Enhancing Continuous Corn Production In High Residue Conditions with Fluid Starter Fertilizer Combinations and Placement

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Justification

- Crop rotations in the Midwest have changed to more corn-intensive rotations.
- Corn after corn produces large amounts of stover (residue) that remains on the soil surface with conservation tillage systems. This is good in terms of erosion control, but can be a significant challenge to corn producers on many poorly drained, colder soils of the Northern Corn Belt from the standpoint of seedbed preparation, early corn growth, and yield (Vetsch et al., 2010).

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Objectives

- The objectives of this study were to:
  1) determine the effects of fluid starter fertilizer combinations and placement of 10-34-0 (APP), 28-0-0 (UAN), and 12-0-0-26 (ATS) on corn production following corn in reduced tillage (chisel plow) high-residue conditions,
  2) provide management guidelines on placement and rate of UAN, APP, and ATS combined as a starter to crop consultants, local ag advisors, and the fertilizer industry.

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Treatments

No.†	APP, 10-34-0 Rate	APP, 10-34-0 Placement	UAN, 28-0-0 Rate	UAN, 28-0-0 Placement	ATS, 12-0-0-26 Rate	ATS, 12-0-0-26 Placement	N+P+S Application rate
	gal./A		gal./A		gal./A		lb $N+P_2O_5+S$
1	0	---	0	---	0	---	0+0+0
2	0	---	0	---	2	Surface dribble	3+0+5.8
3	0	---	0	---	4	Surface dribble	5+0+11.5
4	0	---	8	Surface dribble	0	---	24+0+0
5	0	---	8	Surface dribble	2	Surface dribble	27+0+5.8
6	0	---	8	Surface dribble	4	Surface dribble	29+0+11.5
7	4	In furrow	0	---	0	---	5+16+0
8	4	In furrow	0	---	2	Surface dribble	7+16+5.8
9	4	In furrow	0	---	4	Surface dribble	10+16+11.5
10	4	In furrow	8	Surface dribble	0	---	29+16+0
11	4	In furrow	8	Surface dribble	2	Surface dribble	31+16+5.8
12	4	In furrow	8	Surface dribble	4	Surface dribble	34+16+11.5
13	4	In furrow	0	---	1	In furrow	6+16+2.9
14	4	In furrow	8	Surface dribble	1	In furrow	30+16+2.9

