Assessing Grain NPK Content: Have Removal Levels Changed?

NREC Project 2014-02397

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IFCA, Peoria

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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Before I start:

- Please see the Bulletin article at

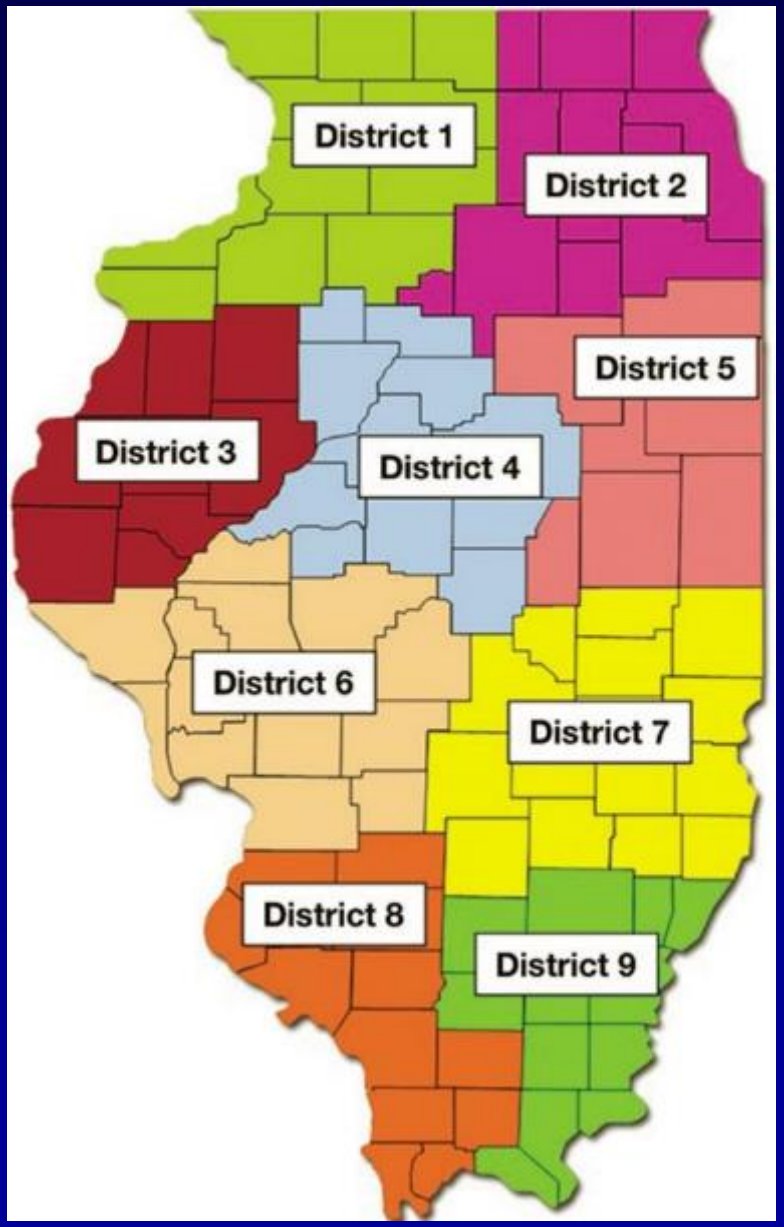
http://bulletin.ipm.illinois.edu/?p=3813

And consider helping a "worthy cause" – gathering information on hundreds of Illinois soybean fields

The goal:

- To extensively sample corn, soybean, and wheat grain across Illinois for three years (2014-2016)
  - Target 800 samples per year for corn and soybean
  - 400 samples per year for wheat
- Measure N, P, and K levels of grain
- Assemble data to show averages, variability, and if factors like yield, location, and year might affect nutrient level
- **To set updated P and K IL removal numbers**

Samples analyzed 2014-2016

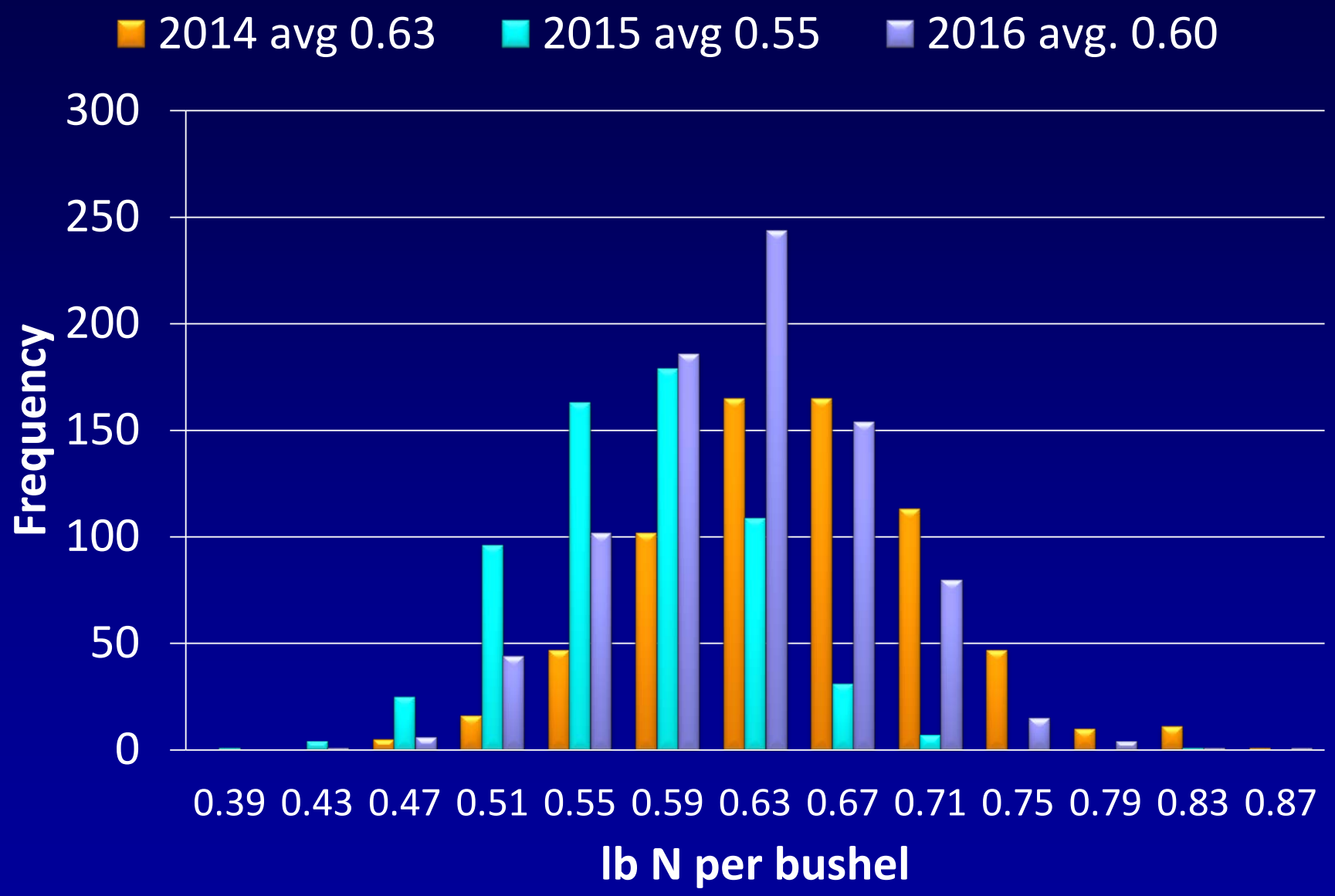


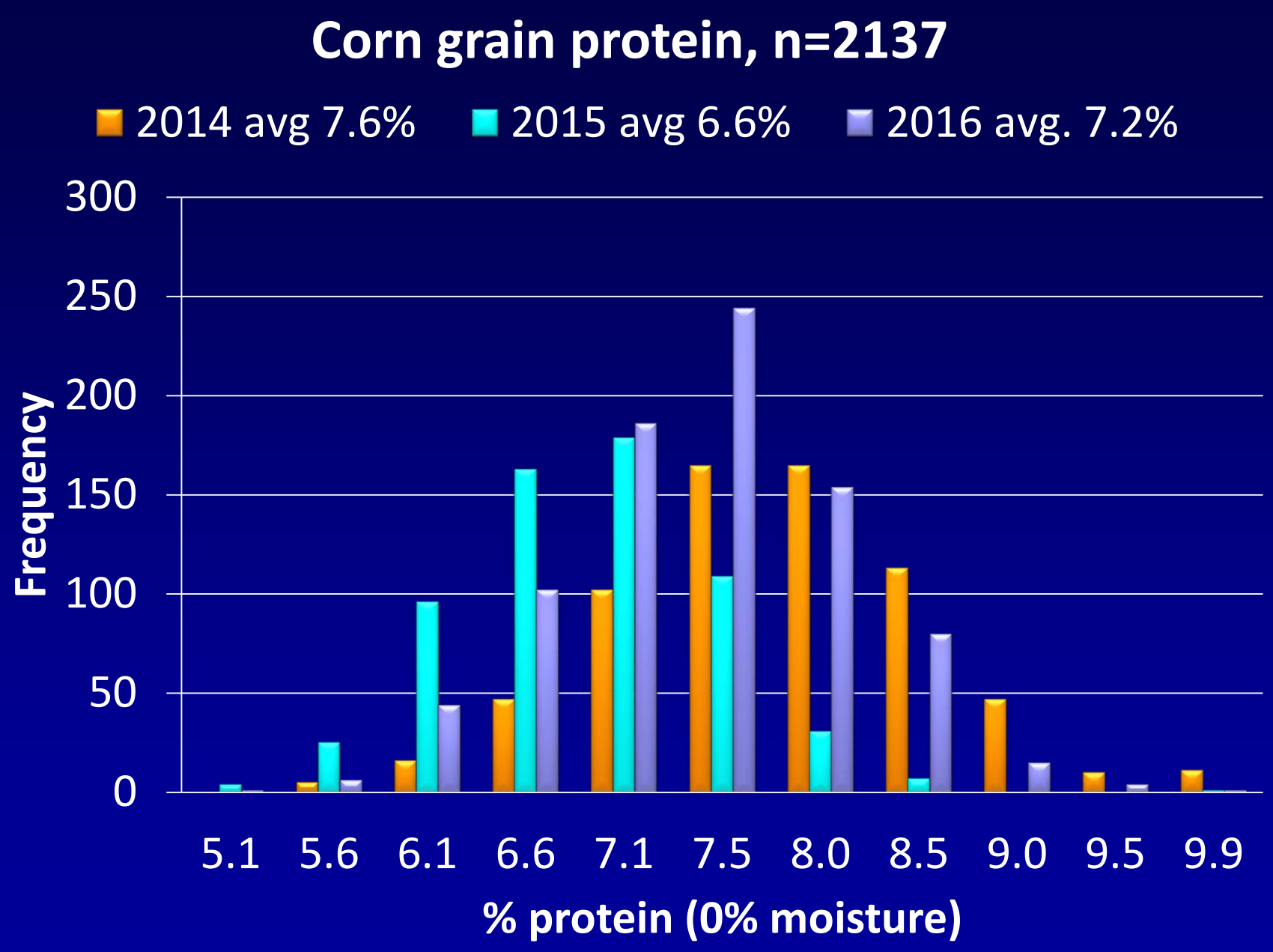
Year	CRD	Corn	Soybean	Wheat
2014	1	183	131	0
	2	45	81	1
	3	60	78	0
	4	103	140	2
	5	86	113	5
	6	88	124	1
	7	36	135	4
	8	43	94	1
	9	39	55	4
2014	**Sub-total**	**684**	**951**	**18**
2015	1	62	104	8
	2	88	78	4
	3	69	79	1
	4	66	117	12
	5	110	85	22
	6	65	92	24
	7	122	145	44
	8	17	64	231
	9	18	59	19
2015	**Sub-total**	**617**	**823**	**365**
2016	**Sub-total**	**840**	**408**	**242**
Total analyzed		**2,141**	**2,182**	**625**

