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

- 15% surface residue (May 12)

Fall Disk chisel 9" deep

- 54% surface residue (May 12)

STP: 26 ppm Bray P_1 (VH)


WHITE 6342


2500

Starter Treatments

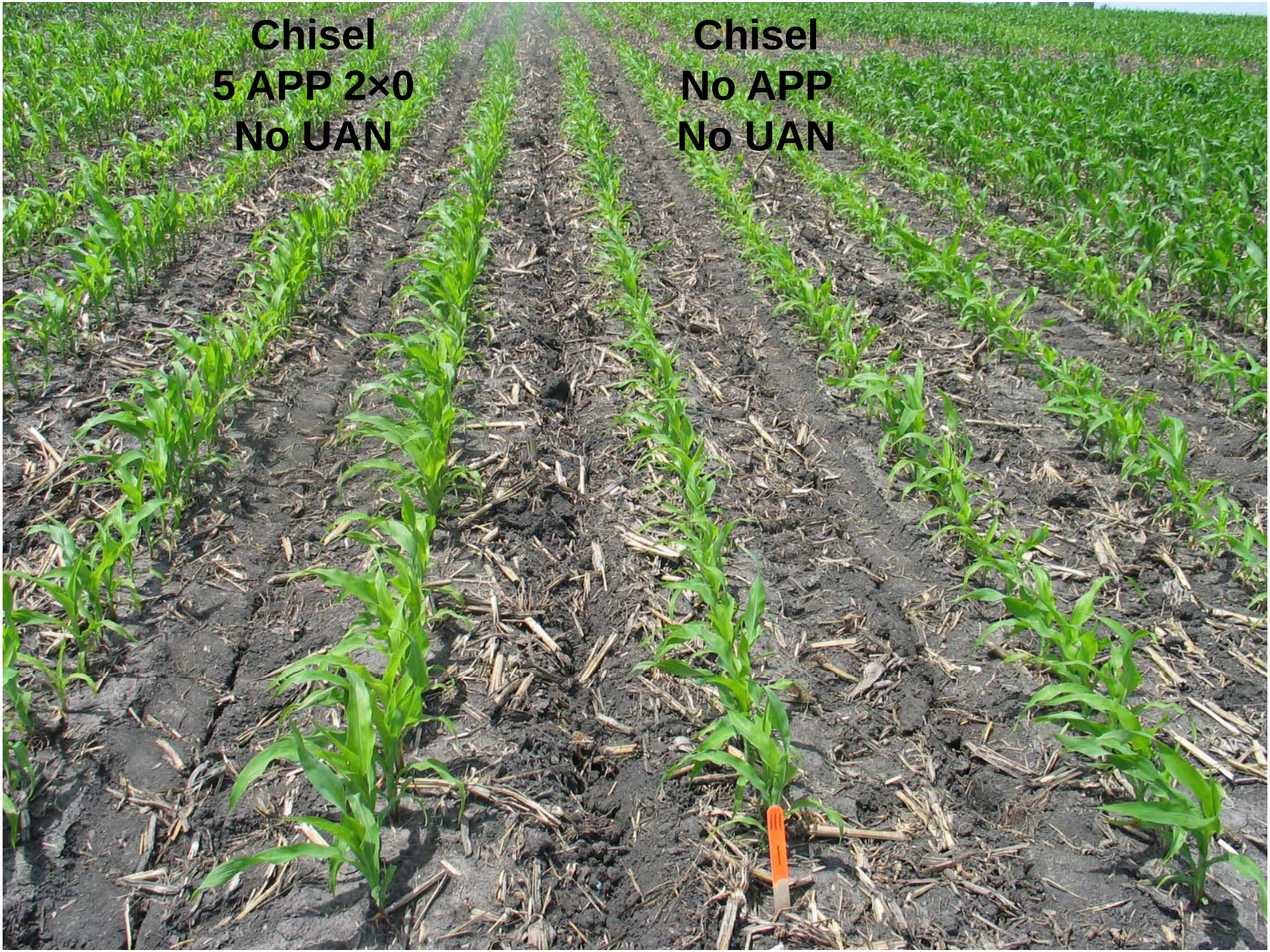
Placement	APP	UAN
	gal/A	lb N/A
Zero control	0	0
Popup	5	0
2 x 0	5	0
“	5	15
“	5	30
“	5	45

Weather

Temps: Cool April-June, GDU's 19% and 6% below normal in May & June and 12% above normal in September

Precipitation: Normal from April through June. 4.18" on July 17 followed by only 4.0" in the next 10 weeks. Available soil water in top 5' was near FMC at tasseling but was at only 36% of FMC on Oct. 1.