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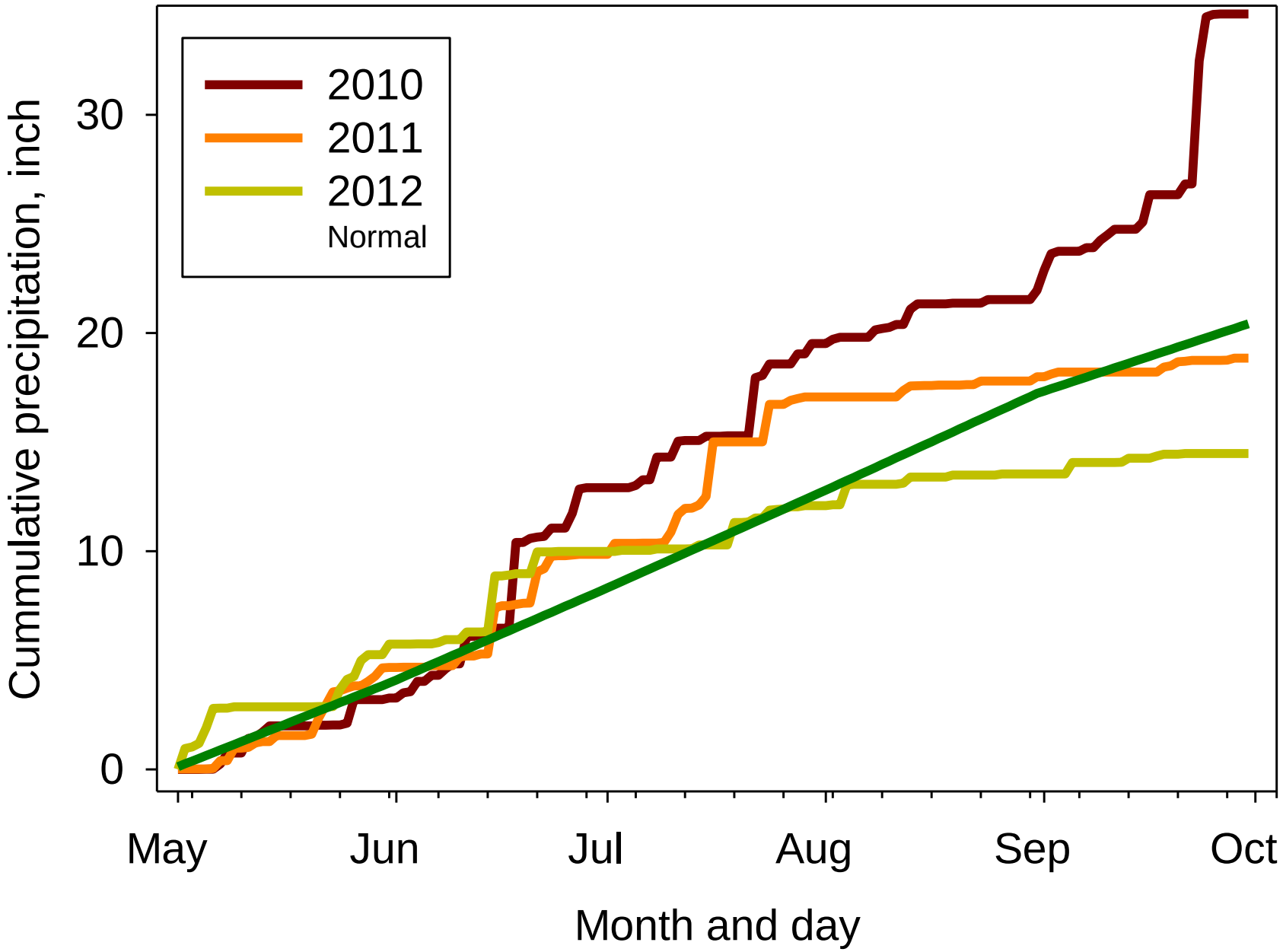
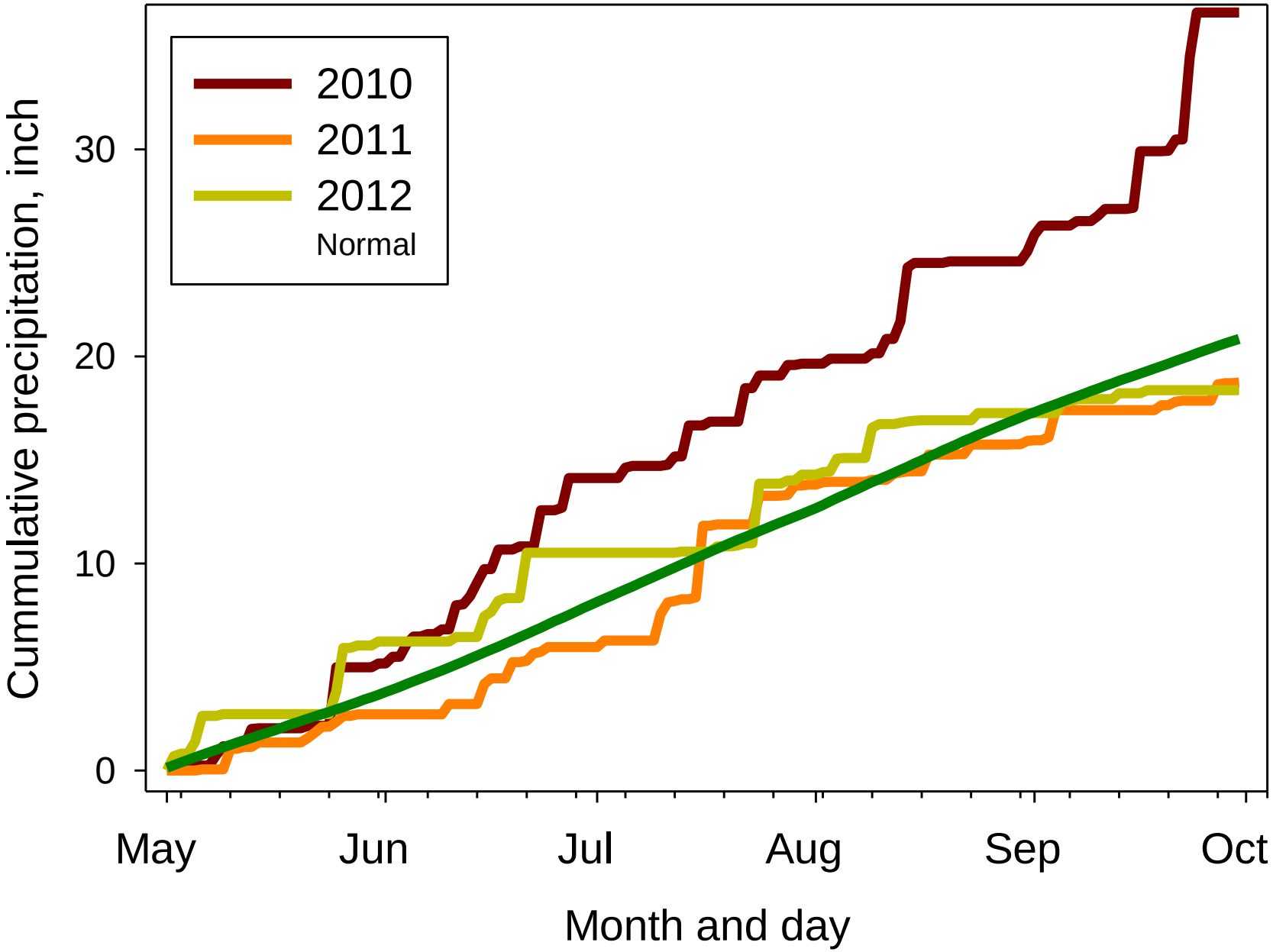
Growing season rainfall at Waseca