Yield and nutrient levels

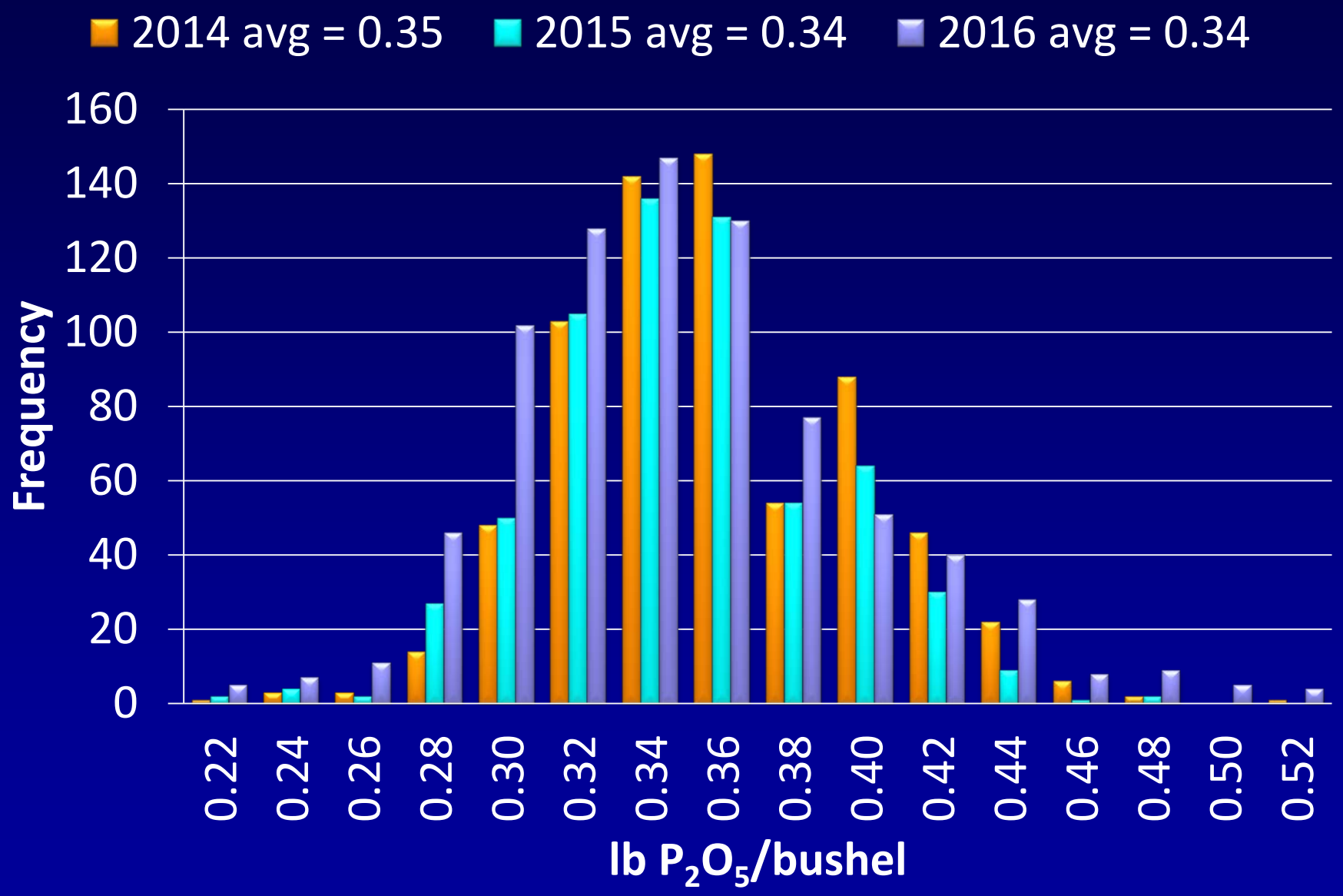
- All of the samples collected in 2014 and some in 2015 came with an estimate of yield
- We found some slight corellations between yield and nutrient levels, but they weren't consistent by crop, nutrient, or year
- We concluded that yield level won't help predict per-bushel nutrient levels, so didn't ask for yield in 2016

Corn grain N, n=2137

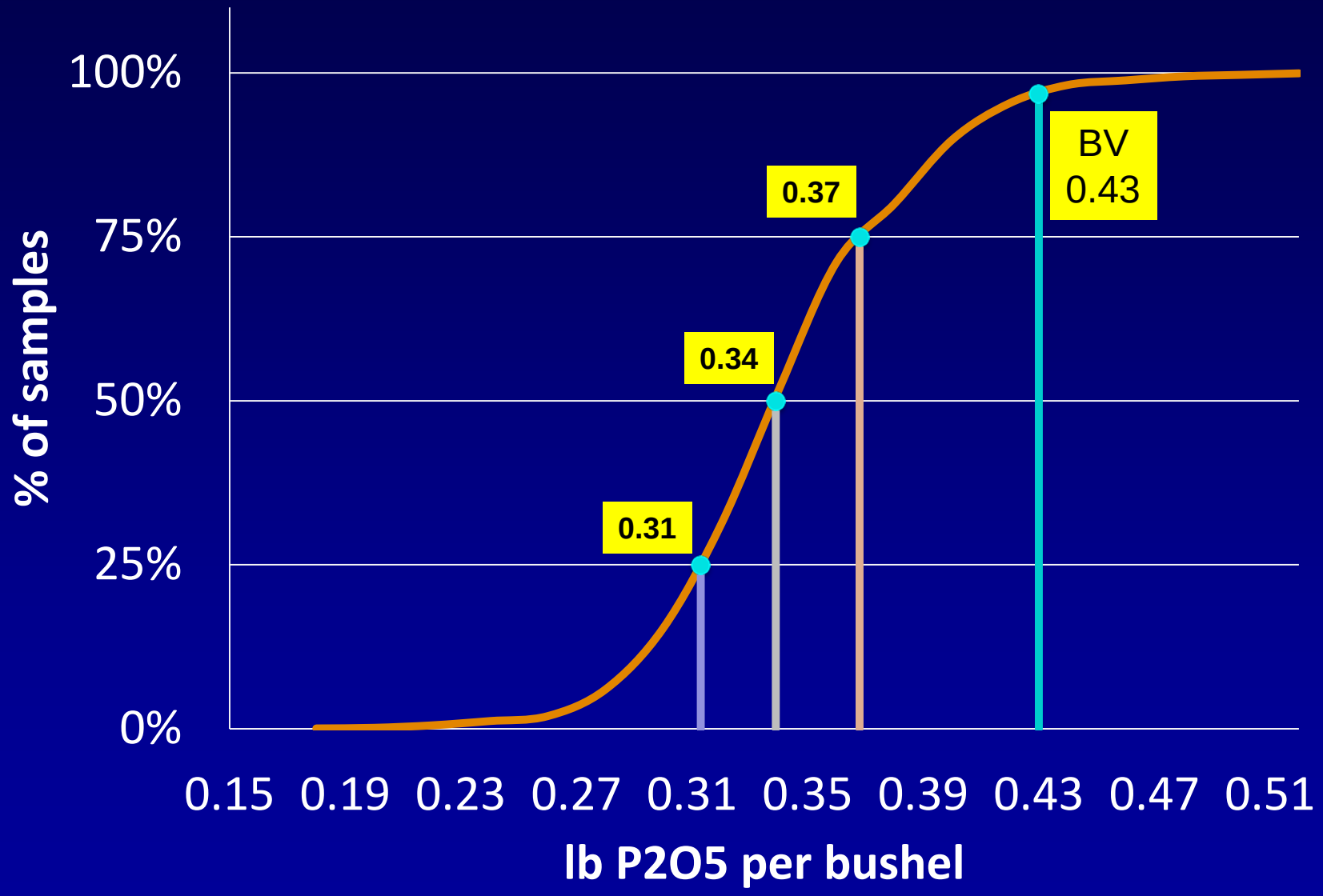



Corn grain protein, n=2137
2014 avg 7.6%
2015 avg 6.6%
2016 avg. 7.2%
Frequency
300
250
200
150
100
50
0
5.1
5.6
6.1
6.6
7.1
7.5
8.0
8.5
9.0
9.5
9.9
% protein (0% moisture)

