Using N Timing to Enhance Yield and NUE in Dryland and Irrigated Corn

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Objectives

- ***Measure the impact of soils, weather, and N application timing on optimum N rate, N uptake, NUE and yield in irrigated and dryland corn production.***
- ***Determine if the use of preplanned split application systems, or split application systems utilizing crop sensors or a professional Agronomists assessment of N need late in the growing season can improve NUE compared to a fixed rate system using current N recommendations applied early in the growing season.***

Experimental Design

- ***Project is designed to run from 2013 through 2015.***
- ***Three irrigated and one dryland site***
  - ***Irrigated sites at KSU experiment fields***
    - ***Two on coarse textured soils***
    - ***One on well drained silt loam***
  - ***Dryland site on excellent farmer cooperator***

Experimental Design

- ***Experimental Design used was a RCB***
- ***Four replications***
- ***Individual Plots size was 10' x 40'***
- ***Sampling***
  - *0-6" and 0-24" soil samples prior to planting*
  - *Tested for O.M., Mehlich-3 P, K, pH, Zn, NO_3, NH_4, Cl, S*
- ***Canopy reflectance was measured at multiple growth stages.***
  - *V-4 through R-1*
- ***Ear leaf samples @ R-1 and Whole Plants @ R-5***
  - *20 ear leaves and 20 whole plants per plot*
  - *Tested for N content only*

Treatments Used

Treatment	Starter N	Emergence	V-4 N	V-10 N	R1 N	Total N applied
1	20*	0	0	0	0	20
2	20	60	0	0	0	80
3	20	120	0	0	0	140
4	20	180	0	0	0	200
5	20	0	60	0	0	80
6	20	0	120	0	0	140
7	20	0	180	0	0	200
8	20	0	0	60	0	80
9	20	0	0	120	0	140
10	20	0	0	180	0	200
Sensor E	20	0	0	Sensor	0	20 +
12	20	0	60	0	180	260
13	20	0	60	0	60	140
14	20	0	60	0	120	200
Sensor L	20	0	60	0	Sensor	80 +
16	20	0	60	0	Agronomist	80 +
17 U/ESN	20	0	0	120	0	140

