DEVELOPMENENT OF INTENSIVE N MANAGEMENT STRATEGIES TO ENHANCE YIELD AND NITROGEN USE EFFICIENCY IN CORN

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OBJECTIVES

- Measure the impact of different N management systems on yield, profitability, and nitrogen use efficiency in high yield corn production.
- Determine if the use of split application systems utilizing crop sensors or professional Agronomists judgment of N need late in the growing season can improve NUE compared to a fixed rate system using current N rate recommendations applied early in the growing season.

EXPERIMENTAL DESIGN

- Research Plots 10’ x 40’
- Randomized complete block design
- Four replications
- Three Irrigated sites at KSU experiment fields
- One dryland site with farmer cooperation

TREATMENT PROTOCOL

Treatment	Starter N	Planting N	V-4 N	V-10 N	R1 N
1	20	0	0	0	0
2	20	60	0	0	0
3	20	120	0	0	0
4	20	180	0	0	0
5	20	0	60	0	0
6	20	0	120	0	0
7	20	0	180	0	0
8	20	0	0	60	0
9	20	0	0	120	0
10	20	0	0	180	0
11	20	0	0	Sensor	0
12	20	0	60	0	180
13	20	0	60	0	60
14	20	0	60	0	120
15	20	0	60	0	Sensor
16	20	0	60	0	Agronomist

SAMPLING METHODS

- 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 @ R-1 and Whole Plants @ R-5
  - 20 ear leaves and 20 whole plants per plot
  - Tested for N content
- Harvested with plot combine at KSU Experiment fields. Hand harvested at farmer fields.
  - Combine harvest area, 5’ x 40’
  - Hand harvest area, 5’ x 17.5’