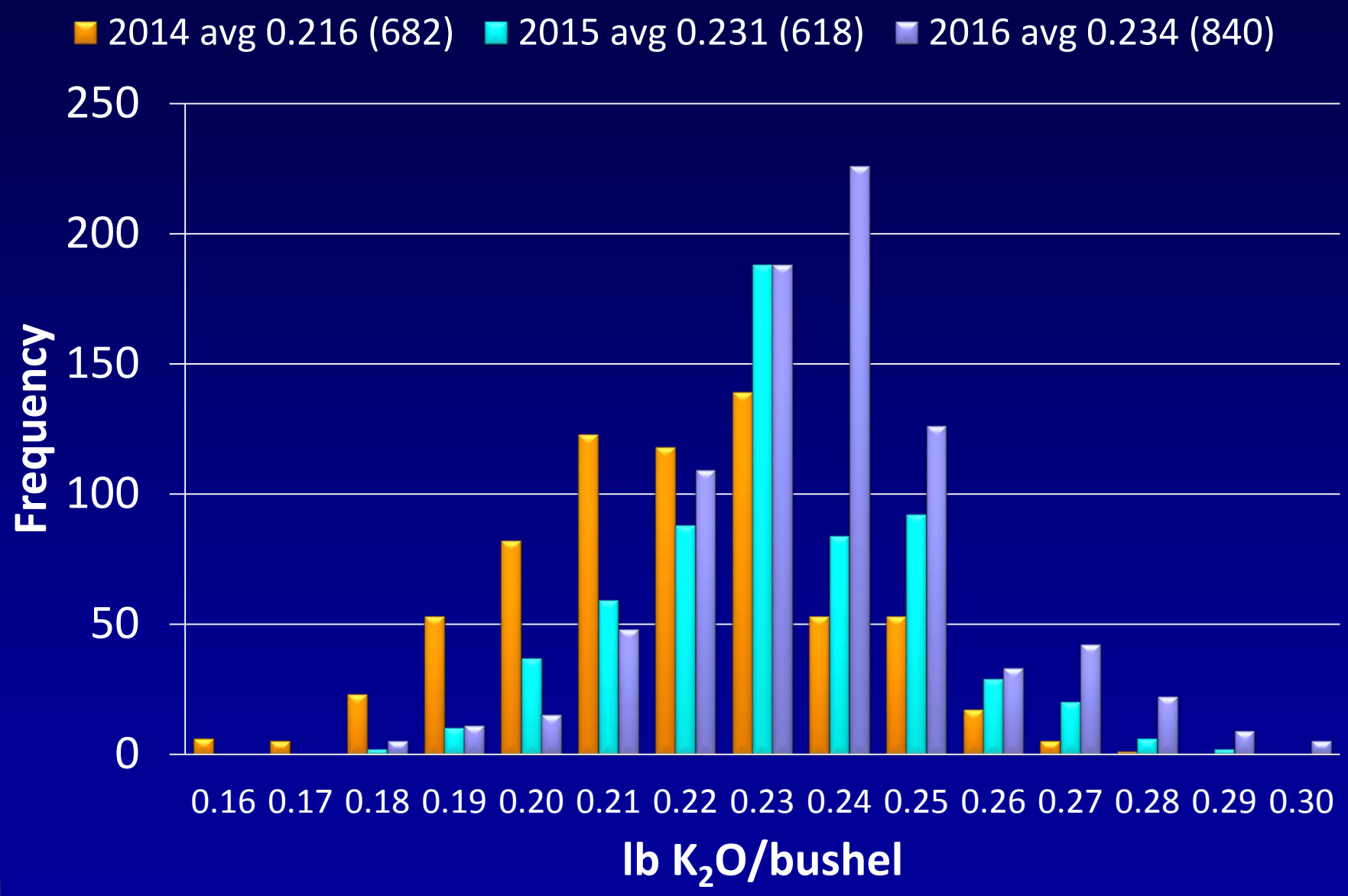
Corn grain P


2014 avg = 0.35
2015 avg = 0.34
2016 avg = 0.34
Frequency
160
140
120
100
80
60
40
20
0
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.40
0.42
0.44
0.46
0.48
0.50
0.52
lb P_2O_5/bushel

