Sept.
Grain harvest	20 Oct.	31 Oct.	4 Nov.	8 Nov.	5 Dec.	12 Nov.

Results

Table 2. Effect of starter fertilizer treatment and high yield management on corn grain yield.

	Starter	Starter Nutrient Composition†					Sidedress	Foliar	Seeding	Arlington			Lancaster		
Trt	Placement	N	P_2O_5	K_2O	S	Micros	N Rate	Fungicide	Rate	2011	2012	2013	2012	2013	2014
		kg ha^{-1}							Seeds ha^{-1}	Grain Yield, Mg ha^{-1}					
1	2 x 2	22.4	22.4	22.4	11.2	yes	high	yes	101,270	11.5	9.1	14.9	7.3	14.1	14.9
2	2 x 2	5.6	22.4	22.4	11.2	yes	high	yes	101,270	12.5	8.8	14.4	6.4	13.8	14.7
3	2 x 2	22.4	0	22.4	11.2	yes	high	yes	101,270	12.4	10.0	15.8	8.0	14.7	14.5
4	2 x 2	22.4	22.4	0	11.2	yes	high	yes	101,270	11.9	9.3	14.4	7.4	13.9	15.0*
5	2 x 2	22.4	22.4	22.4	0	yes	high	yes	101,270	12.5	9.5	14.8	6.8	14.0	14.8
6	2 x 2	22.4	22.4	22.4	11.2	no	high	yes	101,270	11.9	9.3	15.9	7.2	14.6	14.9
7	2 x 2	22.4	0	0	11.2	yes	high	yes	101,270	12.2	8.9	15.9	7.9	14.4	14.5
8	2 x 2	22.4	22.4	22.4	0	no	high	yes	101,270	12.5	9.0	15.6	7.3	14.9	14.2
9	2 x 2	22.4	0	0	0	no	high	yes	101,270	12.0	8.7	14.8	6.6	13.5	15.2
10	-	0	0	0	0	no	high	yes	101,270	11.9	9.3	16.4	6.9	14.3	14.0
11	2 x 2	22.4	22.4	22.4	11.2	yes	medium	yes	101,270	11.7	9.5	16.1	7.8	14.4	14.1
12	2 x 2	22.4	22.4	22.4	11.2	yes	high	no	101,270	11.2	9.5	16.1	7.7	14.2	13.7*
13	2 x 2	22.4	22.4	22.4	11.2	yes	high	yes	86,450	12.0	8.9	14.6	7.7	14.4	14.2
14	In-furrow	7.8	28	0	0	no	high	yes	86,450	12.2	8.8	15.3	8.8	14.1	13.8
15	In-furrow	5.6	12.3	5.6	0	no	high	yes	86,450	11.8	9.2	14.1	8.2	14.9	13.7
16	In-furrow	6.7	22.4	4.5	3.4	no	high	yes	86,450	11.2	9.2*	15.6	7.3	14.7	14.4
									CV, %	6.0	6.8	8.9	12.9	7.0	3.8

† Treatments 1-13 mixed using various amounts and combinations of UAN, 10-34-0, phosphoric acid, 0-0-12, 0-0-30, ammonium thiosulfate, and potassium thiosulfate. Treatment 14 was 10-34-0; treatment 15 was 9-18-9; and treatment 16 was 10-34-0 and potassium thiosulfate. The micronutrients consisted of 0.56 kg ha^{-1} Zn and 0.56 kg ha^{-1} Mn and 0.34 kg ha^{-1} Cu all chelated with EDTA
* Denotes a significant (p <0.05) difference between the treatment and it's contrast. Treatments 4 and 12 were contrasted with treatment 1. Treatment 16 was contrasted with treatment 13.

Weather

- May through September precipitation was dryer than the 30-year average at all sites except Arlington in 2013.
  - 2012 was a drought year at both location with May through September precipitation 251 mm and 201 mm below normal at Arlington & Lancaster, respectively.
  - May and June precipitation in 2013 was wetter than normal (132 mm and 106 mm) at Arlington & Lancaster, respectively. However, July through August precipitation was below normal.
- Average May temperature departure from normal was -1.2, 1.1, and -0.6 ℃ in 2011, 2012, and 2013, respectively at Arlington; and 3.8, 0.9, and 0.4 in 2012, 2013, and 2014, respectively, at Lancaster.

Effect on Yield, Moisture, and Biomass

- **Grain Yield (Table 2):** In 2014, yield was significantly reduced at Lancaster when fungicide was not applied at VT. There was a significant yield increase when K was left out of the 2 x 2 starter at Lancaster in 2014. Lower rates of N-P-K applied in-furrow (treatment 16) resulted in significantly lower yield compared to 2 x 2 placement of N-P-K-S with micros.
- **Grain Moisture:** In 2011, grain moisture was significantly reduced by 4.0% when a low rate of N (5.6 kg ha^{-1}) was applied 2 x 2 (treatment 2) at Arlington in 2011. In-furrow starter placement without S or micros (treatment 16) increased grain moisture by 0.6% at Lancaster in 2014.
- **Silage Yield:** In 2013, 2 x 2 starter fertilizer with all nutrients except for S (treatment 5) increased yield at Arlington and decreased yield at Lancaster compared to treatment 1 which contained all nutrients. Also in 2013, in-furrow application of starter with 5.6-12.3-5.6 kg ha^{-1} of N-P_2O_5-K_2O had significantly greater yield than 2 x 2 placement of 20-20-20-10S with micros at Lancaster. All other starter and management practices had no effect on silage yield.
- **Early Season (V5-6) Biomass:** 2 x 2 starter fertilizer treatments that did not include S or micros (treatments 8-10) or with a lower N rate (treatment 2) had significantly lower early season biomass in 2013 at Arlington. Early season biomass was also significantly reduced in 2013 at Arlington where a lower population was planted. Otherwise there was no effects on early season biomass.

Summary

- Growing season precipitation was drier than normal and average May air temperature was near normal, except for 2012.
- Starter fertilizer nutrient composition and placement had minimal and inconsistent effects on grain and silage yield as well as early season biomass accumulation on soils with optimum to excessively high soil test P and K levels.
- Current University of Wisconsin N rate guidelines were adequate to produce maximum yield for site conditions.
- Seeding rate greater than 86,450 seeds ha^{-1} did not increase yield.
- Use of foliar fungicide at VT increased yield at one of six site-years.

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