Basic Soil and Site Information

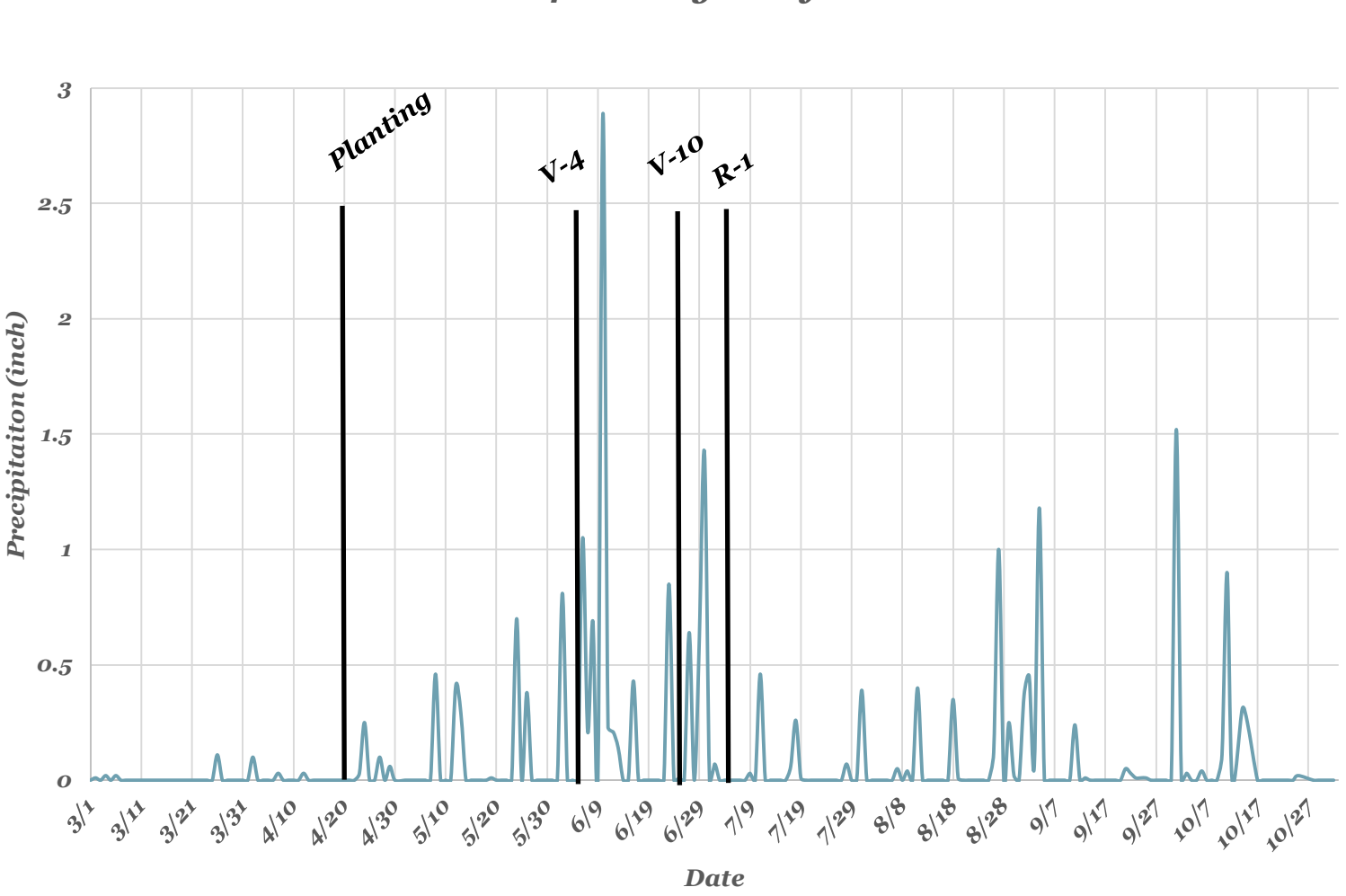
Location	*Sterling*	*Partridge*	*Scandia*	*Rossville*
Soil Type	*Saltcreek and Naron Fine Sandy loams*	*Nalim loam*	*Crete silt loam*	*Eudora sandy loam*
Irrigation	*No*	*Yes*	*Yes*	*Yes*
Previous Crop	*Soybeans*	*Soybeans*	*Soybeans*	*Soybeans*
Tillage Practice	*No-till*	*Conventional*	*Ridge Till*	*Conventional*

Dates and Management Information

Location	Sterling	Partridge	Scandia	Rossville
Irrigation	No	Yes	Yes	Yes
Residual NO_3 lb. N ac^{-1}	26	46	48	24
Corn Hybrid	Pioneer 35F-50 Refuge	Dekalb DK 64-69	Pioneer P1602	Producers H9138 3000GT
Plant Population plants ac^{-1}	19000	25700	33,500	30,400
Planting Date	4/20/14	4/30/14	5/5/14	4/23/14
First Treatment at Emergence	5/14/14	5/21/14	5/30/14	4/29/14
Second Treatment V-4	6/6/14	6/6/14	6/16/14	6/6/14
Third Treatment V-10	6/24/14	6/24/14	7/1/14	6/24/14
Last Treatment R-1	7/3/14	7/2/14	8/4/14	7/8/14
Harvest Date	9/1/14	10/16/14	11/11/14	9/17/14

Results: Sterling, dryland

- ***Weather in 2014 was dry early and late but good during mid-May to mid-July.***
  - ***Excessive rain leading to some loss during June***
- ***Yields were excellent for dryland sand at 156 bu/acre***
- ***Variation was low, CV for yield 4.5%***
- ***Significant response to N, but first increment was enough.***
- ***However, differences were small, large amount of mineralized N which is common on our low SOM sands with rain***