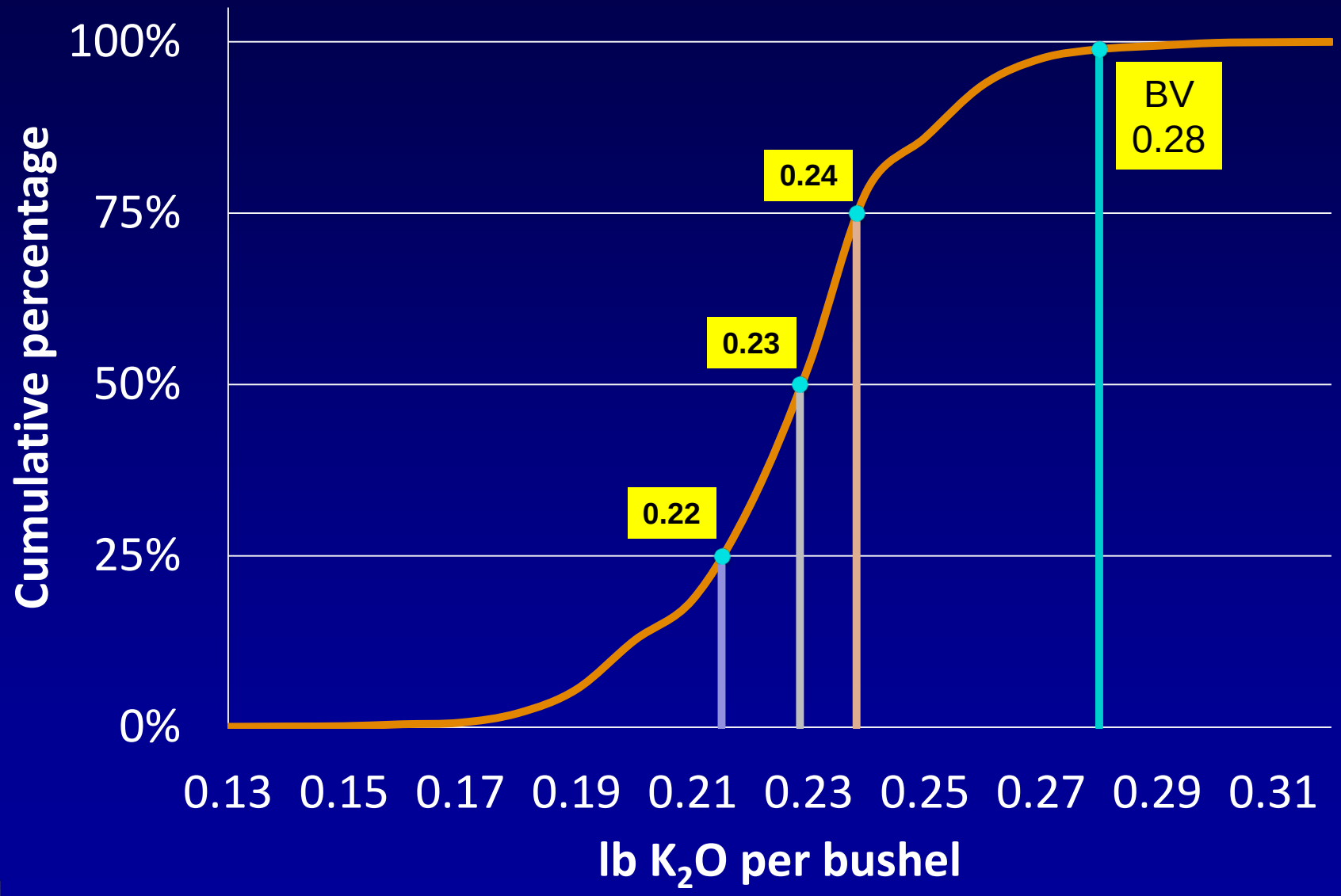
Corn grain P, 2014-16, N=2140

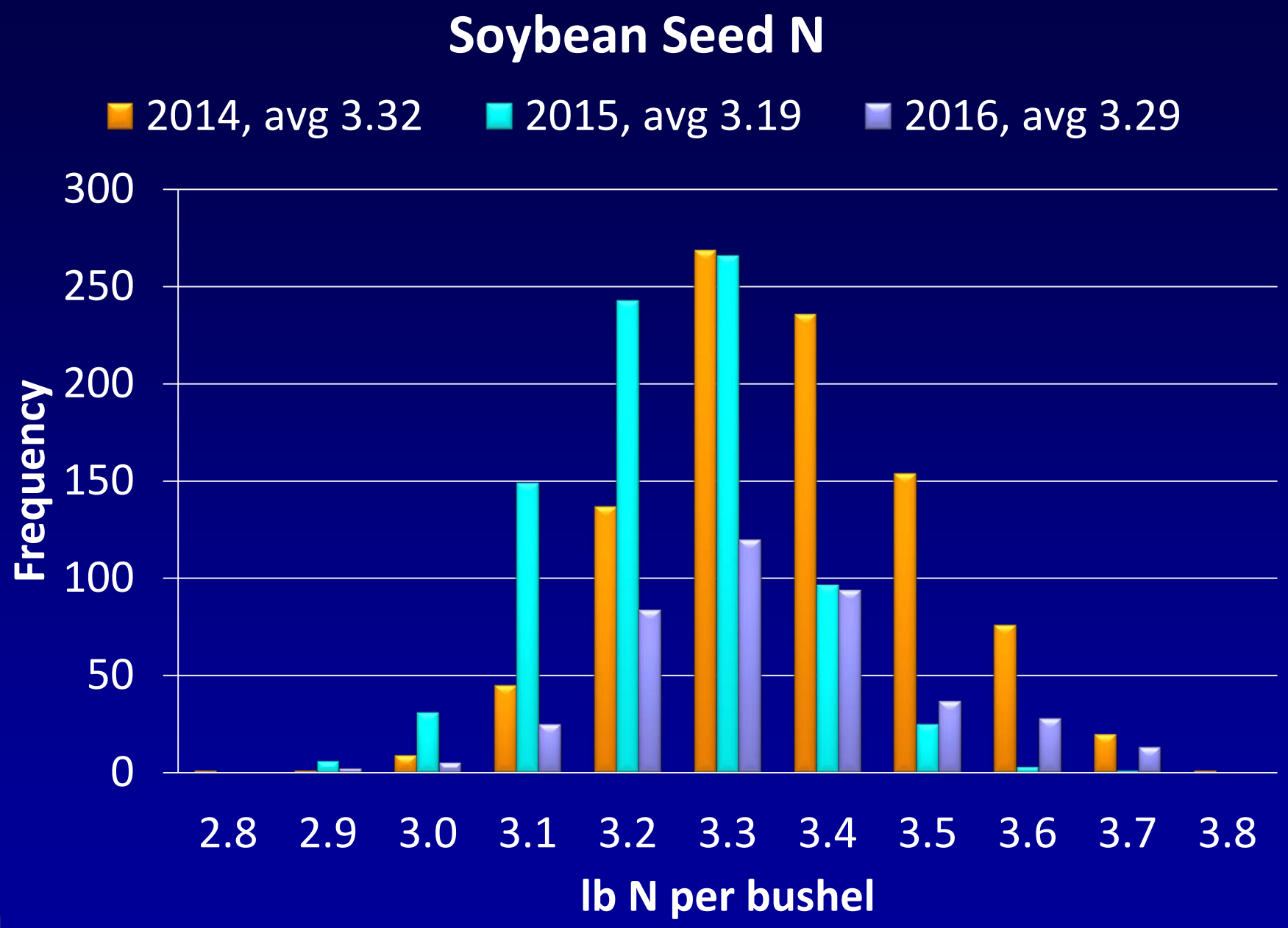


Corn grain K

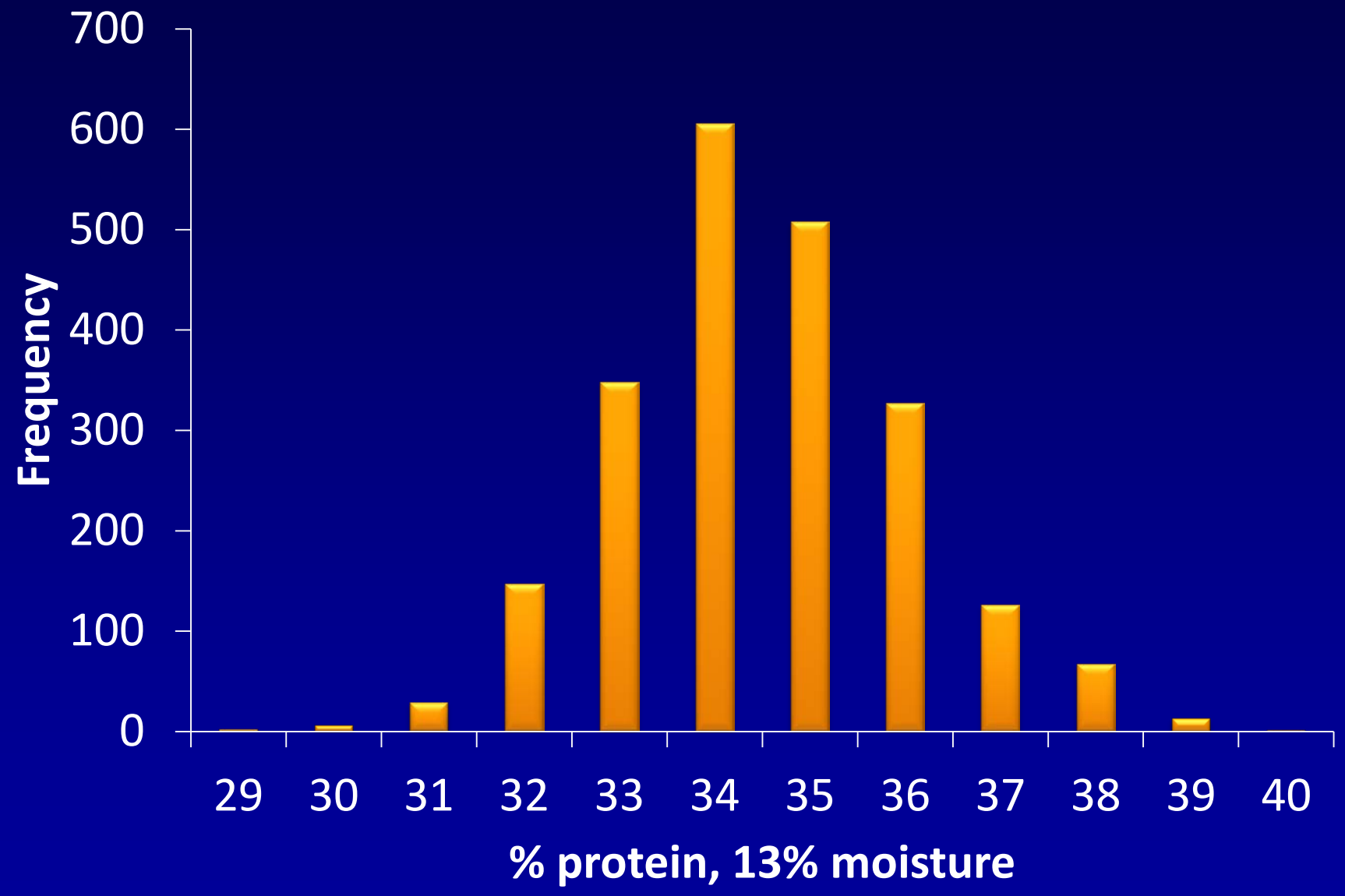

2014 avg 0.216 (682)
2015 avg 0.231 (618)
2016 avg 0.234 (840)
Frequency
250
200
150
100
50
0
0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.28 0.29 0.30
lb K_2O/bushel

Corn Grain K, 2014-16, N=2140

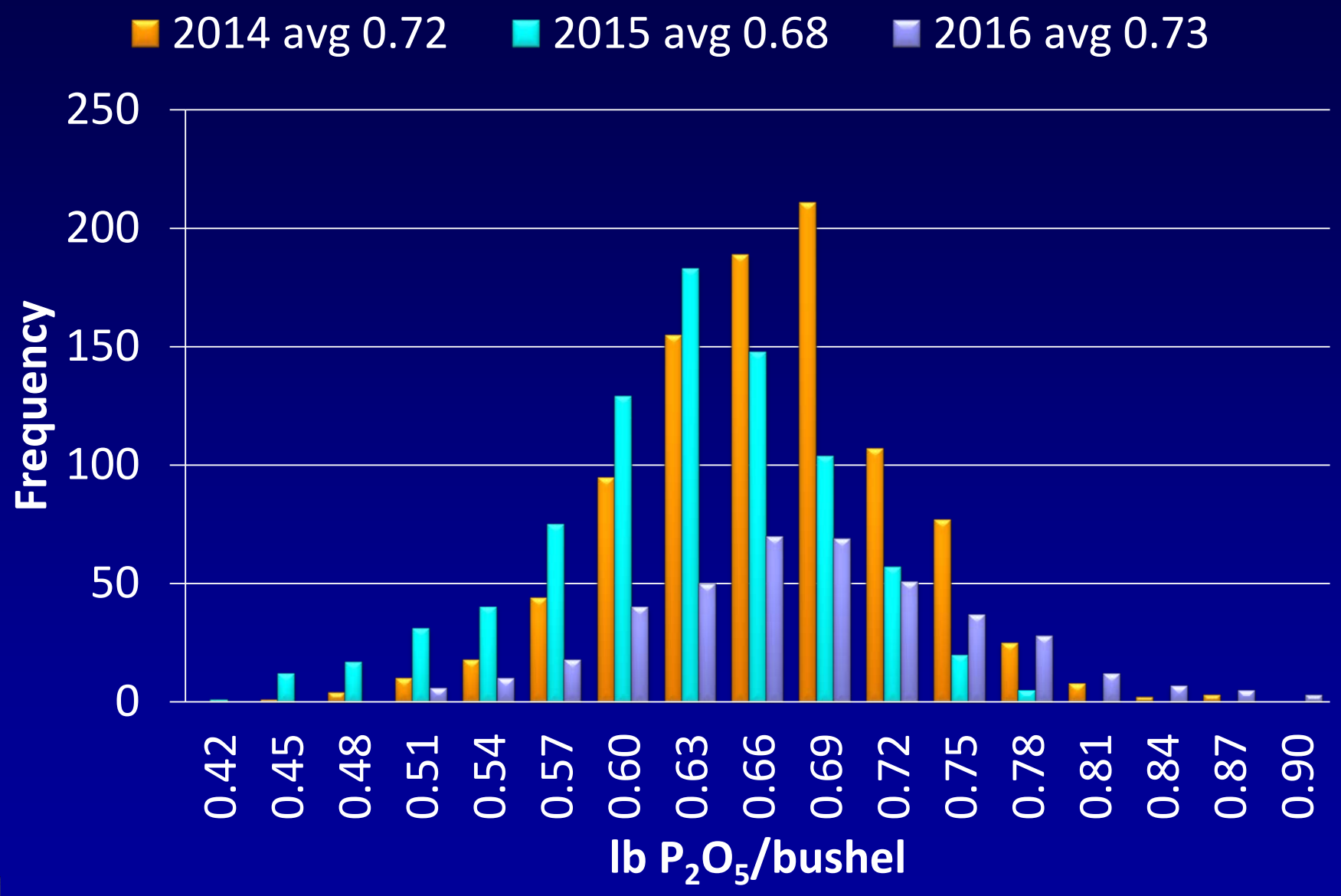



Soybean Seed N
2014, avg 3.32
2015, avg 3.19
2016, avg 3.29
Frequency
300
250
200
150
100
50
0
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
lb N per bushel

