Enhancing Continuous Corn Production Under High-Residue Conditions with Starter Fluid Fertilizer Combinations and Placements

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Justification

- **Crop rotations are changing to meet rapid expansion of bio-fuel industry**
  - C-C-S and other corn-intensive rotations
  - Large amounts of biomass are produced

- **High amounts of surface residue keeps soil temps cool, which can reduce corn yield**

- **Farmers have tillage choices:**
  - moldboard plow; increases potential for erosion
  - conservation; can the yield penalty be overcome with fluid starter fertilizers?

Objectives

- Determine the effects of fluid starter fertilizer placement and combinations of 10-34-0 & 28-0-0 on second-yr corn production under reduced tillage/high-residue conditions
- Provide management guidelines on placement and rates of UAN and APP for corn producers trying to meet the growing needs for corn grain by the ethanol industry and livestock producers.
- Present economic evaluation of fluid fertilizer treatments

Experimental Procedures

Soil: Nicollet-Webster cl at So. Res. & Outreach Ctr., Waseca, MN

Design: Split plot with main plots (60 x 50') as tillage and sub-plots (10' x 50') as combinations of rates and placements of APP and UAN

Tillage: Fall Moldboard plow 9" deep

- 14% surface residue (May 6)

Fall Disk chisel/rip 9" deep

- 52% surface residue (May 6)

STP: 21 ppm Bray P_1 (VH)


WHITE 6342


2500

Starter Treatments

Placement	APP	UAN
	gal/A	lb N/A
Zero control	0	0
Popup	5	0
2 x 0	5	0
“	5	15
“	5	30
“	5	45

Weather

Temps: Cool May-August, GDU's 13% below normal and 28% above normal in September.

Precipitation: Below normal each month from April – September. May-Sept. growing season = 11.0" or 9.42" (46%) below normal. Available soil water from mid-August thru Sept. ranged from 40 to 25% from FMC with >80% below 3'.