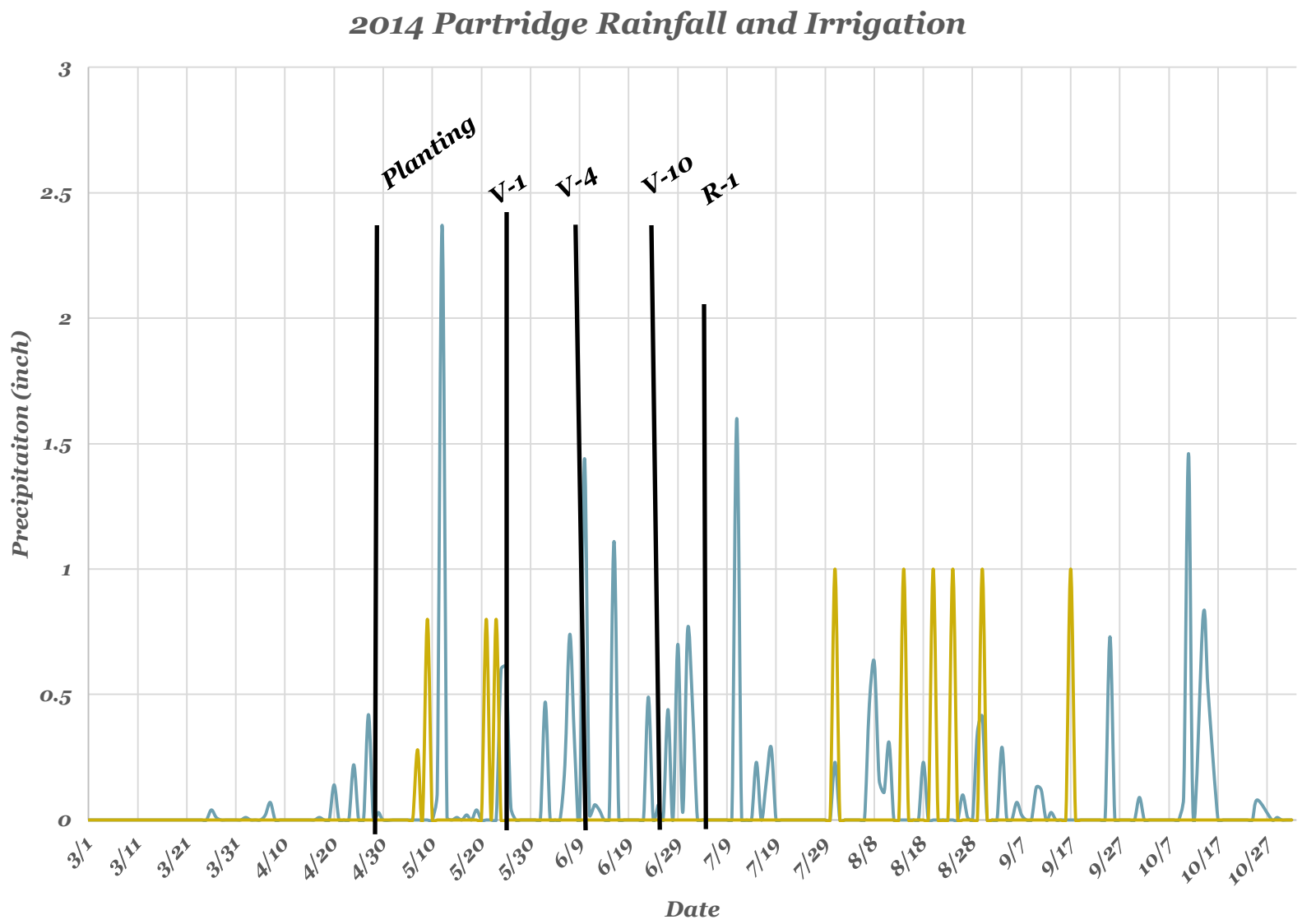

2014 Sterling Rainfall
Planting
V-4
V-10
R-1
Precipitaiton (inch)
3
2.5
2
1.5
1
0.5
0
3/1
3/11
3/21
3/31
4/10
4/20
4/30
5/10
5/20
5/30
6/9
6/19
6/29
7/9
7/19
7/29
8/8
8/18
8/28
9/7
9/17
9/27
10/7
10/17
10/27
Date