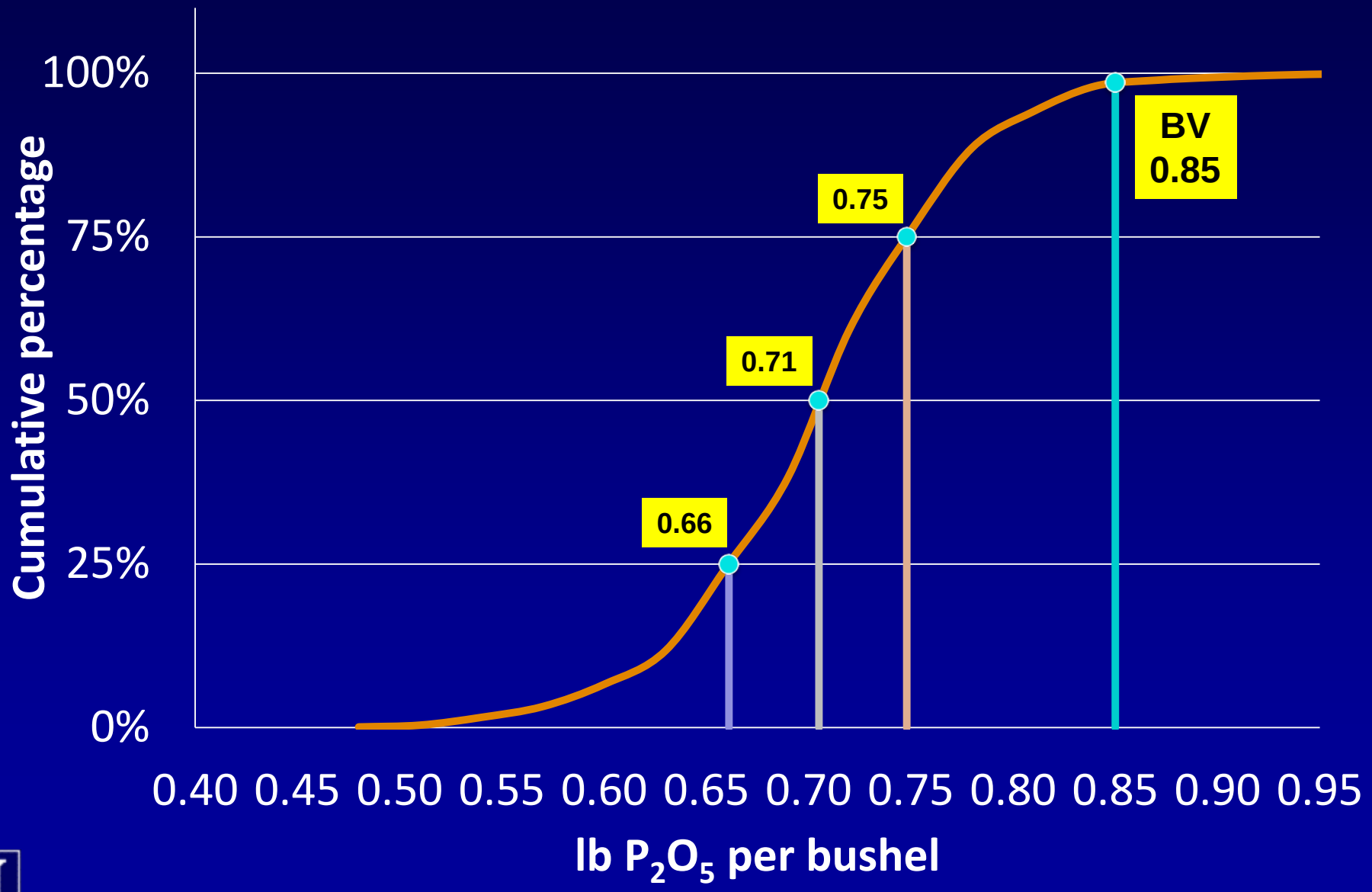
Soybean grain protein, n=2182



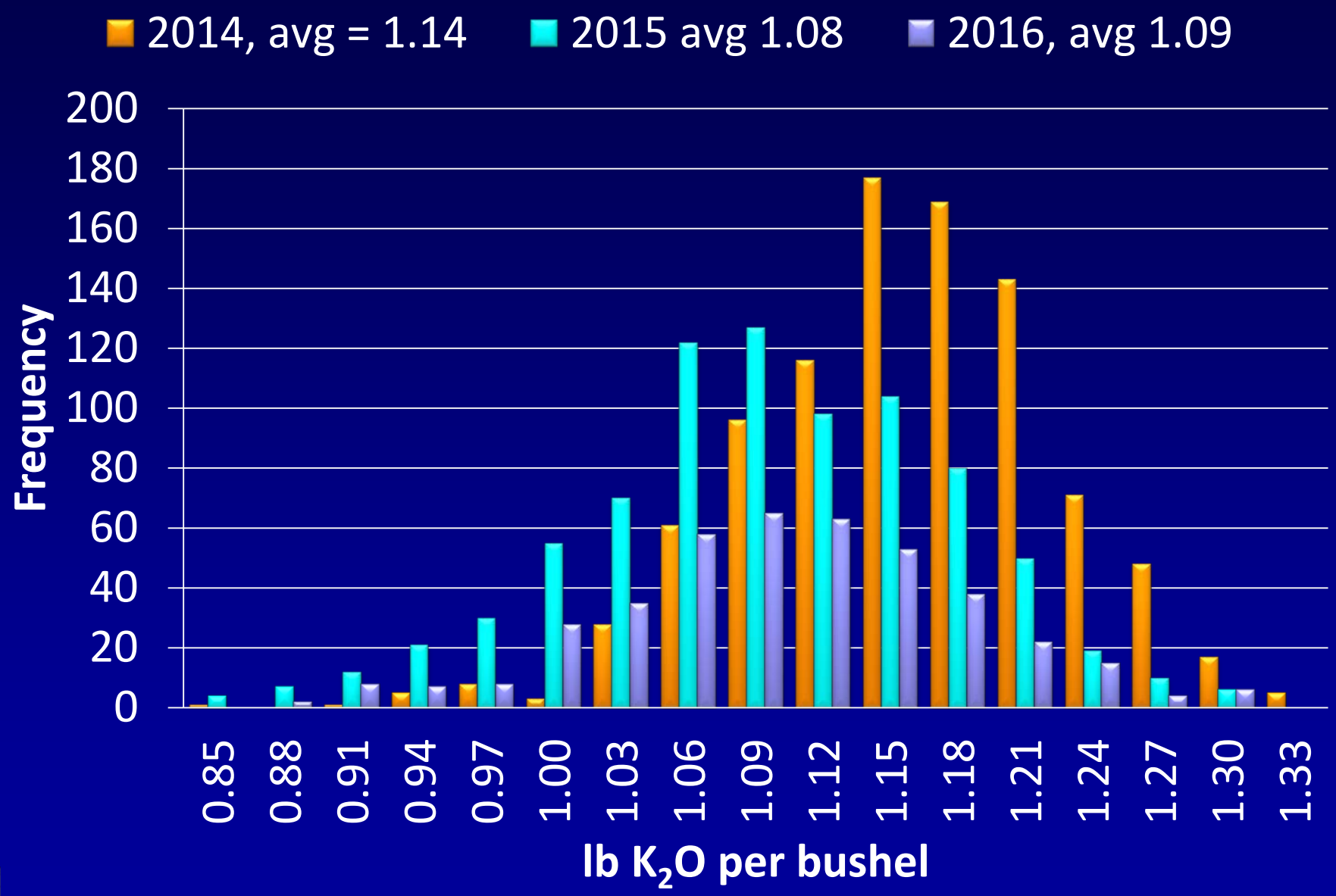
Soybean grain P



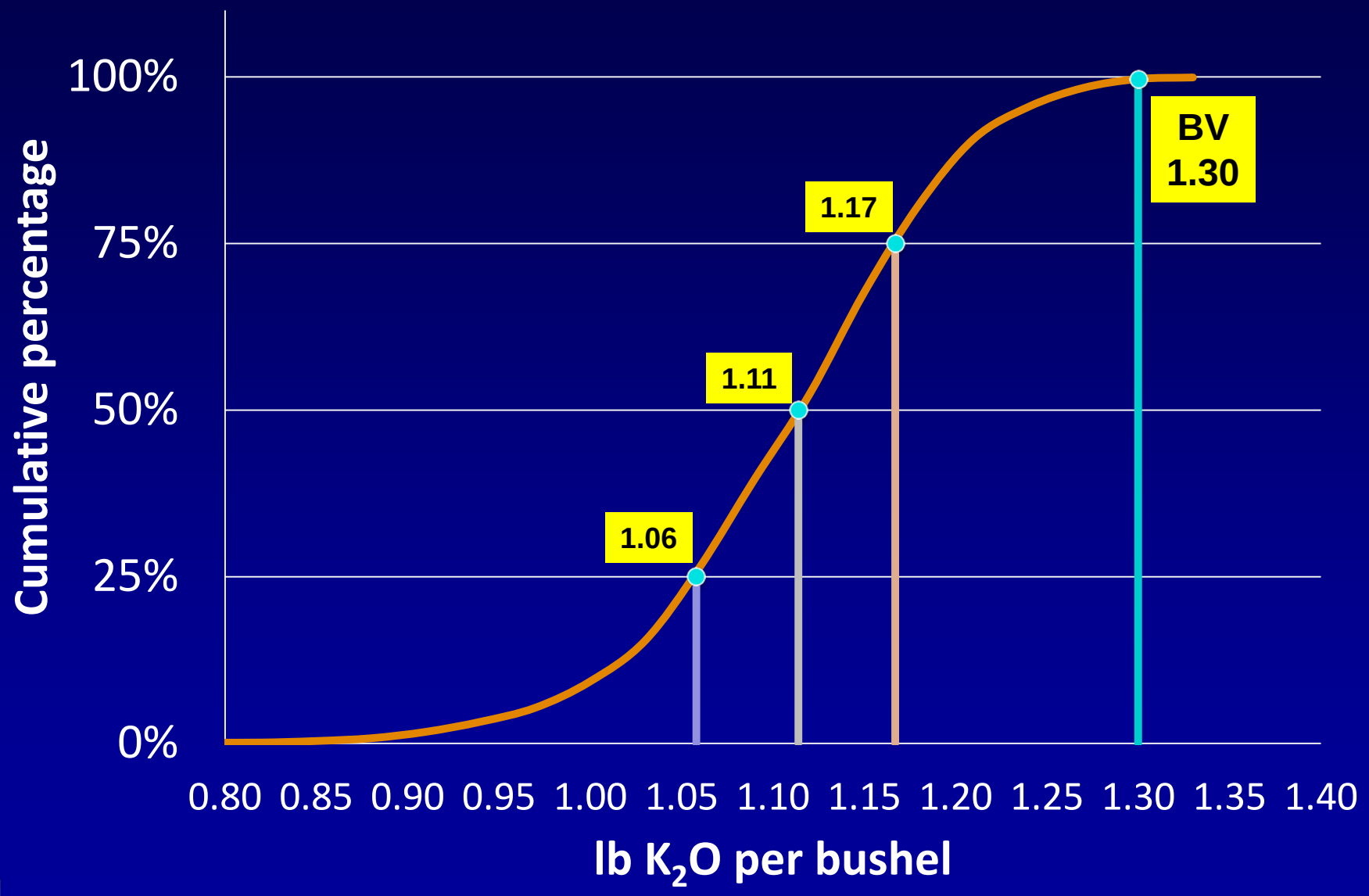
Soybean grain P, n=2181



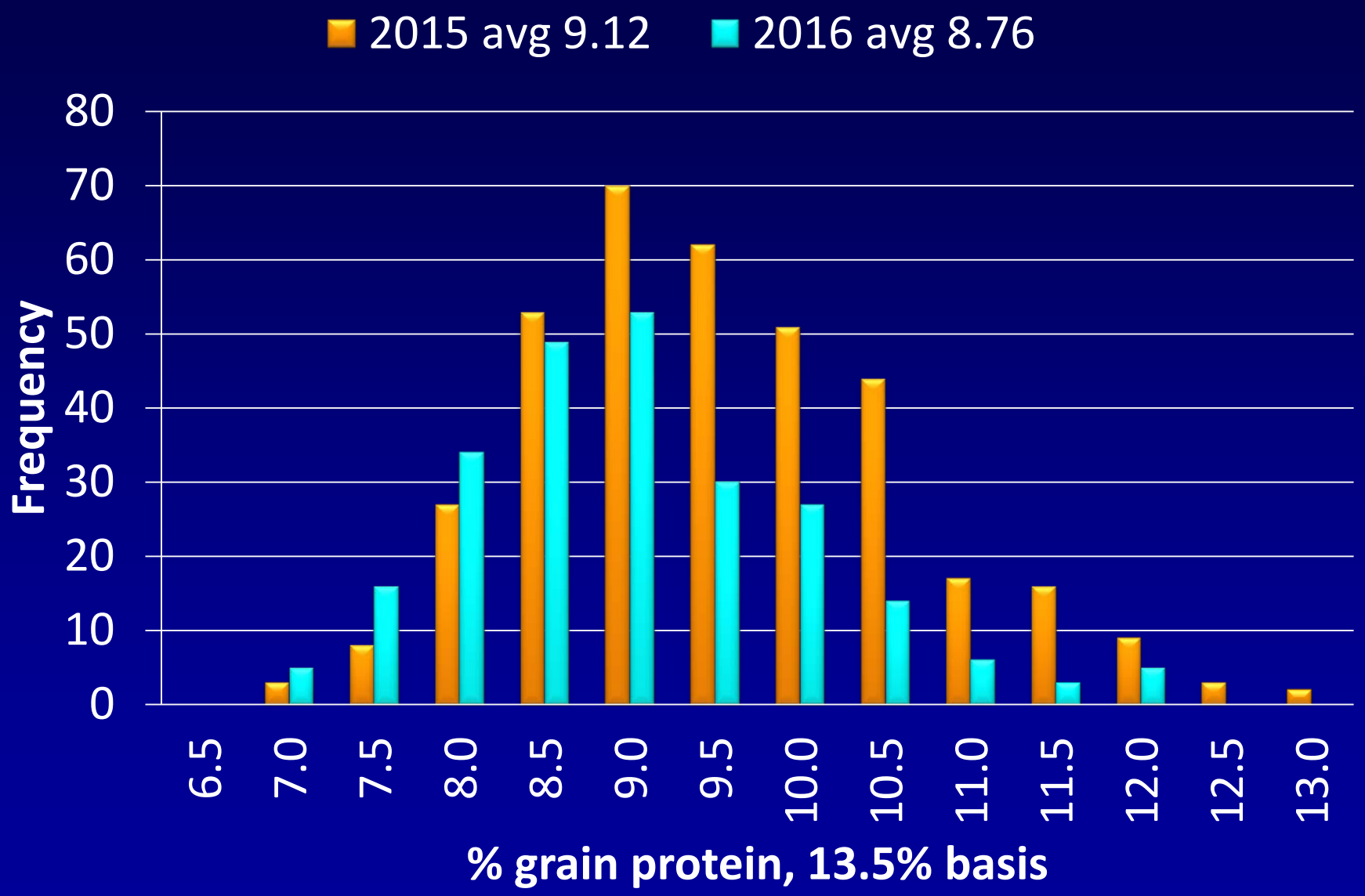
Soybean grain K, n=2181



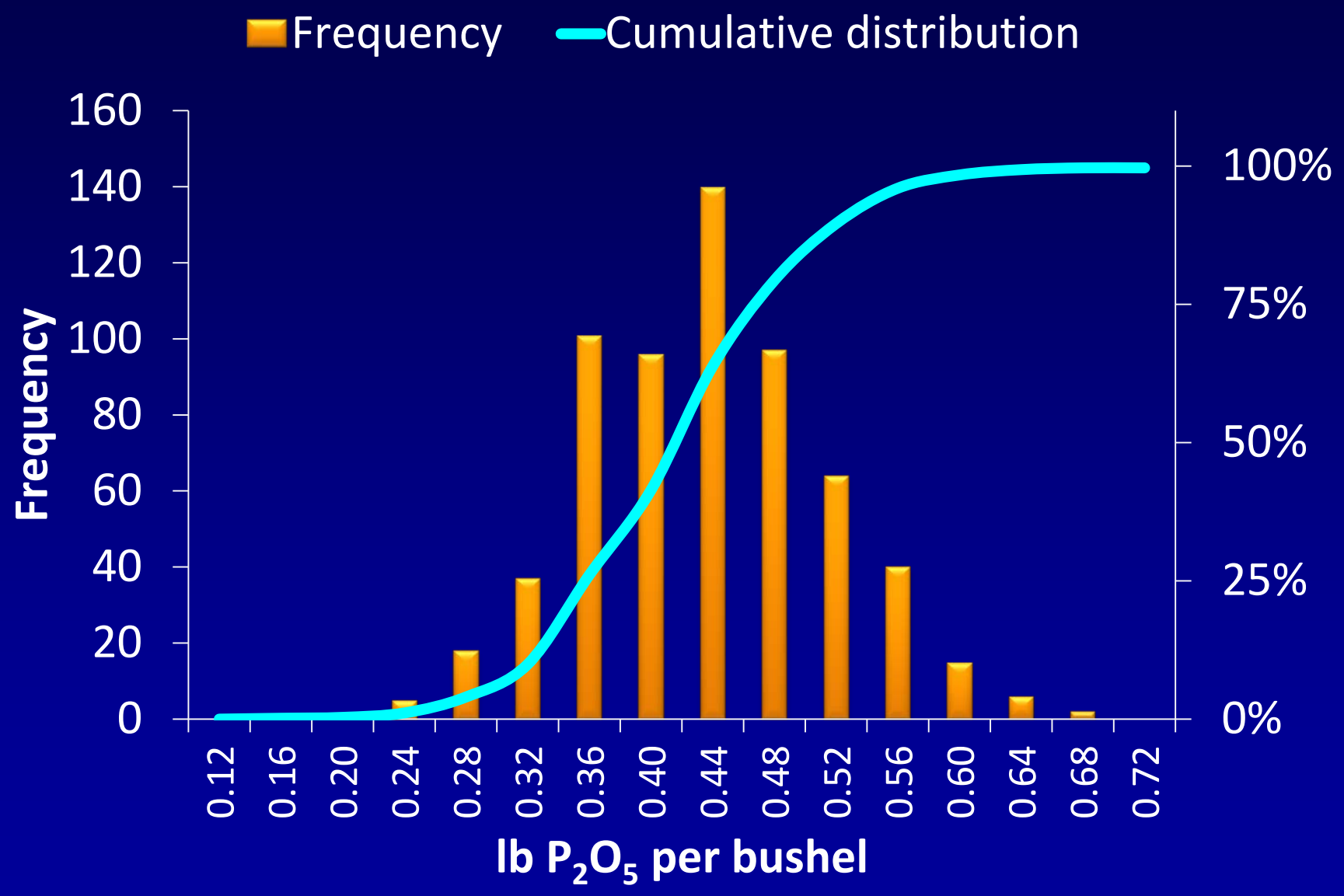
Soybean grain K, n=2181



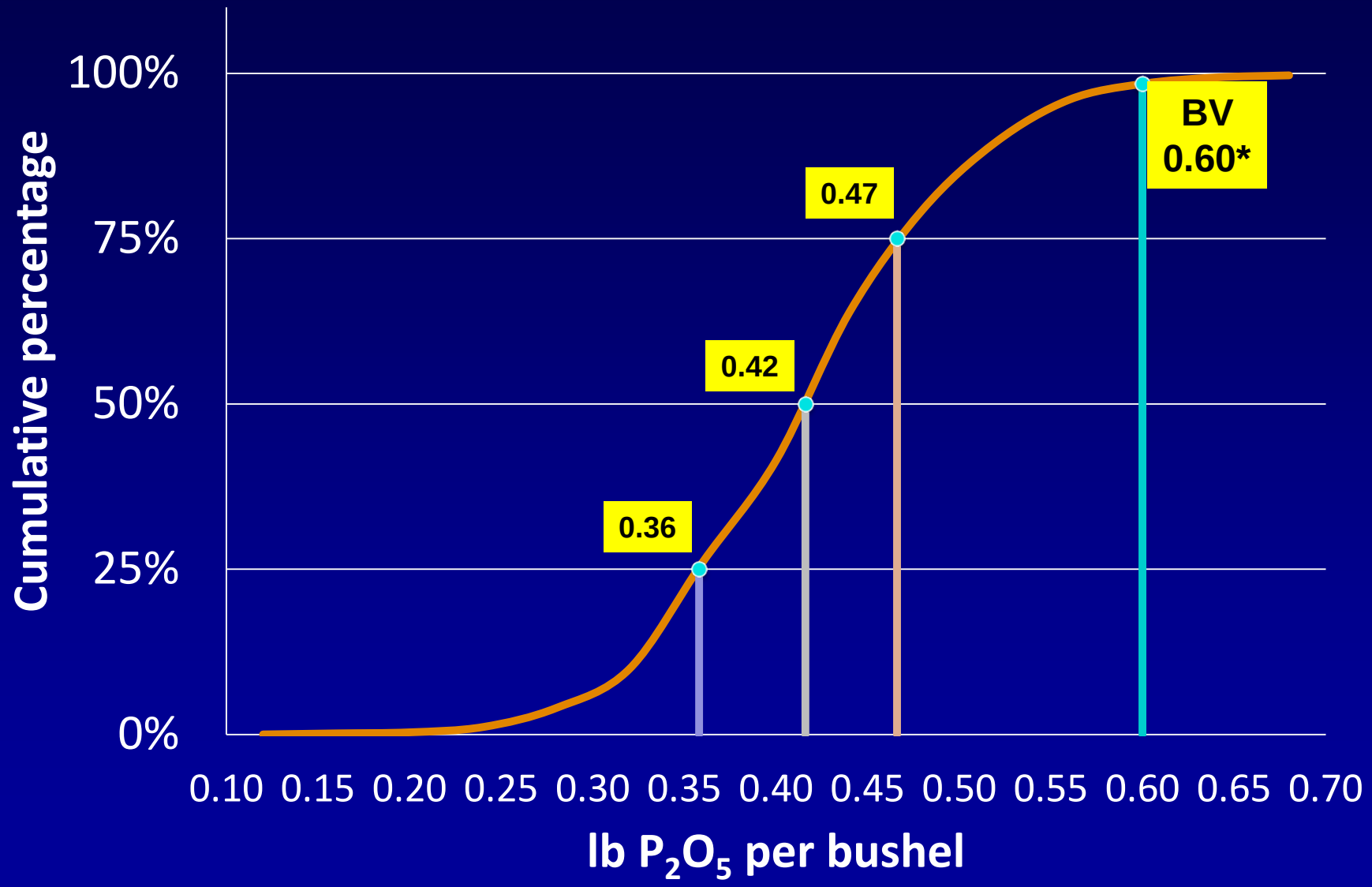
Wheat grain protein



Wheat grain P, 2014-16, n=625

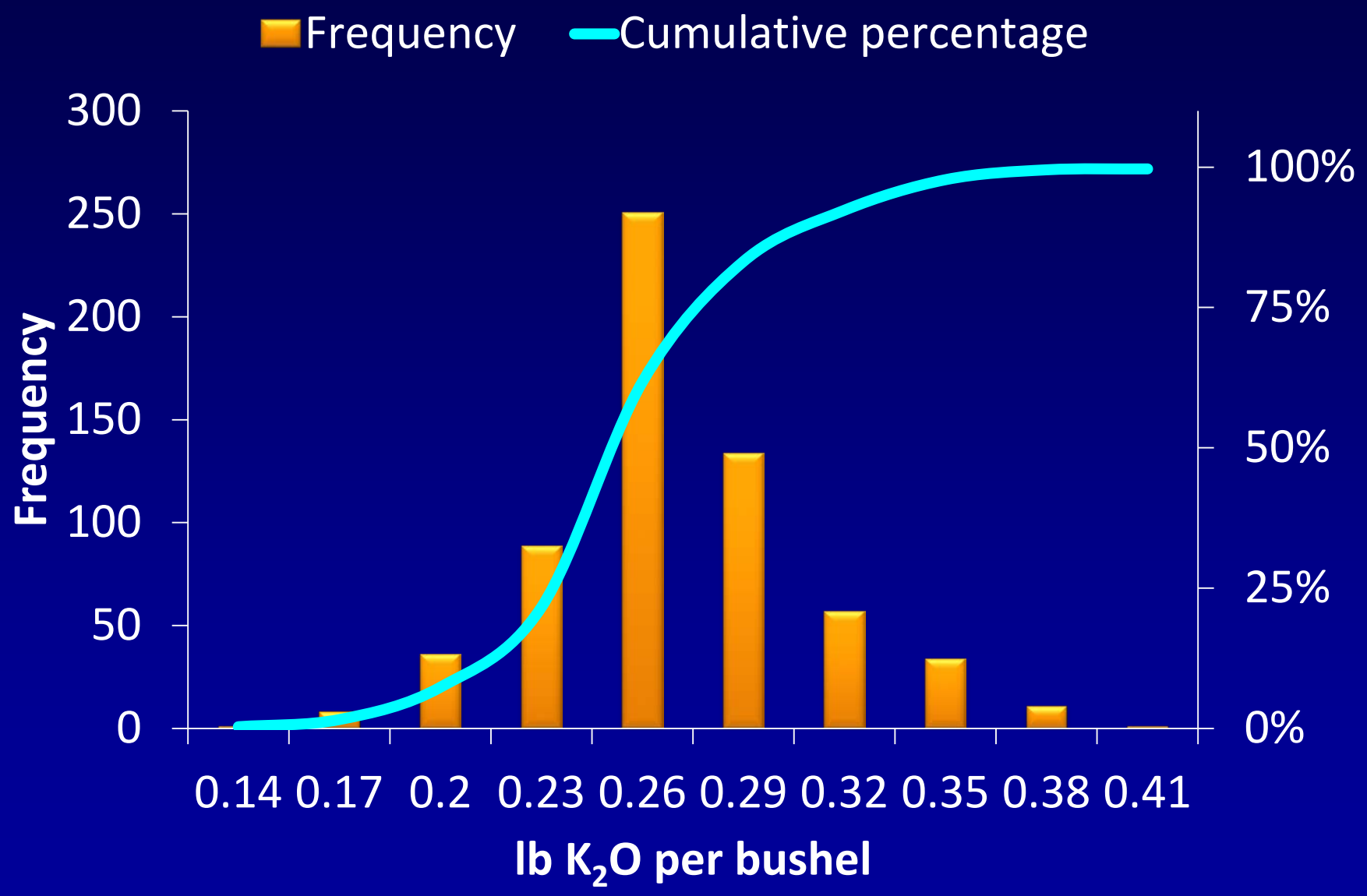


Wheat grain P, 2015-16, n=625

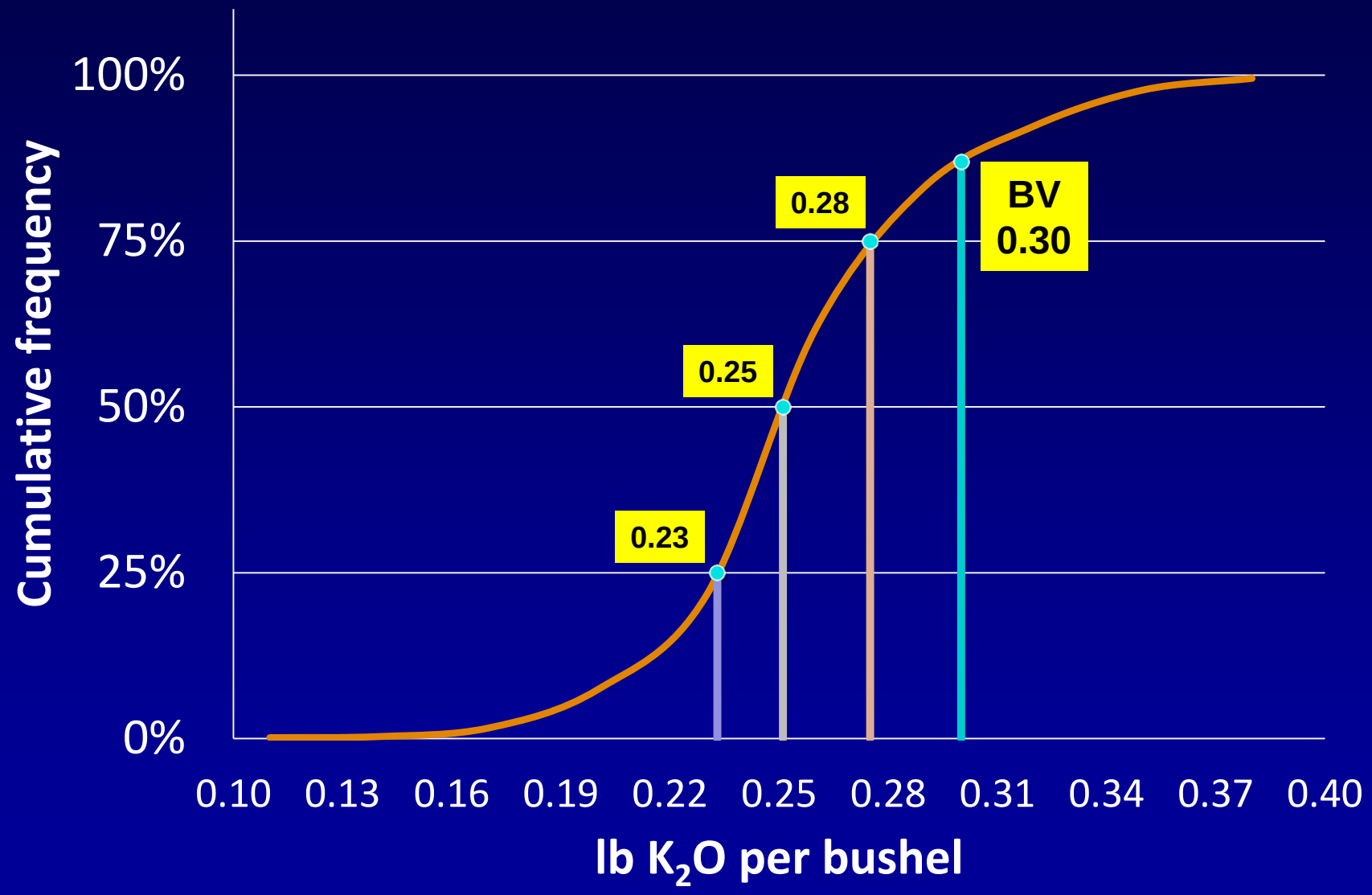


*Removal value in IAH is 0.9, 1.5 times "actual"

Wheat grain K, 2014-16, n=625



Wheat grain K, n=625



Corn	Number	P_2O_5/bu	K_2O/bu
CRD 1-2	508	0.35	0.22
CRD 3-5	792	0.34	0.23
CRD 6-7	508	0.34	0.23
CRD 8-9	332	0.36	0.23
2014	683	0.35	0.22
2015	617	0.34	0.23
2016	840	0.34	0.23
Total/avg	2140	0.34	0.23

Soybean	Number	P_2O_5/bu	K_2O/bu