Results

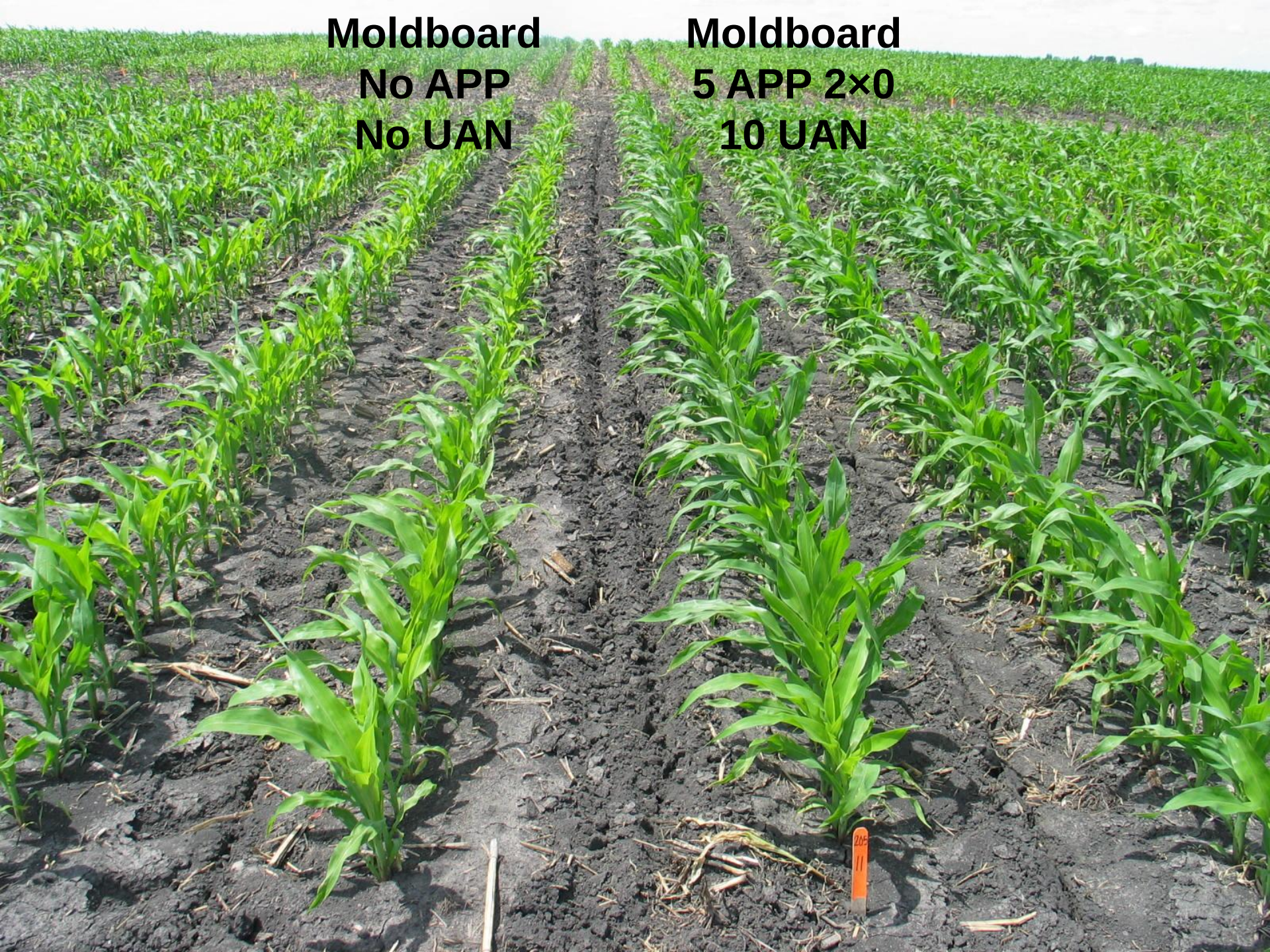

Chisel
5 APP 2 0
No UAN
Chisel
No APP
No UAN

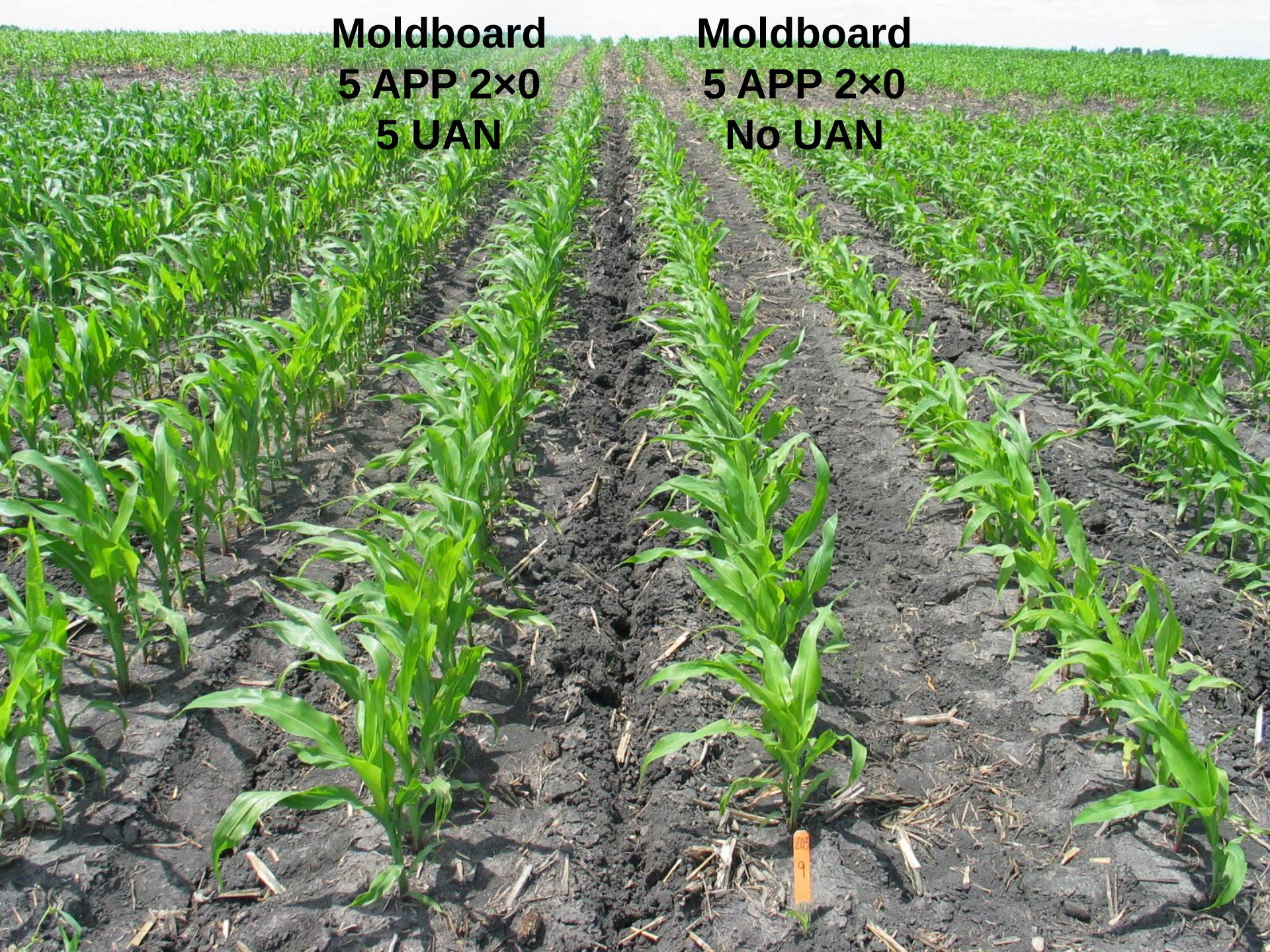

Chisel
5 APP Pop-up
No UAN
Chisel
5 APP 2×0
No UAN


Chisel
No APP
No UAN
Chisel
5 APP 2×0
10 UAN
112
5


Chisel
5 APP 2×0
10 UAN
Chisel
5 APP Pop-up
No UAN


Chisel
5 APP 2×0
15 UAN
Chisel
5 APP 2×0
5 UAN


Moldboard
No APP
No UAN
Moldboard
5 APP 2×0
10 UAN


Moldboard
5 APP 2×0
5 UAN
Moldboard
5 APP 2×0
No UAN

Interactions

- There were no significant (P=0.05 level) interactions between Tillage System and Starter Treatment except for grain moisture.
  - thus, main effects are valid for all except grain moisture.

Effect of tillage on small whole plant (V7) growth and uptake of N and P in 2009.

Tillage	DM Yield	Uptake	
		N	P
	lb/A	- - - - - lb/A - - - - -	
Moldboard	652	24.3	2.45
Chisel/rip	446	15.7	1.66
P > F:	*0.022*	*0.021*	*0.040*

Effect of starter treatments on small whole plant (V7) growth and uptake of N and P in 2009.

Starter Treatment			DM	Uptake	
Placement	APP	UAN	Yield	N	P
	gal/A	lb N/A	lb/A	- - lb/A - -	
Zero-control	0	0	332	12.5	1.29
Popup	5	0	712	23.5	2.48
2 x 0	5	0	472	17.5	1.88
"	5	15	552	20.4	2.01
"	5	30	590	21.7	2.18
"	5	45	634	24.5	2.47
LSD (0.10):			*92*	*3.5*	*0.35*

Effect of tillage on grain yield and moisture and uptake of N and P in 2009.