Growing season rainfall in Olmsted Co.



2012 Methods and measurements:

- Took 0-*6" soil samples for pH, P, K and OM*
  - Canisteo clay loam, OM=7.2%, Bray P=23, K=221, pH=7.0
  - Mt Carroll silt loam, OM=4.6%, Bray P=16, K=137, pH=7.5
- Planted corn at 35,000 seeds/A
  - DeKalb 52-43 at Waseca on May 1, **56% residue cover**
  - DeKalb 51-85 at Rochester on April 24, 54% residue cover
- Applied UAN at V2 to bring all plots up to 200 lb N/A
- In June, K deficiency symptoms noted at Rochester, surface applied 60 lb K_2O

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June 13, 2012 Waseca

June 13, 2012 Waseca

Dry matter yield (V6) at Waseca, 2012

Starter Fertilizer Rate			Dry matter
APP	UAN	ATS	yield
---------- gal/acre ----------			%
0	0	0	100
0	0	2	107
0	0	4	131
0	8	0	145
0	8	2	184
0	8	4	184
4	0	0	144
4	0	2	151
4	0	4	153
4	8	0	193
4	8	2	187
4	8	4	200

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Dry matter yield (V6) at Rochester, 2012

Starter Fertilizer Rate			Dry matter
APP	UAN	ATS	yield
---------- gal/acre ----------			%
0	0	0	100
0	0	2	104
0	0	4	117
0	8	0	117
0	8	2	127
0	8	4	125
4	0	0	131
4	0	2	113
4	0	4	135
4	8	0	135
4	8	2	138
4	8	4	131

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Corn grain moisture and yield, plant height, CV of height and relative leaf chlorophyll (Waseca, 2012)

Main effects of trts 1-12	Grain H_2O	Grain Yield	Plant height	CV of height	Leaf Chloro
	%	bu/A	inch	%	%
APP (10-34-0) in-furrow					
None	15.8 a	214 a	25.3 b	9.2 a	97 a
4 gal/A	15.4 b	212 a	27.8 a	8.2 a	97 a
UAN (28-0-0) surface dribble band					
None	15.9 a	210 a	24.6 b	10.6 a	97 a
8 gal/A	15.4 b	215 a	28.5 a	6.7 b	97 a
ATS (12-0-0-26) surface dribble band					
None	15.6 a	212 a	26.2 a	8.3 a	97 a
2 gal/A	15.6 a	211 a	26.2 a	9.1 a	97 a
4 gal/A	15.7 a	215 a	27.3 a	8.6 a	97 a

2012 Waseca site summary

- No significant differences in grain yield were found at this site. (DROUGHT)
  - Rep 1 deleted (151–218 bu/ac yield range)
- APP and UAN application reduced grain moisture slightly.
- APP and UAN application increased early growth (plant height and dry matter yield at V6)
- UAN application reduced variability (CV) in plant height.

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Corn grain moisture, yield, plant height, CV of height and relative leaf chlorophyll at Rochester in 2012

Main effects of trts 1-12	Grain H_2O	Grain Yield	Plant height	CV of height	Leaf Chloro
	%	bu/A	inch	%	%
APP (10-34-0) in-furrow					
None	16.6 a	239 a	24.2 a	7.6 a	98 a
4 gal/A	16.5 a	233 b	24.7 a	7.3 a	99 a
UAN (28-0-0) surface dribble band					
None	16.6 a	236 a	24.0 b	7.6 a	98 b
8 gal/A	16.5 a	236 a	24.9 a	7.3 a	99 a
ATS (12-0-0-26) surface dribble band					
None	16.7 a	236 a	24.1 a	8.3 a	98 b
2 gal/A	16.4 a	237 a	24.7 a	7.0 a	99 a
4 gal/A	16.4 a	235 a	24.5 a	7.2 a	99 a

2012 Rochester site summary

- APP application reduced grain yield 6 bu/A.
- No effects on grain moisture (grain very dry at harvest).
- UAN application increased early growth (plant height and dry matter yield at V6)
- APP application increased V6 dry matter yield.
- ATS and UAN application increased relative leaf chlorophyll slightly.