CRD 1-2	464	0.70	1.11
CRD 3-5	715	0.69	1.11
CRD 6-7	571	0.70	1.11
CRD 8-9	431	0.73	1.09
2014	919	0.71	1.12
2015	712	0.69	1.11
2016	338	0.73	1.09
Total/avg	2181	0.70	1.11

Wheat	Number	P_2O_5/bu	K_2O/bu
CRD 1-2	56	0.42	0.26
CRD 3-5	78	0.47	0.28
CRD 6-7	170	0.40	0.26
CRD 8-9	321	0.41	0.25
2015	382	0.42	0.24
2016	243	0.41	0.27
Total/avg	625	0.42	0.26

Grain P and K: summary to date

Nutrient	No. of samples	Average value	Range 25th -75th%	Book value	% change BV to 75th%	Iowa State numbers
		----------lb P/K (oxide) per bushel----------				
Corn P	2,140	0.34	0.31-**0.37**	0.43	-14	0.32
Corn K	2,140	0.23	0.22-**0.24**	0.28	-15	0.22
Soy P	2,181	0.70	0.66-**0.75**	0.85	-12	0.72
Soy K	2,181	1.11	1.06-**1.17**	1.30	-10	1.20
Wheat P	625	0.42	0.36-**0.47**	*0.60	-22	0.55
Wheat K	625	0.26	0.23-**0.28**	0.24	15	0.27

*IAH book value is 0.9, 1.5x actual

Final comments