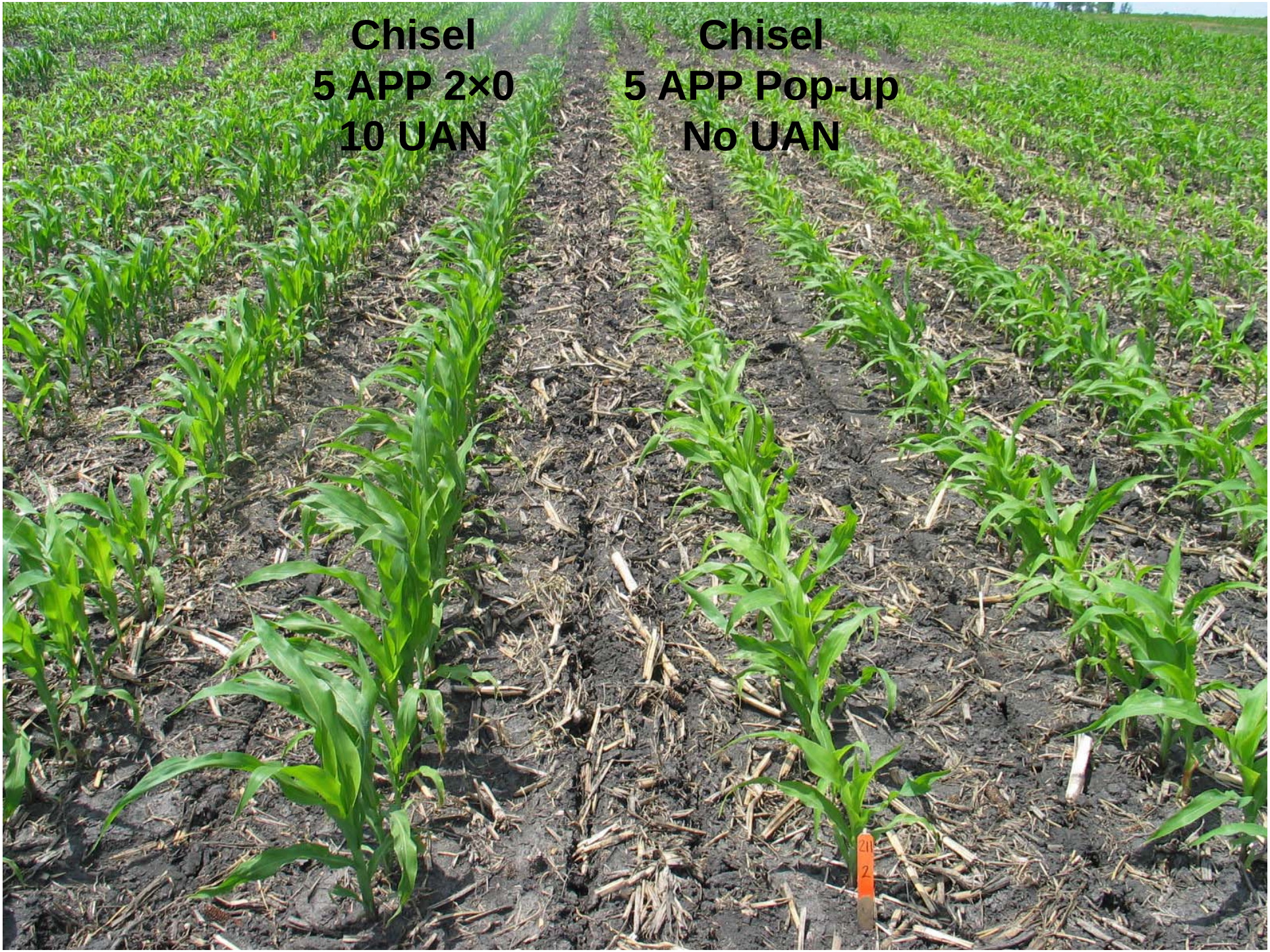
Results


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

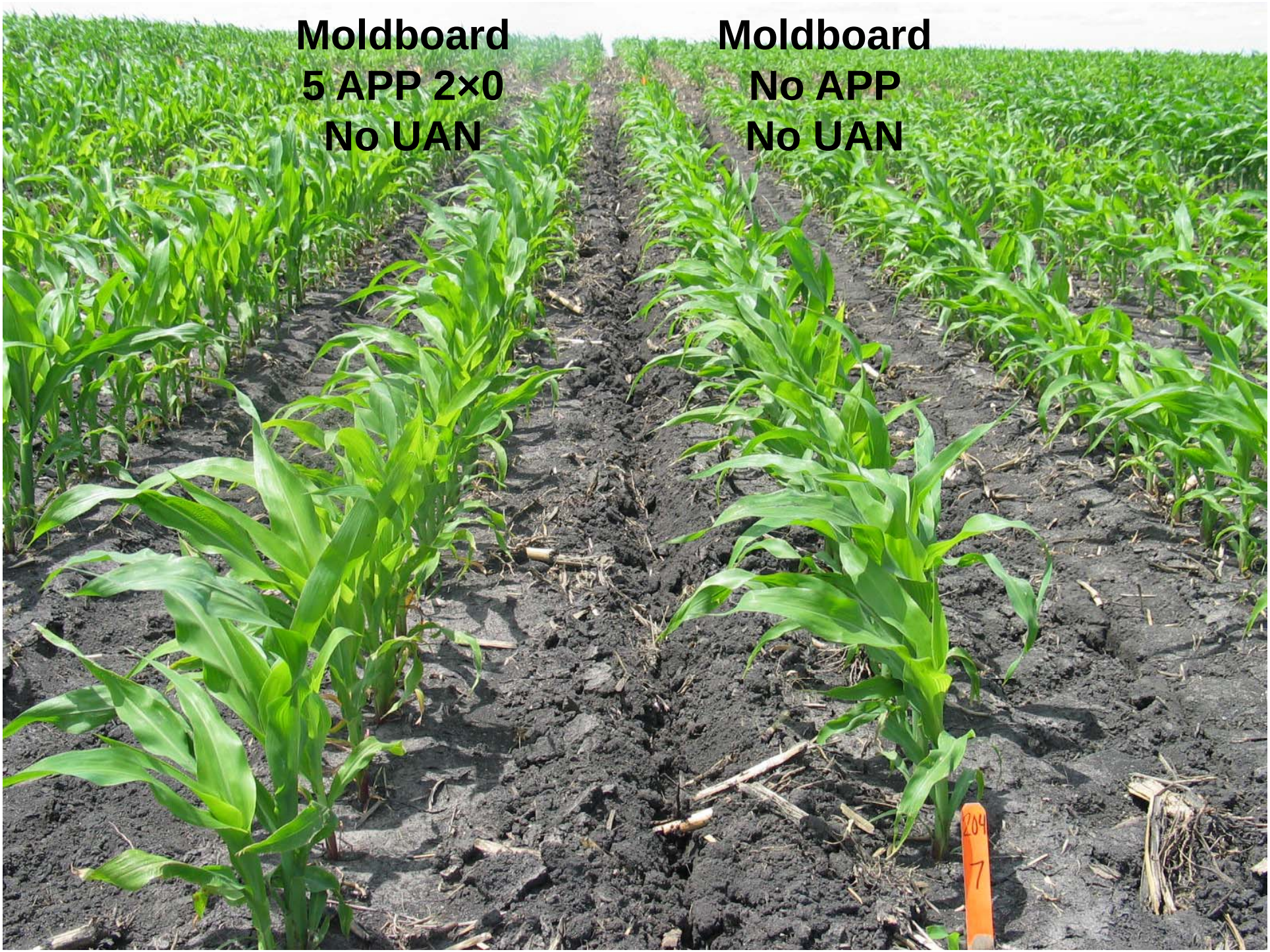

Chisel
5 APP Pop-up
No UAN
Chisel
5 APP 2×0
No UAN

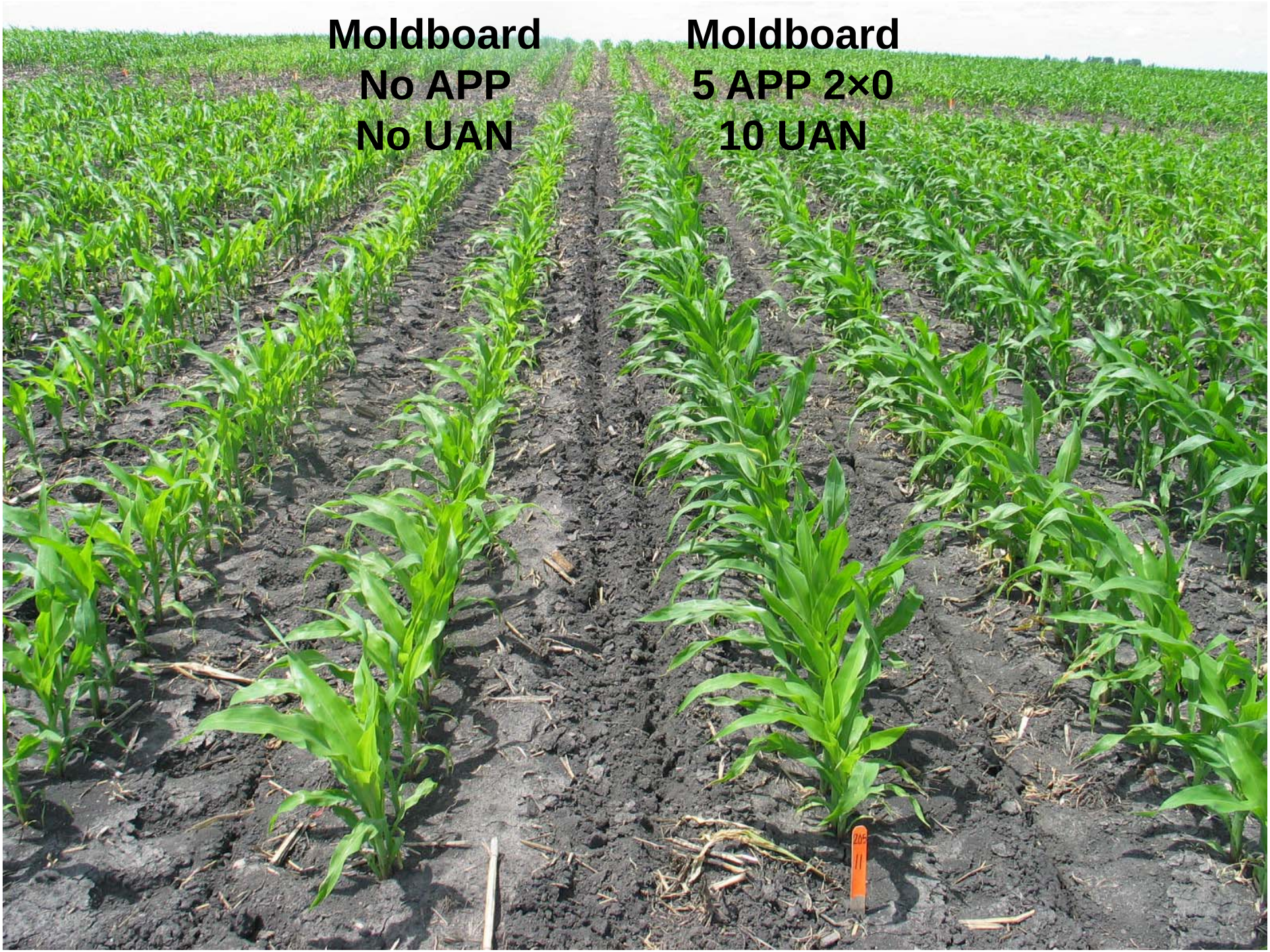

Chisel
No APP
No UAN
Chisel
5 APP 2×0
10 UAN
112
5

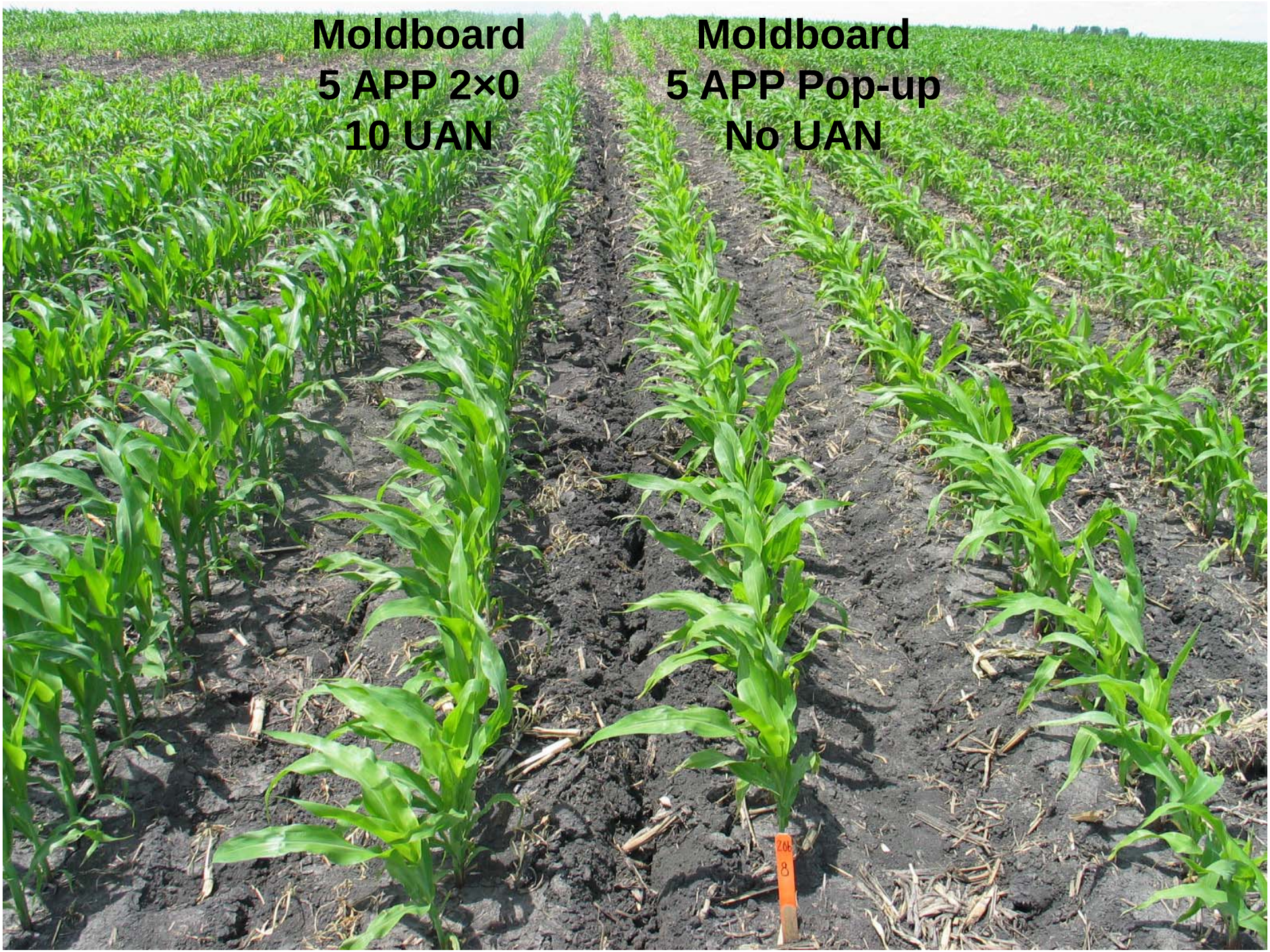

Chisel