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Corn grain moisture and yield, plant height, height CV, and relative leaf chlorophyll at Waseca (3-yr).

Main effects of trts 1-12	Grain H_2O	Grain Yield	Plant height	CV of height	Leaf Chloro
	%	bu/A	inch	%	%
APP (10-34-0) in-furrow					
None	17.7 a	207 a	30.8 b	8.0 a	97 a
4 gal/A	17.0 b	208 a	33.4 a	7.0 b	97 a
UAN (28-0-0) surface dribble band					
None	17.6 a	207 a	30.7 b	**8.6 a**	97 a
8 gal/A	17.1 a	208 a	33.5 a	**6.5 a**	97 a
ATS (12-0-0-26) surface dribble band					
None	17.6 a	205 a	31.1 b	7.7 a	95 a
2 gal/A	17.2 a	209 a	32.1 a	7.8 a	97 a
4 gal/A	17.2 a	209 a	33.0 a	7.0 a	98 a

Three-year Summary: Waseca

- Applying 4 gal/A of APP in-furrow
  - did not affect grain yield (very high STP sites, not high pH).
  - reduced grain moisture in 2 of 3 yr and for the 3–yr avg.
  - increased plant height and/or dry matter yield in 3 of 3 yr and the 3-yr avg., also reduced CV of height (3-yr avg.).
- Applying 8 gal/A of UAN as a surface dribble band
  - reduced grain moisture in 2 of 3 yr.
  - did not affect corn grain yield
  - increased plant height and DM yield in 3 of 3 yr and 3-yr avg.
  - trended CV of plant height lower (3-yr avg., *P* value = 0.118)
- Applying ATS in a surface dribble band
  - reduced grain moisture at 1 of 3 yr
  - increased grain yield in 1 of 3 yr (4 bu/A avg.)
  - increased plant height and/or DM yield in 3 of 3 yr & 3-yr avg.

Corn grain moisture and yield, plant height, height CV, and relative leaf chlorophyll at Rochester (3-yr).

Main effects of trts 1-12	Grain H_2O	Grain Yield	Plant height	CV of height	Leaf Chloro
	%	bu/A	inch	%	%
APP (10-34-0) in-furrow					
None	18.4 a	214 a	29.9 a	6.7 a	98 a
4 gal/A	17.6 a	214 a	32.6 a	6.4 a	98 a
UAN (28-0-0) surface dribble band					
None	18.1 a	214 a	30.8 b	6.7 a	98 a
8 gal/A	17.9 b	214 a	31.7 a	6.5 a	98 a
ATS (12-0-0-26) surface dribble band					
None	18.2 a	213 a	30.8 a	7.1 a	97 b
2 gal/A	18.0 b	214 a	31.4 a	6.3 b	98 a
4 gal/A	17.9 b	216 a	31.5 a	6.4 b	98 a

Three-year Summary: Rochester

- Applying 4 gal/A of APP in-furrow
  - Increased grain yield in 1 of 3 yr and decreased in 1 of 3 yr
  - reduced grain moisture in 2 of 3 yr
  - increased plant height and/or dry matter yield in 3 of 3 yr
- Applying 8 gal/A of UAN as a surface dribble band
  - reduced grain moisture slightly in 1 of 3 yr
  - did not affect corn grain yield
  - increased plant height in 2 of 3 yr and for the 3-yr avg.
- Applying ATS in a surface dribble band
  - reduced grain moisture only for the 3-yr avg.
  - increased grain yield in 1 of 3 yr
  - slightly reduced CV of plant height (3-yr avg.)

Summary

- Generally, fluid starter fertilizers containing N, P and S applied as UAN, APP, and ATS increased early growth and reduced plant variability of corn grown after corn with conservation tillage.
- N, P and S starter fertilizers were shown to reduce grain moisture at harvest.
- Yield responses to fluid starters were inconsistent during this study period, however drought increased yield variability in 2 of 3 yr at Waseca.
- Yield responses appear more likely on poorly drained glacial till soils.

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Conclusion

- Although only a few positive grain yield responses were found in this study, consistent responses in early growth and reduced plant to plant variability were observed, especially at Waseca.
- Collectively these responses should increase yield potential of corn after corn grown in high residue environments and more importantly narrow the yield gap between corn after corn and corn after soybean.

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Outreach activities in 2012

- FFF forum, Feb. 20 (170 attendees)
- SROC Agronomy tour, Jun 21 (138)
- AFREC tour, Aug 10 (15)
- Rochester plot tour, Aug 29 (25)
- ASA meeting poster, Oct 21-23
- NC Ext. Industry poster, Nov 14-15
- ISU Crop Management Conf, Nov 29 (435)

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QUESTIONS

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http://sroc.cfans.umn.edu/People/Staff/JeffreyVetsch/index.htm