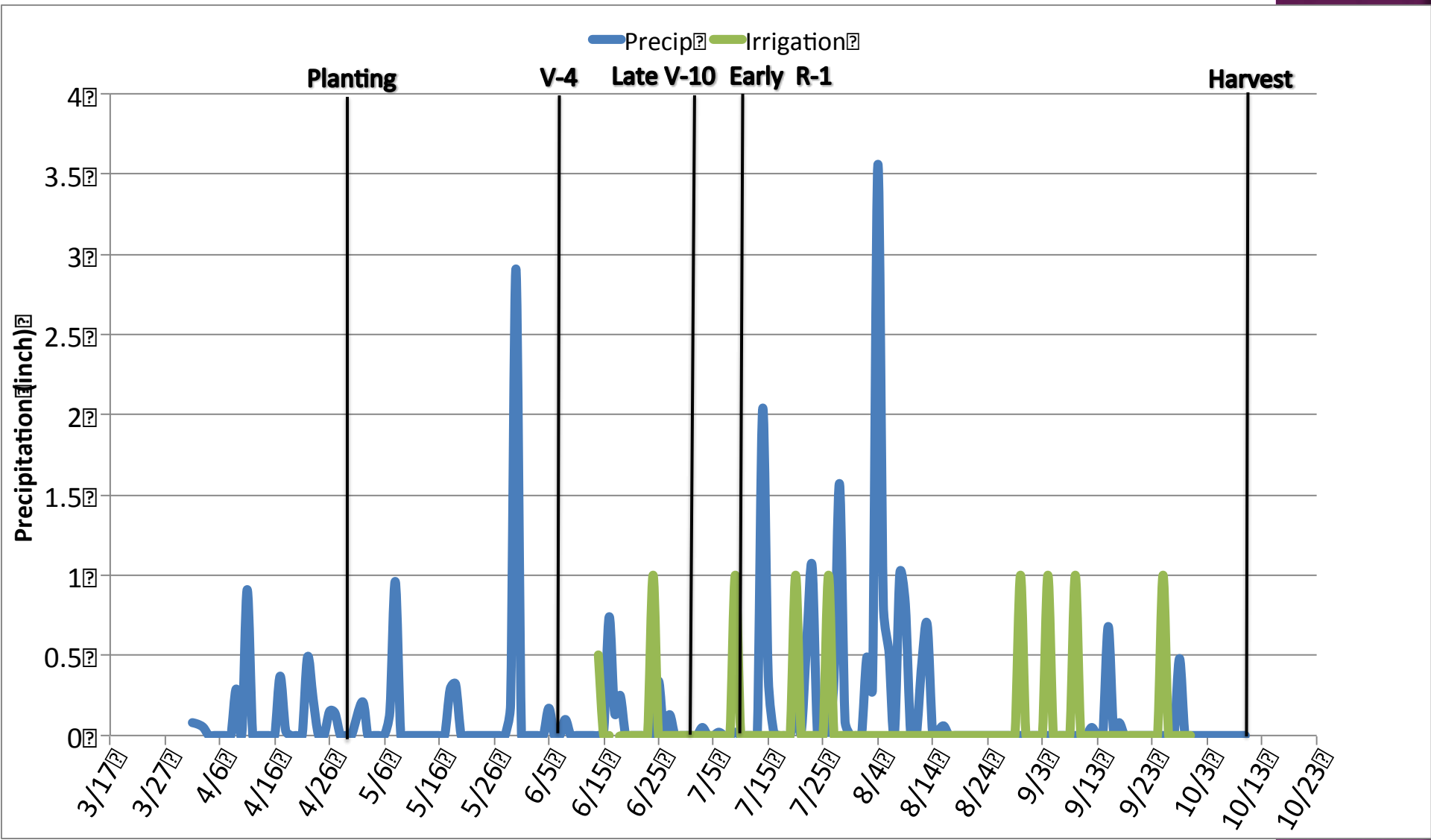
SITE INFORMATION

Location	Sterling	Partridge	Scandia	Rossville
Soil Type	Saltcreek and Naron Fine Sandy loams	Nalim loam	Crete silt loam	Eudora sandy loam
Previous Crop	Soybeans	Soybeans	Soybeans	Soybeans
Tillage Practice	No-till	Conventional	Ridge Till	Conventional
Corn Hybrid	35F-50 Refuge	DK 64-69	NA	H9138 3000GT
Plant Population plants ac^{-1}	19000	25700	29500	30,400
Irrigation	No	Yes	Yes	Yes
Residual NO_3 lb. N ac^{-1}	26	46	48	24
Planting Date	4/30/13	4/30/13	5/16/13	4/29/13
First Treatment at Planting	4/30/13	4/30/13	5/16/13	4/29/13
Second Treatment V-4	6/7/13	6/7/13	6/11/13	6/6/13
Third Treatment V-10	6/24/13	7/1/13	7/5/13	6/24/13
Last Treatment R-1	7/10/13	7/10/13	7/18/13	7/12/13
Harvest Date	9/21/13	10/10/13	10/25/13	9/23/13

PRELIMINARY RESULTS

- Sterling had no response to applied N and Scandia only a minor response.
- Data is available for all locations in proceedings.
- Discussion will focus on Partridge and Rossville.
- Significant response to N rate and timing was observed at Partridge and Rossville.