Effects of Nitrogen application timing on corn grain yield, 2014, dryland, Sterling, KS

Treatment	Starter N	Early N	V-4 N	V-10 N	R1 N	Total N Applied	2014 Yield
1	7	0	0	0	0	7	144f
2	7	60	0	0	0	67	154bcd
3	7	120	0	0	0	127	155 bcd
4	7	180	0	0	0	187	157 abc
5	7	0	60	0	0	67	148 ef
6	7	0	120	0	0	127	160 abc
7	7	0	180	0	0	187	155 bcd
8	7	0	0	60	0	67	157 abc
9	7	0	0	120	0	127	154 bcd
10	7	0	0	180	0	187	160 abc
Sensor, V-10	7	0	0	0	0	7	148 def
12	7	0	60	0	180	247	161 ab
13	7	0	60	0	60	127	158 abc
14	7	0	60	0	120	187	159 abc
Sensor, R1	7	0	60	0	0	67	153 cde
16, Agron	7	0	60	0	0	67	160 abc
17 U/ESN	7	0	0	120	0	127	164 a

Results: Partridge, irrigated

- ***Weather alternated from hot and dry, to wet and cold.***
- ***Yields were lousy for irrigated sand at 85-128 bu/acre***
- ***Variation was high, CV for yield 11.5%***
- ***Significant response to N, N rate, and N timing was observed.***
- ***Later applications, starter plus V-10 were best***