	Grain		Uptake	
Tillage	Yield	Moisture	N	P
	bu/A	%	- - - lb/A - - -	
Moldboard	209	30.6	117	23.4
Chisel/rip	198	32.8	116	24.6
P > F:	*0.021*	*0.016*	*0.664*	*0.088*

Effect of starter treatments on grain yield and uptake of N and P in 2009.

Starter Treatment			Grain	Uptake	
Placement	APP	UAN	Yield	N	P
	gal/A	lb N/A	lb/A	- - - lb/A - - -	
Zero-control	0	0	204	118	24
Popup	5	0	206	118	25
2 x 0	5	0	204	119	24
"	5	15	203	115	24
"	5	30	202	116	24
"	5	45	201	113	24
LSD (0.10):			*NS*	*NS*	*NS*

Grain moisture as affected by tillage and starter fertilizer in 2009.

Starter Treatment			Tillage	
Placement	APP	UAN	M. Plow	Chisel/rip
	gal/A	lb N/A	- - - - - - - - % - - - - - -	
Zero-control	0	0	31.0	34.8
Pop-up	5	0	29.4	32.5
2 x 0	5	0	30.0	34.8
"	5	15	30.9	31.8
"	5	30	31.3	31.9
"	5	45	31.0	31.1

Conclusions - 2009

Tillage:

- Moldboard plow tillage increased early plant growth (V7) by 46% and grain yield by 11 bu/A.
- N and P uptake was increased in the V7 plant by 55 and 48%, respectively, by moldboard plow tillage but uptake in the grain was not affected by tillage
- Grain moisture at harvest for chisel/rip tillage (34.8%) was decreased about 3 points by APP + UAN, but for moldboard tillage (31.0%) starter fertilizer had no effect. Pop-up placement of APP was most effective.

Conclusions - 2009

Starter fertilizers:

- In-furrow, pop-up placement of APP increased early growth (V7 stage) over the no-starter control by 150% for chisel/rip tillage and 93% for moldboard tillage.
- Averaged across tillage systems pop-up and 2 x 0 dribble placement of APP increased early growth over the no-starter control by 114 and 42%, respectively.
- Adding UAN to 2 x 0 placed APP increased early growth by 25% when averaged across N rates and tillage.
- In-furrow, pop-up placement of APP increased early growth over the 2 x 0 dribble placement of APP + 45 lb N/A as UAN by 12%.
- Grain yields were not influenced by starter fertilizer in this year when precipitation and soil moisture were limiting.

Three-Year Results

2007-2009

Effect of tillage on average small plant (V7) growth and uptake of N and P in 2007 - 2009.

Tillage	DM Yield	Uptake	
		N	P
	lb/A	- - - - - lb/A - - - - -	
Moldboard	724	23.9	2.63
Chisel/rip	560	18.2	2.08
P > F:	*0.001*	*0.001*	*0.001*

No Year x Tillage interaction

Effect of tillage on average grain yield and moisture in 2007 – 2009.

	Grain	
Tillage	Yield	Moisture
	bu/A	%
Moldboard	191.4	23.4
Chisel/rip	184.9	24.4
P > F	*0.001*	*0.009*

Year x Tillage interaction was significant.

Effect of starter treatments on average small whole plant (V7) growth and grain yield in 2007 - 2009.

Starter Treatment			DM	Grain
Placement	APP	UAN	Yield	Yield
	gal/A	lb N/A	lb/A	bu/A
Zero-control	0	0	520	184.5
Popup	5	0	752	190.4
2 x 0	5	0	534	185.9
"	5	15	642	191.5
"	5	30	656	189.5
"	5	45	748	187.1
LSD (0.10):			*46*	*4.3*

A significant Yr x Starter interaction for all

Three-Year Conclusions

- Moldboard plowing increased early plant growth by 29% and grain yield by 6.5 bu/A compared to chisel/rip tillage.
- APP placed in the seed furrow as a pop-up or combined with UAN and dribbled on the soil surface increased early plant growth by 3 to 45% and grain yield by 1 to 7 bu/A on these very high P-testing soils.

Acknowledgement

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Thanks

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