WEATHER CONDITIONS FOR 2013 PARTRIDGE, KS



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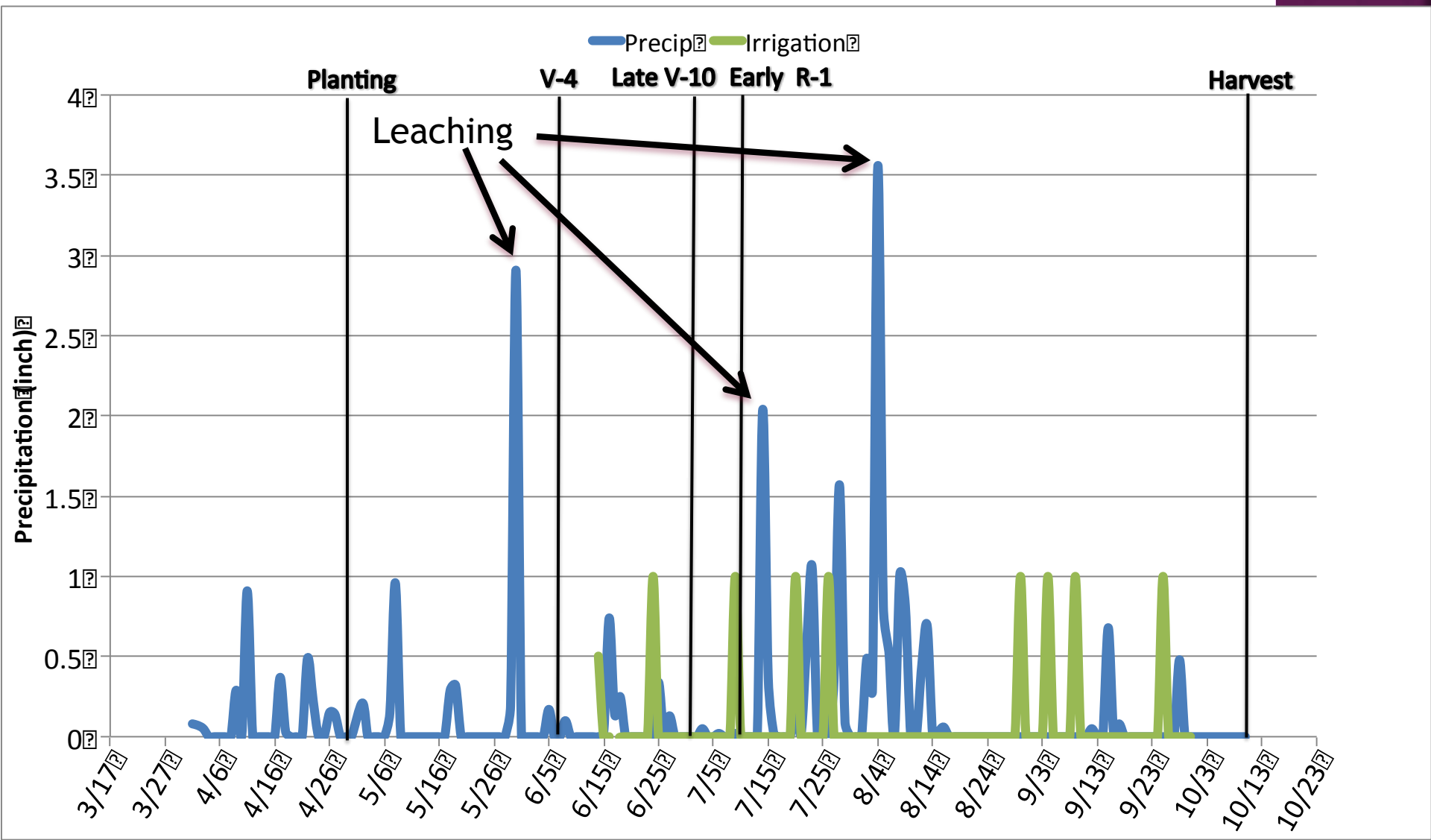
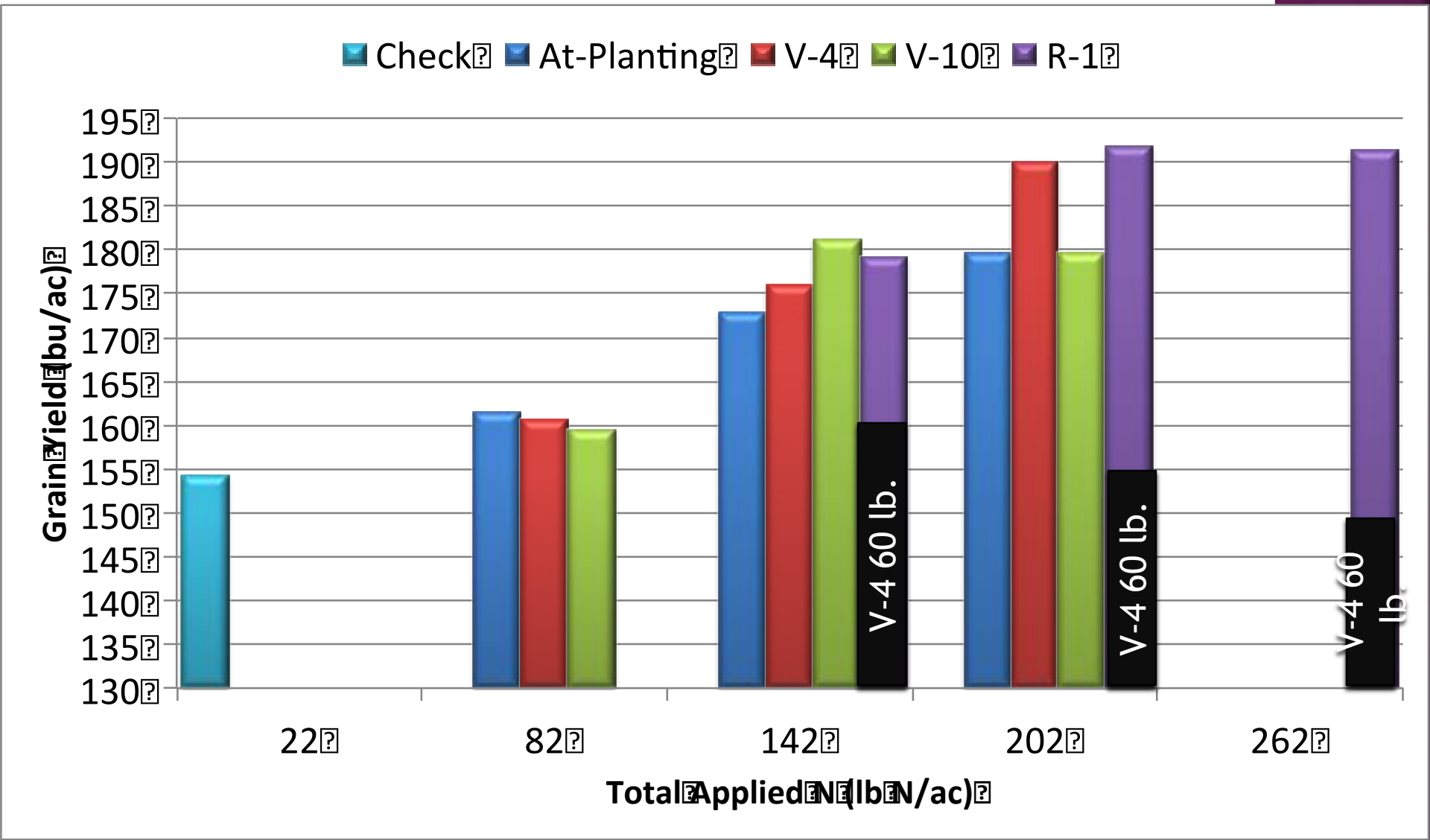