5 APP 2×0
15 UAN
Chisel
5 APP 2×0
No UAN

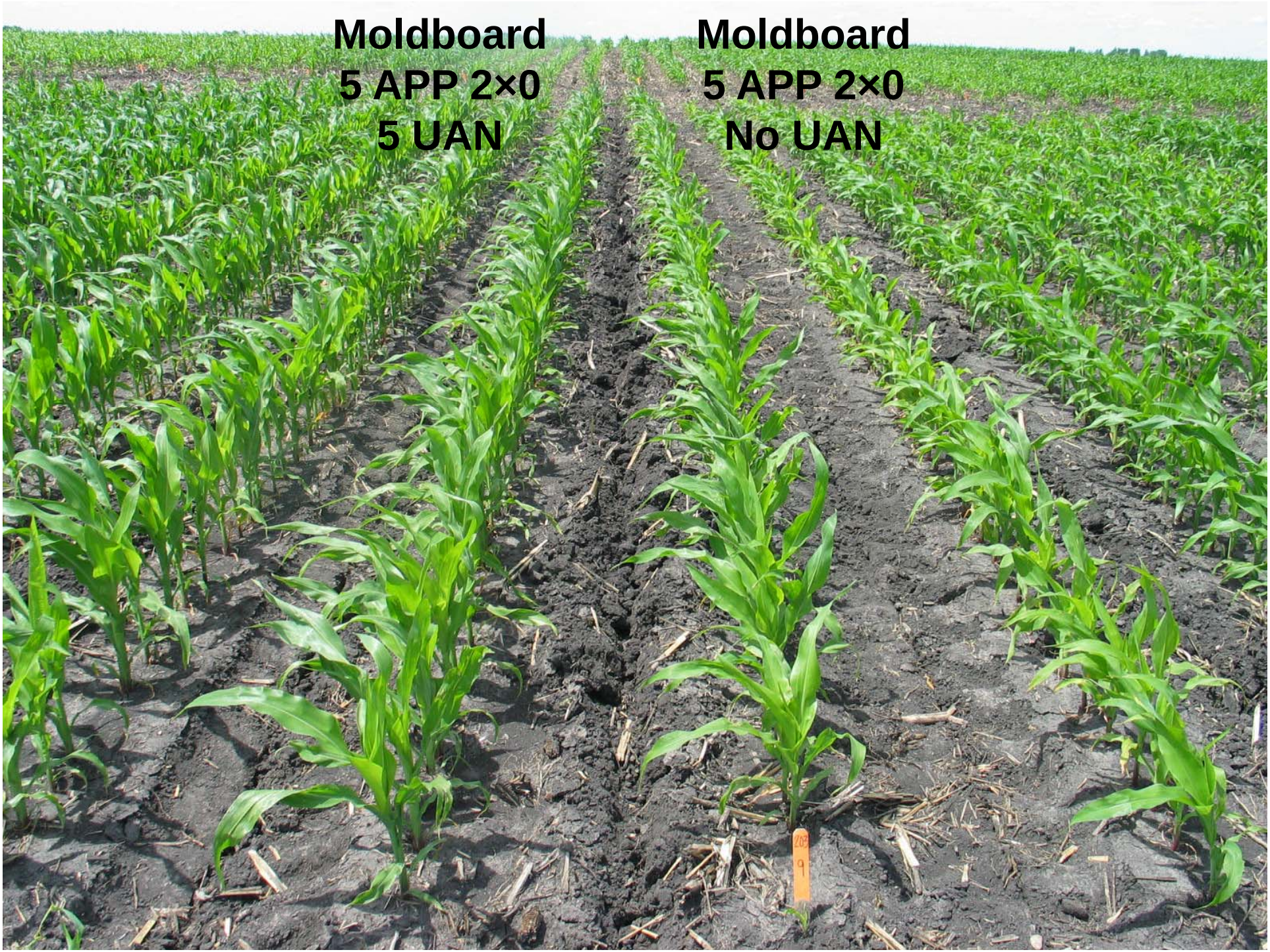

Chisel
5 APP 2×0
10 UAN
Chisel
5 APP Pop-up
No UAN


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


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


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


Moldboard
5 APP 2×0
10 UAN
Moldboard