- The origin and validity of the "book values" in long-term use are not very clear
- Current (75th percentile) numbers are modestly lower than the book values except for wheat K
- Differences between years and regions aren't large enough to consider these in guidelines
- Removal levels don't vary with crop yield; we don't have a good idea why they do vary
- The new IL numbers are comparable to the (2011) Iowa State University numbers

Update on NREC-funded Nitrogen on Corn Projects:

IFCA, Peoria
January 17, 2017

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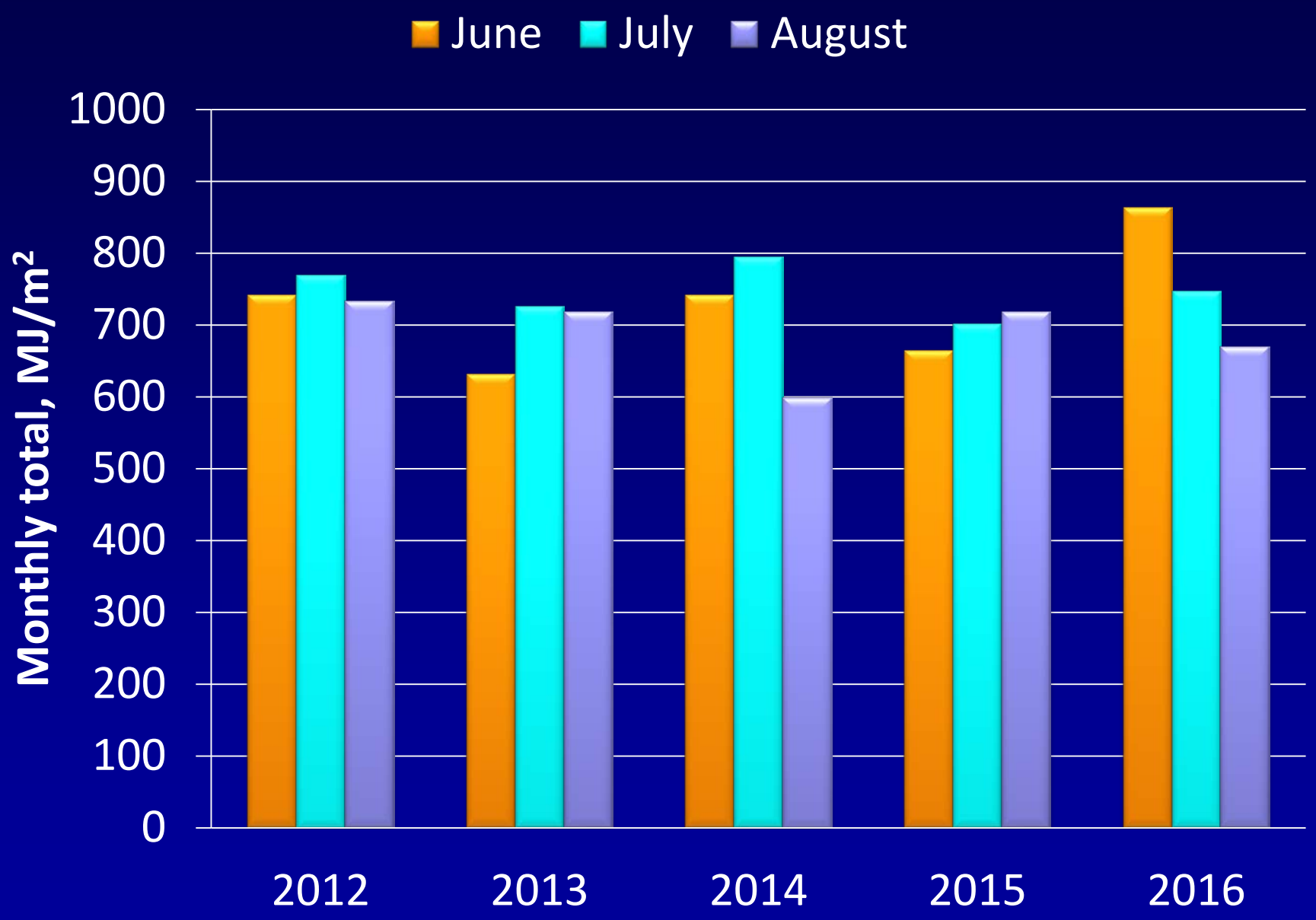
Projects for today's discussion

- Comprehensive N management (started in 2014):
  - On-farm N rate trials (with IFCA)
  - Research center trials with 28 treatments, including N rates, times, forms, and additives
  - N-timing strip trials with late N application
  - DAP as an N source
- N-tracking project (started in 2015)