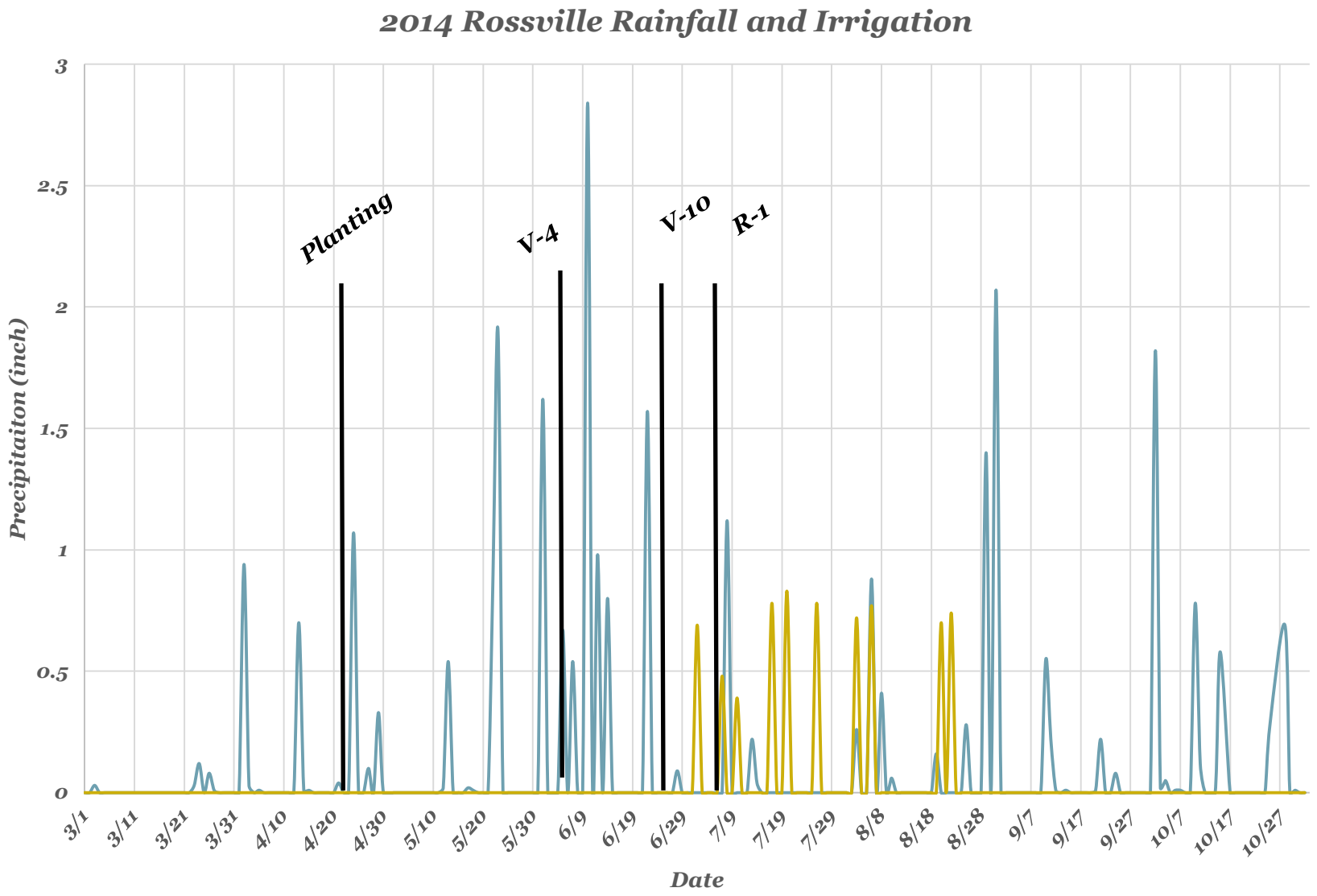

2014 Partridge Rainfall and Irrigation
Precipitaiton (inch)
3
2.5
2
1.5
1
0.5
0
Planting
V-1
V-4
V-10
R-1
3/1
3/11
3/21
3/31
4/10
4/20
4/30
5/10
5/20
5/30
6/9
6/19
6/29
7/9
7/19
7/29
8/8
8/18
8/28
9/7
9/17
9/27
10/7
10/17
10/27
Date

Effects of Nitrogen application timing on corn grain yield, 2014, irrigated, Partridge, KS

Treatment	Starter N	Early N	V-4 N	V-10 N	R1 N	Total N Applied	2014 Yield
1	20	0	0	0	0	20	85 hi
2	20	60	0	0	0	80	96 fghi
3	20	120	0	0	0	140	94 fghi
4	20	180	0	0	0	200	96 fghi
5	20	0	60	0	0	80	86 ghi
6	20	0	120	0	0	140	101 def
7	20	0	180	0	0	200	99 defg
8	20	0	0	60	0	80	104 cdef
9	20	0	0	120	0	140	128 a
10	20	0	0	180	0	200	125 ab
Sensor V10	20	0	0	0	0	20	82 i
12	20	0	60	0	180	260	118 abc
13	20	0	60	0	60	140	111 bcd
14	20	0	60	0	120	200	111 bcd
Sensor R1	20	0	60	0	0	80	97 fghi
16, Agron	20	0	60	0	0	80	94 fghi
17 U/ESN	20	0	0	120	0	140	116 abc

Results: Rossville, irrigated

- ***Weather was wet and cool early, hot and dry late.***
  - *Significant rain to cause loss from pre-emerge and sidedress N.*
- ***Yields were fair for irrigated sand at 180-190 bu/acre***
- ***Variation was high, CV for yield 13.8%***
  - *Significant soil variability*
- ***Significant response to N, N rate, and N timing was observed.***
- ***Later applications, starter plus V-10 and splits were best***