5 APP Pop-up
No 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.
    - thus, main effects are valid

Effect of tillage on small whole plant (V7) growth and uptake of N and P in 2008.

Tillage	DM Yield	Uptake	
		N	P
	lb/A	- - - - - lb/A - - - - -	
Moldboard	696	18.6	2.36
Chisel	516	14.0	1.89
P > F:	*0.043*	*0.018*	*0.078*

Effect of starter treatments on small whole plant (V7) growth and uptake of N and P in 2008.

Starter Treatment			DM	Uptake	
Placement	APP	UAN	Yield	N	P
	gal/A	lb N/A	lb/A	- - lb/A - -	
Zero-control	0	0	444	13.5	1.79
Popup	5	0	636	15.7	2.25
2 x 0	5	0	500	13.9	1.88
"	5	15	596	15.3	2.06
"	5	30	680	18.0	2.20
"	5	45	780	21.3	2.57
LSD (0.10):			*76*	*1.9*	*0.25*

Effect of tillage on grain yield and moisture and uptake of N and P in 2008.

	Grain		Uptake	
Tillage	Yield	Moisture	N	P
	bu/A	%	- - - lb/A - - -	
Moldboard	185	23.4	110	23.4
Chisel	182	24.3	109	23.2
P > F:	*0.471*	*0.364*	*0.618*	*0.860*

Effect of starter treatments on grain yield and moisture and uptake of N and P in 2008.