PRELIMINARY RESULTS
PARTRIDGE, KS

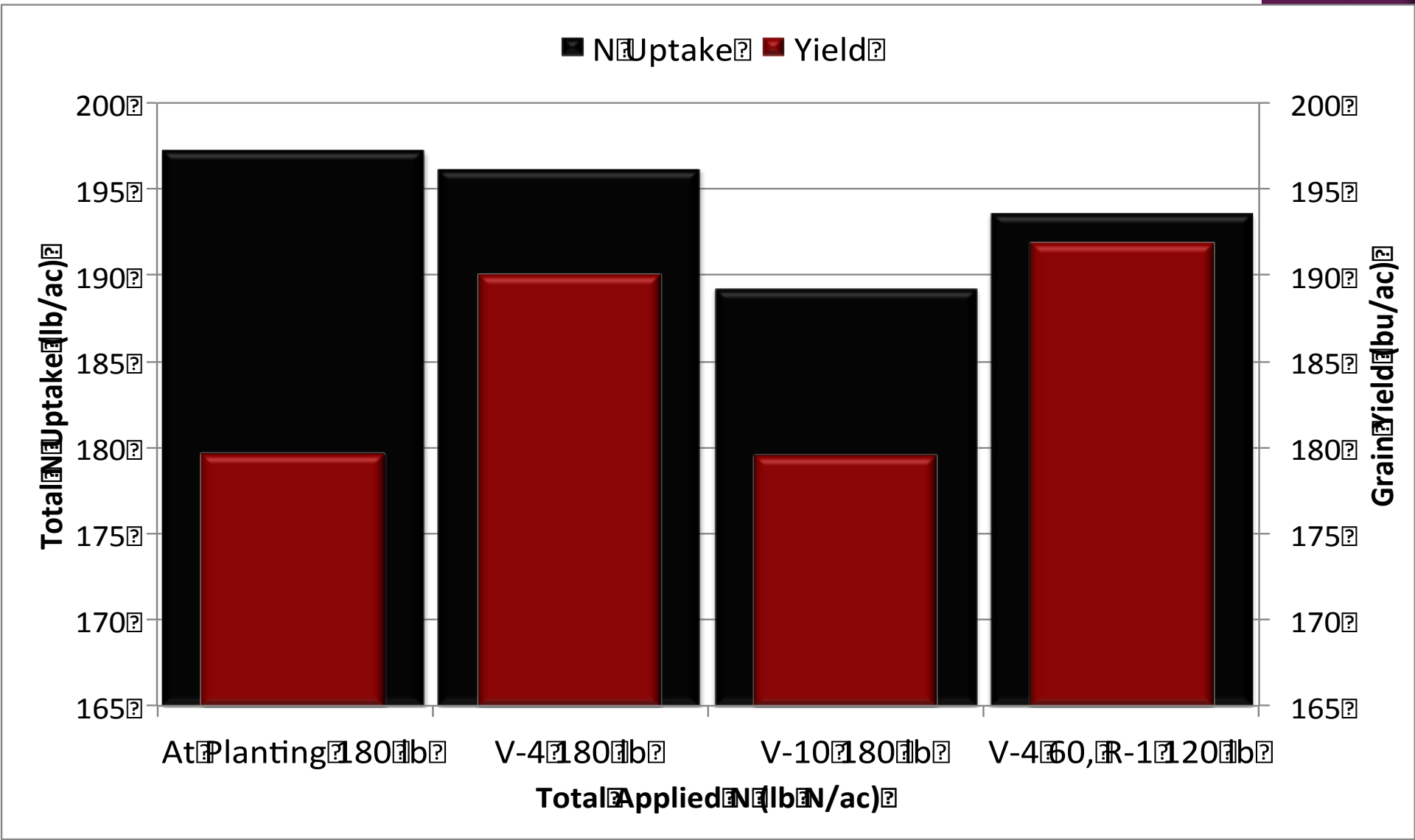
Treatment	Starter N	Planting N	V-4 N	V-10 N	R-1 N	Total N	Grain Yield	Total N Uptake
		lb. N ac^{-1}					bu. ac^{-1}	lb. N ac^{-1}
14	22	0	60	0	120	202	192 A	194 AB
12	22	0	60	0	180	262	191 A	211 A
7	22	0	180	0	0	202	190 AB	196 AB
Agronomist	22	0	60	0	130	212	190 AB	190 BC
9	22	0	0	120	0	142	181 BC	184 BC
4	22	180	0	0	0	202	180 CD	197 AB
10	22	0	0	180	0	202	180 CD	189 BC
13	22	0	60	0	60	142	179 CD	176 CD
6	22	0	120	0	0	142	176 CD	186 BC
5	22	0	60	0	0	82	173 CD	158 DEF
3	22	120	0	0	0	142	173 D	194 AB
2	22	60	0	0	0	82	162 E	162 DEF
Sensor	22	0	60	0	0	82	161 E	157 EF
8	22	0	0	60	0	82	159 E	174 CDE
Sensor	22	0	0	92	0	114	156 E	148 F
1	22	0	0	0	0	22	154 E	147 F