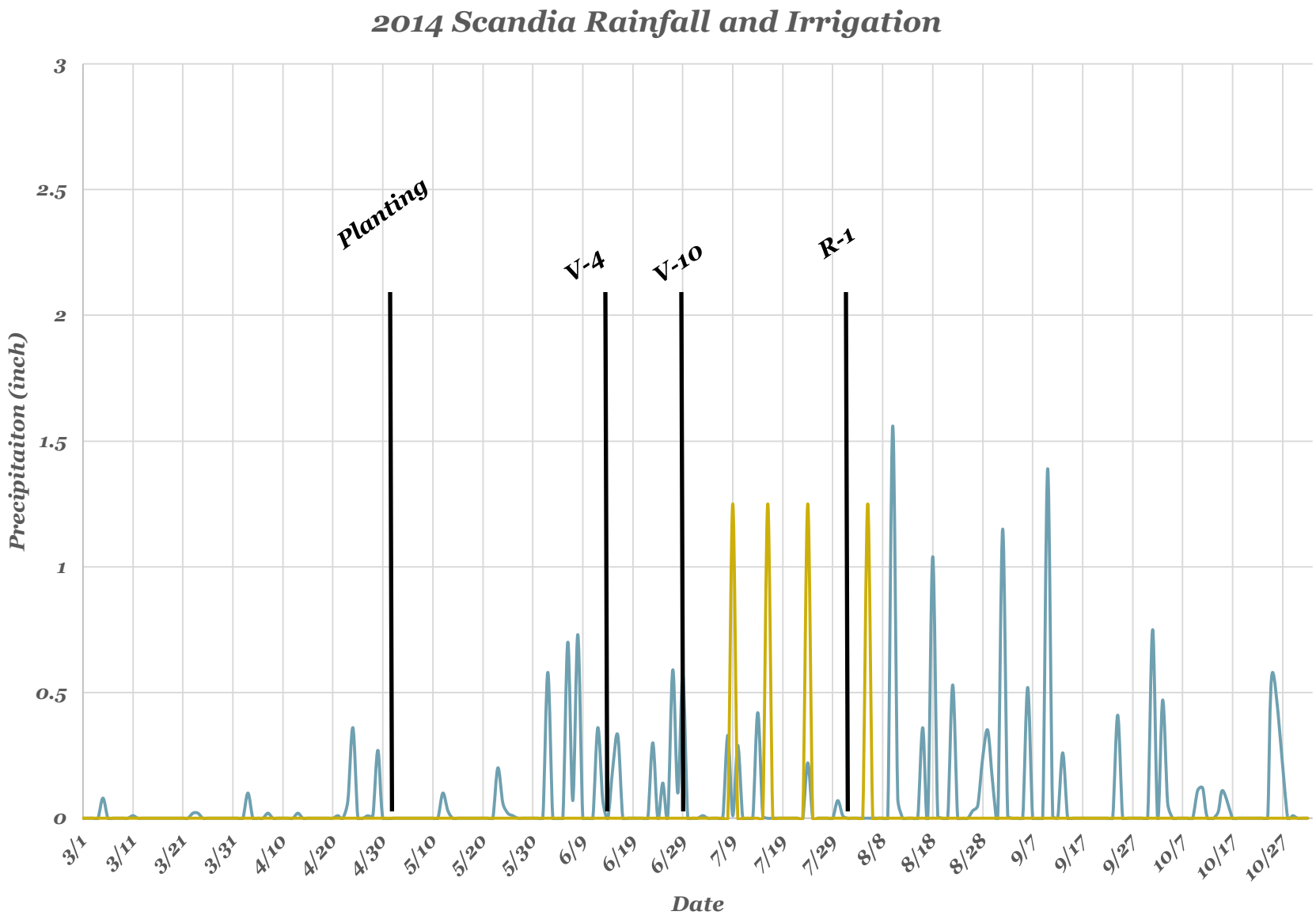

2014 Rossville Rainfall and Irrigation
Precipitaiton (inch)
3
2.5
2
1.5
1
0.5
0
Planting
V-4
V-10
R-1
3/1
3/11
3/21
3/31
4/10
4/20
4/30
5/10
5/20
5/30
6/9
6/19
6/29
7/9
7/19
7/29
8/8
8/18
8/28
9/7
9/17
9/27
10/7
10/17
10/27
Date

Effects of Nitrogen application timing on corn grain yield, 2014, irrigated, Rossville, KS