Starter Treatment			Grain		Uptake	
Placement	APP	UAN	Yield	H_2O	N	P
	gal/A	lb N/A	lb/A	%	- - - lb/A - - -	
Zero-control	0	0	174	23.5	107	23
Popup	5	0	184	25.2	110	24
2 x 0	5	0	184	23.9	110	22
"	5	15	189	23.8	111	23
"	5	30	189	23.5	111	25
"	5	45	183	23.2	106	23
LSD (0.10):			*7*	*1.1*	*NS*	*NS*

Conclusions - 2008

- Although early plant growth (V7) was increased 35% and early N & P uptake was increased 25 to 33% by moldboard plow (MP) tillage and silking was about 7 days earlier, grain yields were not different between the two tillage systems. Perhaps moisture stress between 7/15 and 9/30 limited grain production more for MP tillage.
- Early plant growth and N and P uptake (V7 stage) were significantly increased by 10-34-0 placed in the seed furrow w/o extra N and dribbled on the soil surface with15 to 45 lb extra N/A.
- Grain yields were increased 10-15 bu/A by the starter fertilizer treatments with no significant difference between placement or among N rates on this VH P-testing soil.

Two-Year Results

2007-2008

Effect of tillage on average small plant (V7) growth and uptake of N and P in 2007 and 2008.

Tillage	DM Yield	Uptake	
		N	P
	lb/A	- - - - - lb/A - - - - -	
Moldboard	758	23.7	2.72
Chisel/rip	618	19.5	2.29
P > F:	*0.002*	*0.001*	*0.003*

No Year x Tillage interaction

Effect of tillage on average grain yield and moisture in 2007 and 2008.

	Grain	
Tillage	Yield	Moisture
	bu/A	%
Moldboard	182.5	19.8
Chisel/rip	178.5	20.2
P > F	*0.056*	*0.370*

No Year x Tillage interaction

Effect of starter treatments on average small whole plant (V7) growth and uptake of N and P in 2007 and 2008.

Starter Treatment			DM	Update	
Placement	APP	UAN	Yield	N	P
	gal/A	lb N/A	lb/A	- - - lb/A - - -	
Zero-control	0	0	532	18.6	2.12
Popup	5	0	682	19.7	2.41
2 x 0	5	0	530	17.3	2.08
"	5	15	602	18.6	2.29
"	5	30	602	18.7	2.15
"	5	45	760	23.9	2.68
LSD (0.10):			*54*	*1.7*	*0.22*

A significant Yr x Starter interaction for all

Effect of starter treatments on average grain yield and moisture in 2007 and 2008.

Starter Treatment			Grain	
Placement	APP	UAN	Yield	Moisture
	gal/A	lb N/A	bu/A	%
Zero-control	0	0	174.6	19.8
Popup	5	0	180.3	20.8
2 x 0	5	0	174.1	20.4
"	5	15	181.1	20.3
"	5	30	181.5	20.0
"	5	45	179.2	20.1
LSD (0.10):			*4.9*	*NS*

No Yr x Starter interaction

Two-Yr Economic return to TILLAGE

Parameter	Tillage	
	Chisel	Moldboard Plow
Corn yield (bu/A)	178.5	182.5
Gross return ($/A)[1/]	$714.	$730.
Tillage cost ($/A)	$13.00	$17.75
Return to tillage ($/A)	$701.00	$712.25
Profit advantage ($/A)	--	$11.25

[1/] Corn price = $4.00/bu.

Two-Year
Economic return to STARTER FERTILIZER

Starter Treatment[1/]			Corn	Gross[2/]	Fert.	Net
Placement	APP	UAN	Yield	Return	cost	Return
	gal/A	lb N/A	bu/A	- - - - - - -	$/A - - - - - - -	
Zero-control	0	0	174.6	698	0	
Popup	5	0	180.3	721	20.25	3
2 x 0	5	0	174.1	696	"	-22
"	5	15	181.1	724	"	+6
"	5	30	181.5	726	"	+8
"	5	45	179.2	717	"	-1

[1/] APP = $4.05/gal. (Spr. '07 + '08 avg.) No extra cost for UAN

[2/] Corn price = $4.00/bu

Two-Year Conclusions

- Moldboard plowing increased early plant growth by 23% and grain yield by 4 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 13 to 43% and grain yield by 5 to 7 bu/A on these very high P-testing soils.

Acknowledgement

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Thanks

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http://sroc.cfans.umn.edu