Results with the same letter are not statistically different at 0.1 alpha

PRELIMINARY RESULTS
PARTRIDGE, KS



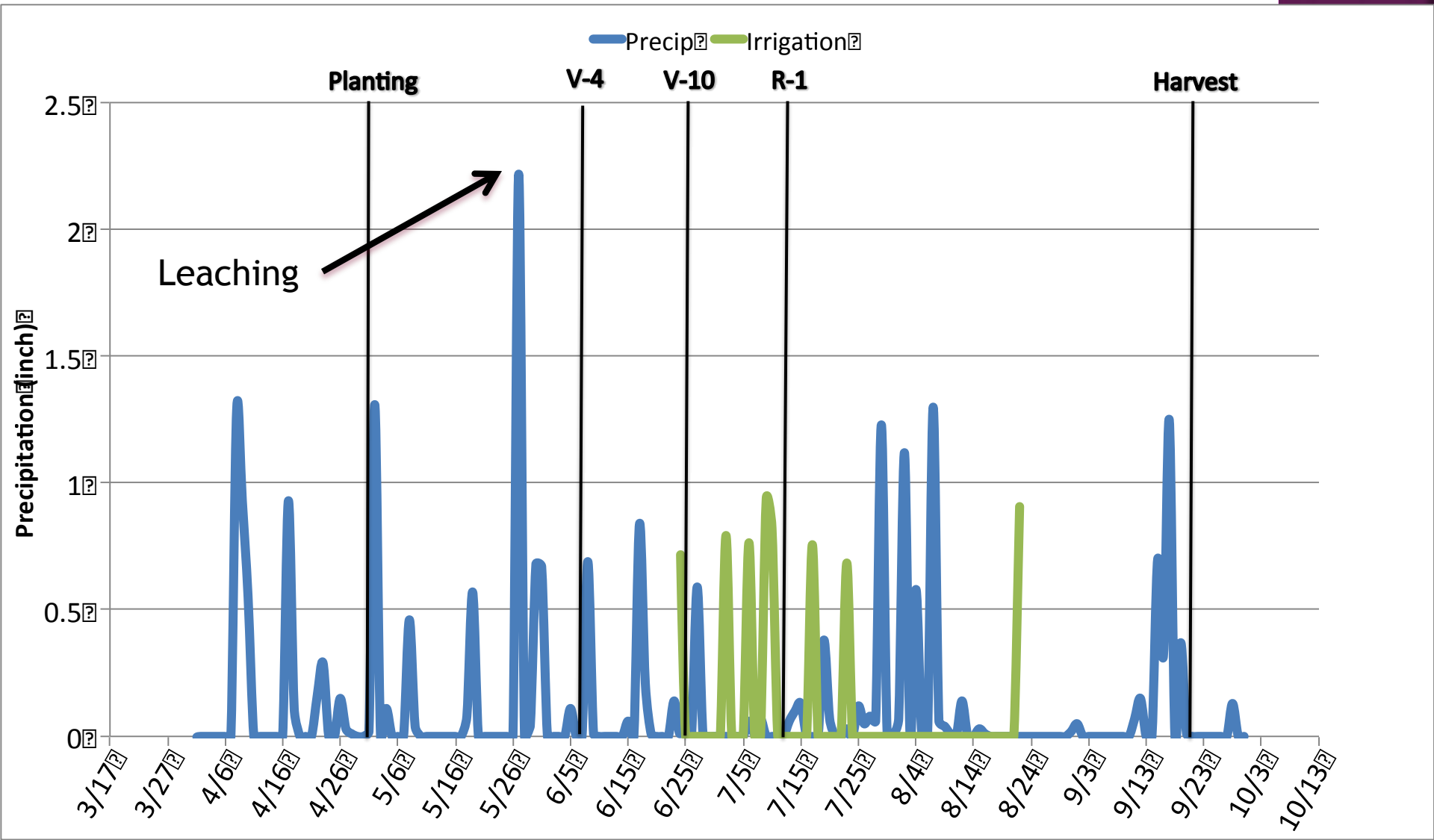
PRELIMINARY RESULTS
PARTRIDGE, KS



PRELIMINARY RESULTS PARTRIDGE, KS

- Substantial improvements in yield were made by delaying N applications to V-4 and/or split applications at R-1.
- At-planting treatments resulted in lower yields and decreased efficiency due to the time of N application not matching crop demand and resulting in increased N loss potential.
- V-10 treatments resulted in yield reductions. The 22 lb. N ac^{-1} applied as Starter was not enough to prevent N stress during in ear size determination.
- Sensor treatments greatly underestimated N needs, resulting in severe yield reductions.