Treatment	Starter N	Early N	V-4 N	V-10 N	R1 N	Total N Applied	2014 Yield
1	20	0	0	0	0	20	97 e
2	20	60	0	0	0	80	165 bcd
3	20	120	0	0	0	140	151 dc
4	20	180	0	0	0	200	175 abc
5	20	0	60	0	0	80	139 d
6	20	0	120	0	0	140	168 bc
7	20	0	180	0	0	200	187 ab
8	20	0	0	60	0	80	154 cd
9	20	0	0	120	0	140	172 ab
10	20	0	0	180	0	200	188 ab
Sensor, V-10	20	0	0	0	0	20	111 e
12	20	0	60	0	180	260	197 a
13	20	0	60	0	60	140	183 ab
14	20	0	60	0	120	200	192 ab
Sensor, R1	20	0	60	0	20	100	167 bc
16, Agron	20	0	60	0	45	125	174 abc
17 U/ESN	20	0	0	120	0	140	186 ab

Results: Scandia, irrigated

- ***Weather was dry early and wet late.***
  - ***Stored soil water carried the crop early***
  - ***Irrigation starting in early July saved the day***
    - ***Only applied 5-6 inches of water***
- ***Yields were good, up to 230 bu/acre***
- ***Variation was low, CV for yield 4.3%***
- ***Significant response to N and N timing was observed.***
- ***Later applications, starter plus V-10, or splits were best***


2014 Scandia Rainfall and Irrigation
Precipitaiton (inch)
3
2.5
2
1.5
1
0.5
0
Planting
V-4
V-10
R-1
3/1
3/11
3/21
3/31
4/10
4/20
4/30
5/10
5/20
5/30
6/9
6/19
6/29
7/9
7/19
7/29
8/8
8/18
8/28
9/7
9/17
9/27
10/7
10/17
10/27
Date

Effects of Nitrogen application timing on corn grain yield, 2014, irrigated, Scandia, KS

Treatment	Starter N	Early N	V-4 N	V-10 N	R1 N	Total N Applied	2014 Yield
1	20	0	0	0	0	20	160 h
2	20	60	0	0	0	80	192 g
3	20	120	0	0	0	140	211 ef
4	20	180	0	0	0	200	216 de
5	20	0	60	0	0	80	202 fg
6	20	0	120	0	0	140	229 abc
7	20	0	180	0	0	200	230 ab
8	20	0	0	60	0	80	195 g
9	20	0	0	120	0	140	216 de
10	20	0	0	180	0	200	229 abc
Sensor V-10	20	0	0	0	0	20	148 def
12	20	0	60	0	180	260	233 a
13	20	0	60	0	60	140	218 bcd
14	20	0	60	0	120	200	223 abcd
Sensor R1	20	0	60	0	30	110	221 bcde
16, Agron	20	0	60	0	30	80	210 ef
17 U/ESN	20	0	0	120	0	140	225 abcd

Observation and Conclusions

- ***Rainfall patterns were not unusual***
  - *Early spring is often dry*
  - *Late May, June and early July are typical high rainfall months*
  - *Rainfall comes in thunderstorms, so often intense*
  - *Timing has a history of success but not often done*
- ***Delayed application or split application worked best***
  - *On both sands and silt loams*
- ***Sensors aren't quite ready for prime time yet to predict late season N needs***
- ***A good Agronomist can help, especially using***
  - *Fired leaf counts*
  - *Chlorophyll meter*
  - *Sensors (at some point)*

Things I would do in the future: both research and production

- ***Incorporate fertigation concepts with more late applications, especially on coarse textured soils***
  - *Todays hybrids take up N during grain fill*
    - ***Similar to many of the hybrids we used in the 70's & 80's***
  - *More applications simulating adding N with the system*
  - *Use ½ the N early, balance V-16 through early fill.*
  - *Be willing to adjust N rates in response to environment*
- ***Look at tools to guide the Agronomist***
  - *Fired leaf counts: systems exist*


Questions?
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