WEATHER CONDITIONS FOR 2013 ROSSVILLE, KS

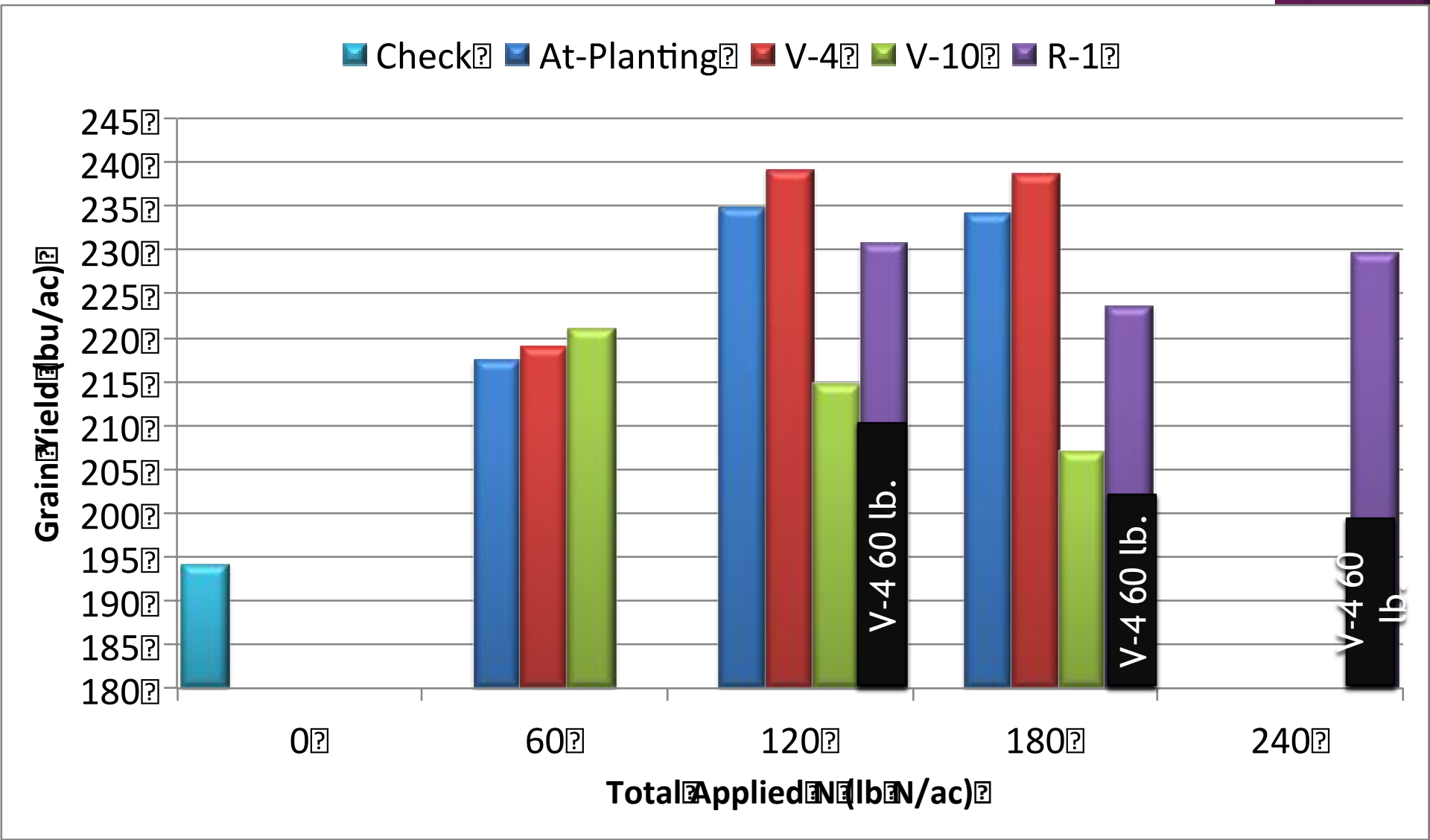


PRELIMINARY RESULTS ROSSVILLE, KS

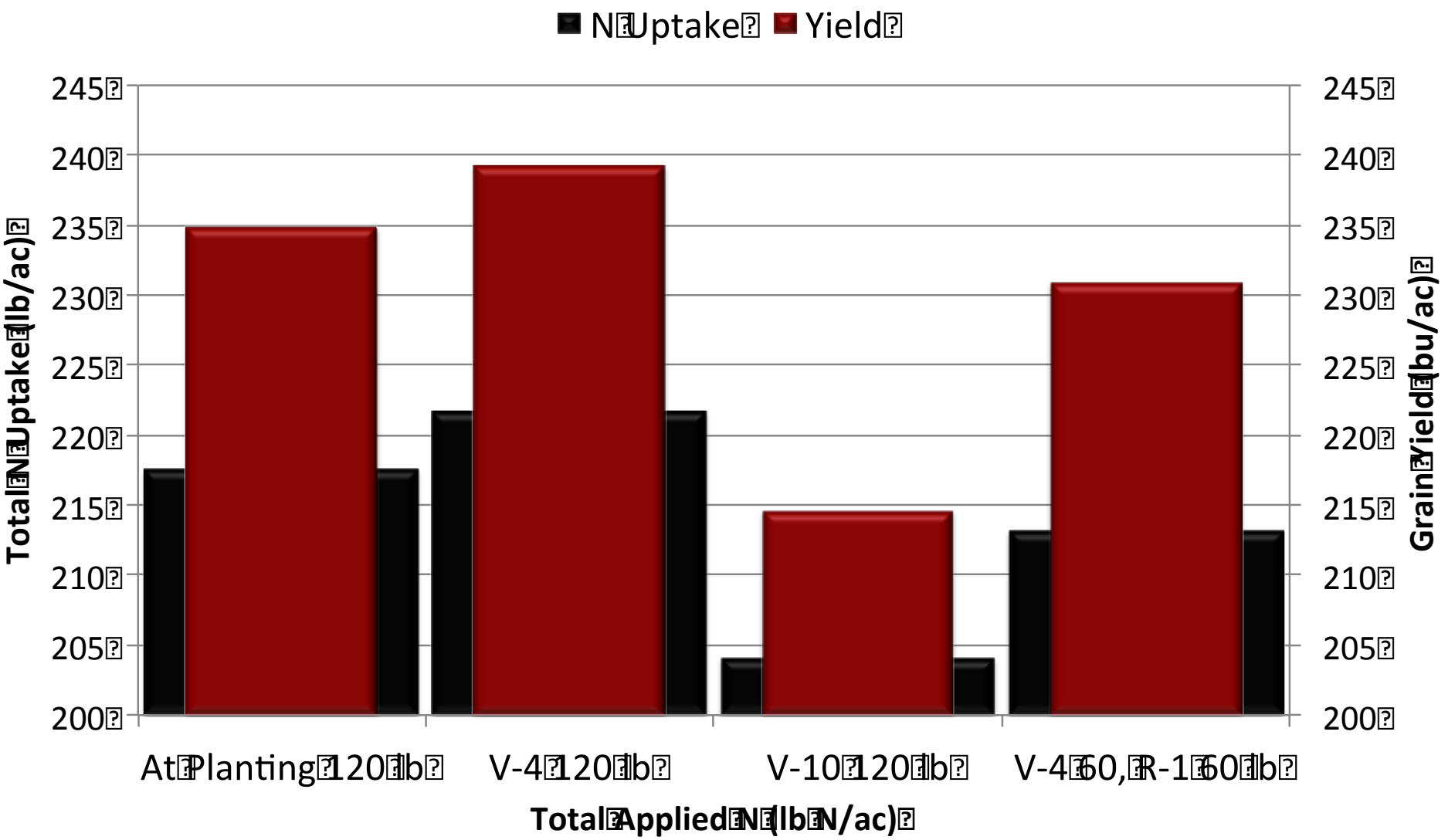
Treatment	Starter N	Planting N	V-4 N	V-10 N	R-1 N	Total N	Grain Yield	Total N Uptake
	lb. N ac^{-1}						bu. ac^{-1}	lb. N ac^{-1}
6	0	0	120	0	0	120	239 A	222 AB
7	0	0	180	0	0	180	238 A	219 AB
3	0	120	0	0	0	120	235 AB	218 AB
4	0	180	0	0	0	180	234 AB	233 A
13	0	0	60	0	60	120	231 ABC	213 BC
Sensor	0	0	60	0	0	60	230 ABC	206 BCD
12	0	0	60	0	180	240	230 ABC	213 BC
14	0	0	60	0	120	180	224 BCD	210 BCD
Agronomist	0	0	60	0	60	120	222 BCD	211 BCD
8	0	0	0	60	0	60	221 BCDE	193 DEF
5	0	0	60	0	0	60	219 CDE	193 DEF
2	0	60	0	0	0	60	217 CDE	187 EF
9	0	0	0	120	0	120	215 DE	204 BCDE
Sensor	0	0	0	198	0	198	212 DE	206 BCD
10	0	0	0	180	0	180	207 EF	197 CDE
1	0	0	0	0	0	0	194 F	177 F

Results with the same letter are not statistically different at 0.1 alpha

PRELIMINARY RESULTS
ROSSVILLE, KS



PRELIMINARY RESULTS
ROSSVILLE, KS



PRELIMINARY RESULTS ROSSVILLE, KS

- Although Rossville's sandy loam soils are conducive for nitrate leaching losses, rainfall distribution was excellent and no extremely high rain fall events occurred.
- There were no statistical differences in yield between at-planting, V-4, and R-1 N applications times with N rates greater than 120 lb. ac^{-1}. However, there were strong trends in increasing yield with N applications made at-planting and V-4.
- Split applications at R-1 and full applications at V-10 experienced yield reductions. The lack of Starter N and low N rates applied at V-4 were not enough to prevent N stress before the next N application would occur.

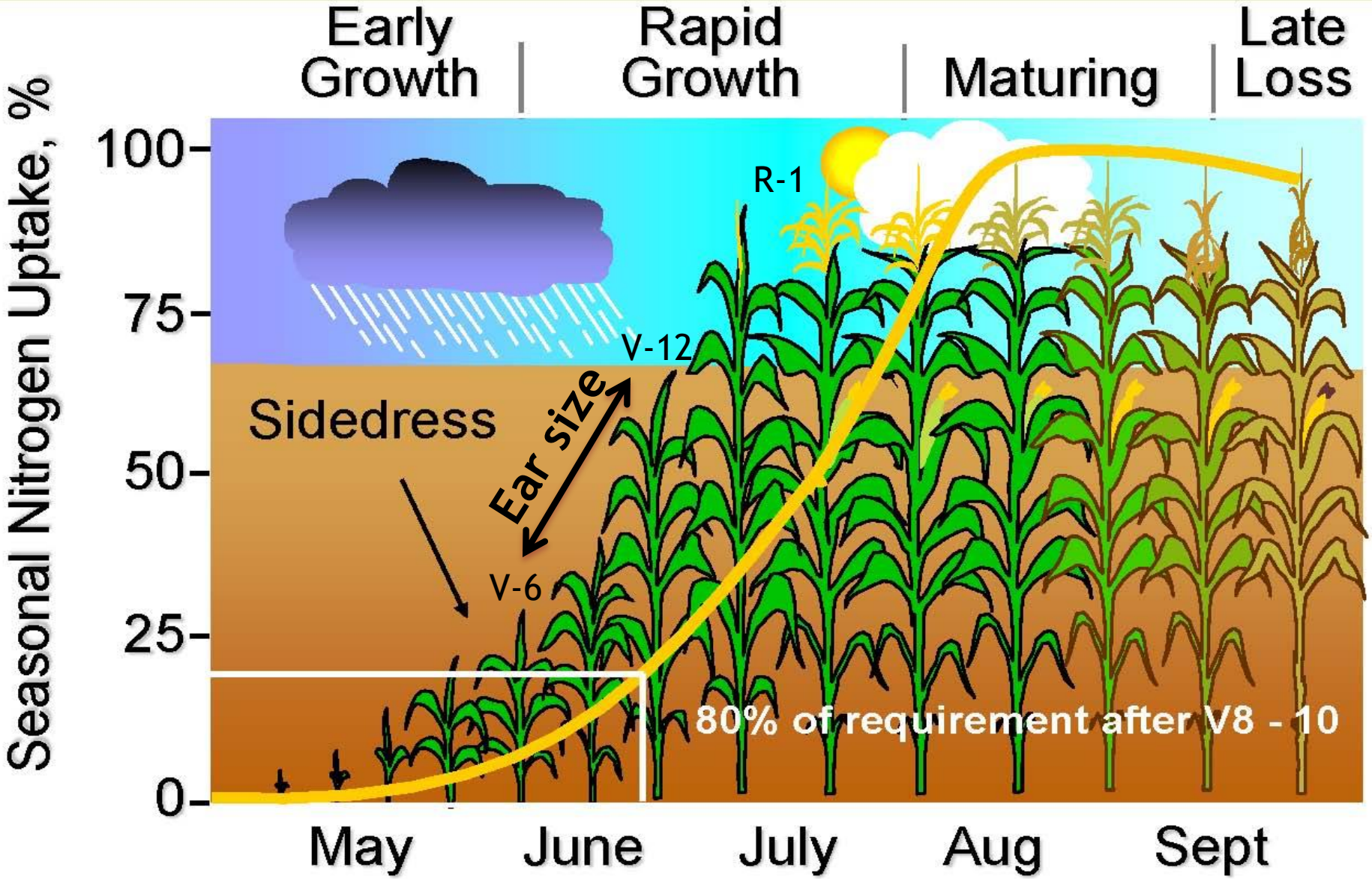
DISCUSSION

- Results indicate increased N efficiency and grain yield can be achieved by changing the time, rate, and number of N applications to coincide with corn N demand and the potential for N loss in the current growing environment.
- Further research is needed to evaluate the effects of the N application timing and N management strategies under different weather conditions and soil types to determine their applicability in corn production.

CONTINUING RESEARCH AND PROPOSED CHANGES

- Implement new KSU corn sensor algorithms
- Obtain measurements of corn ear size for determining potential causes in yield reduction by potential early season N stress.
- Include management strategies that split N applications rates to 70 % of total applied N at V-4 and remaining 30% at R-1.
- Implement prototype N management system that utilizes dynamic strategies, thus adjusting the timing, rate, and placement of N based on crop physiology and site specific environmental conditions. This approach would ensure N applications coincide with N demand, maximize ear size, and optimize NUE.

CONTINUING RESEARCH AND PROPOSED CHANGES



Questions?

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