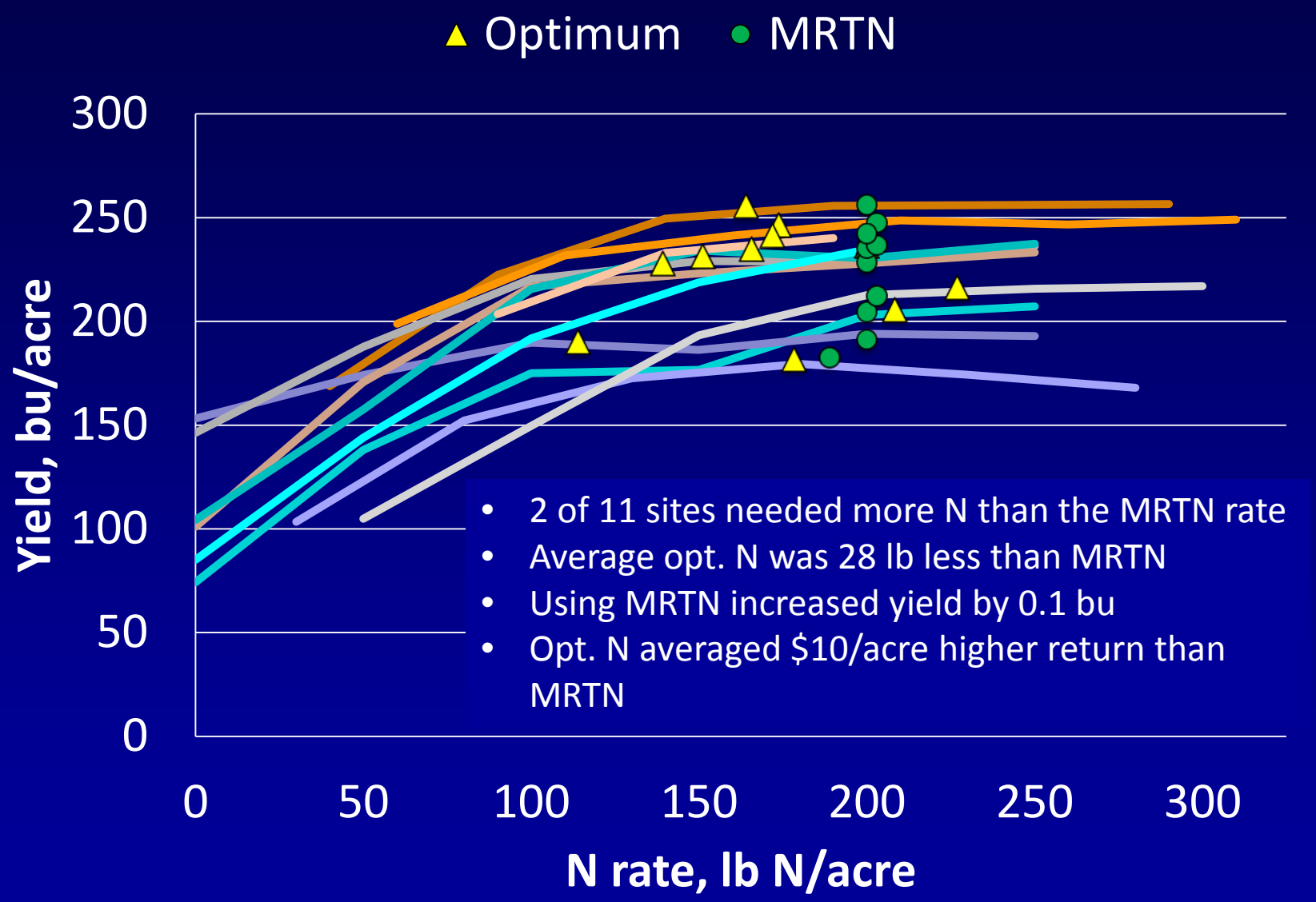
The 2016 Illinois corn crop:

- Planting was on time, and early establishment was good
- Weather highlights:
  - May rainfall and temperatures about normal
  - June was mostly dry with temperatures above normal
  - July rainfall was normal to above normal: temperatures were normal
  - August rainfall was normal to above-normal, with temperatures a little above normal
- Early maturity and normal harvest progress
- Final yield estimate 197

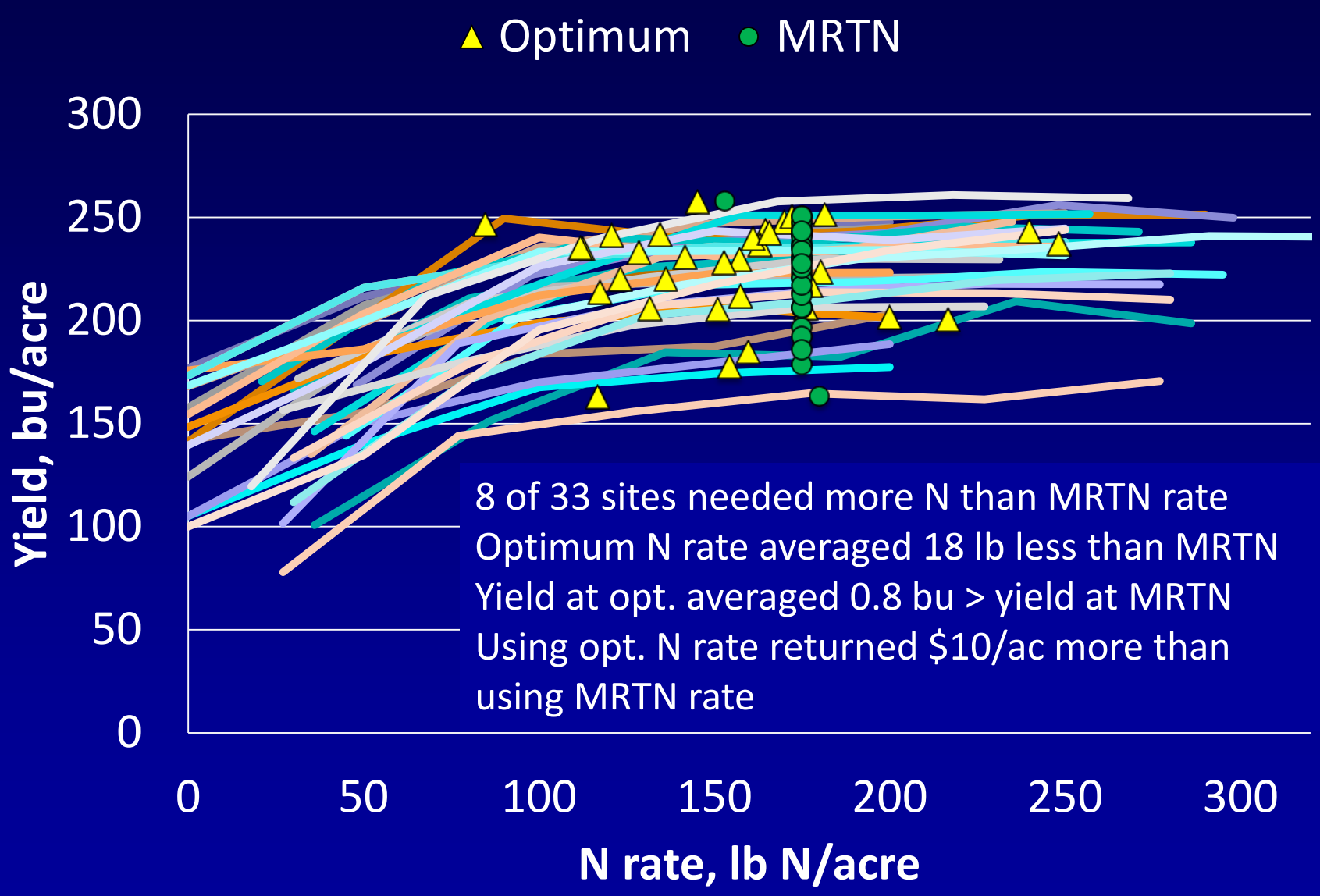
Sunlight at Bondville ICN site, Champaign County



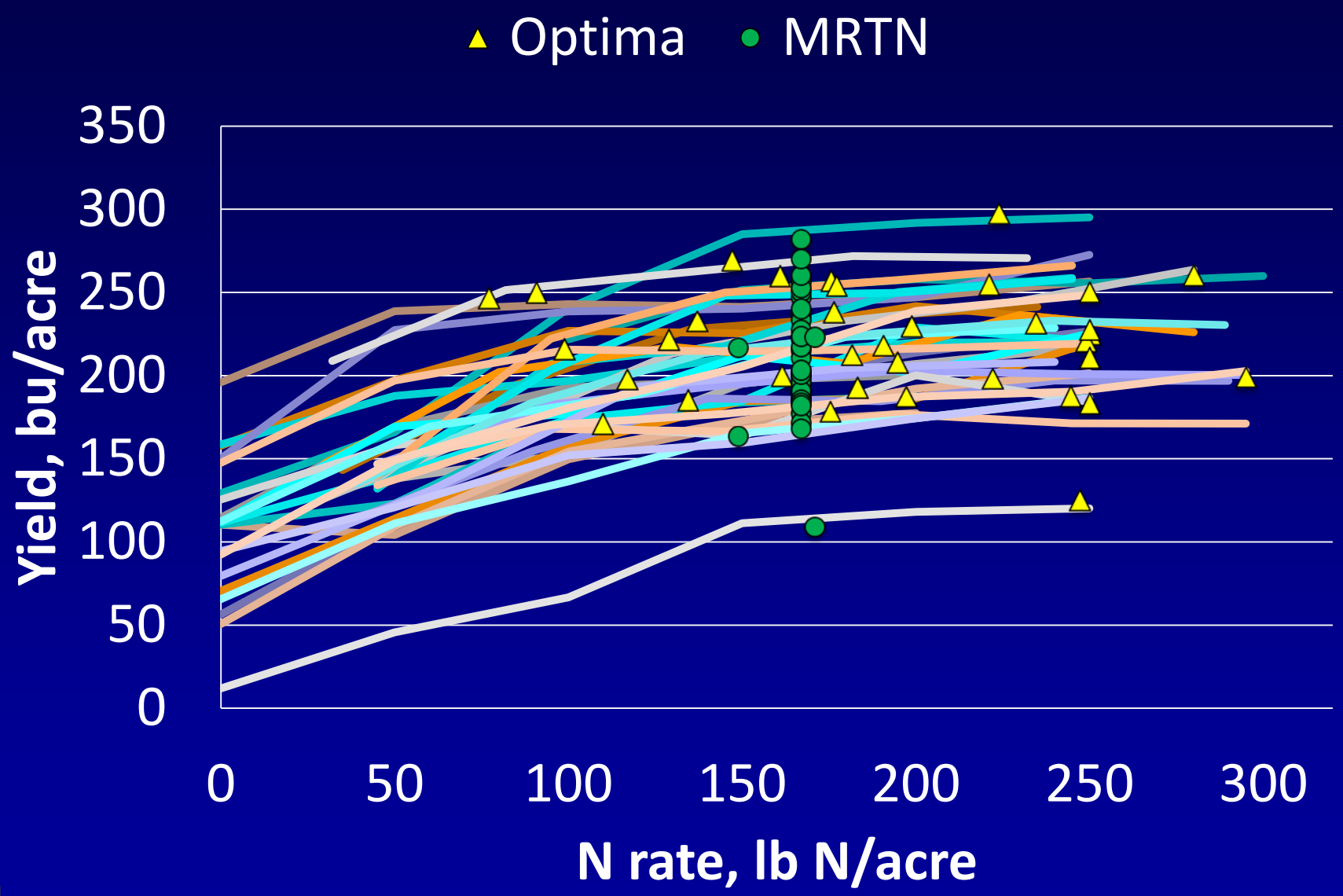
11 on-farm N trials Corn-Corn 2016



33 on-farm N trials Soy-Corn 2016



35 on-farm trials Soy-Corn 2015

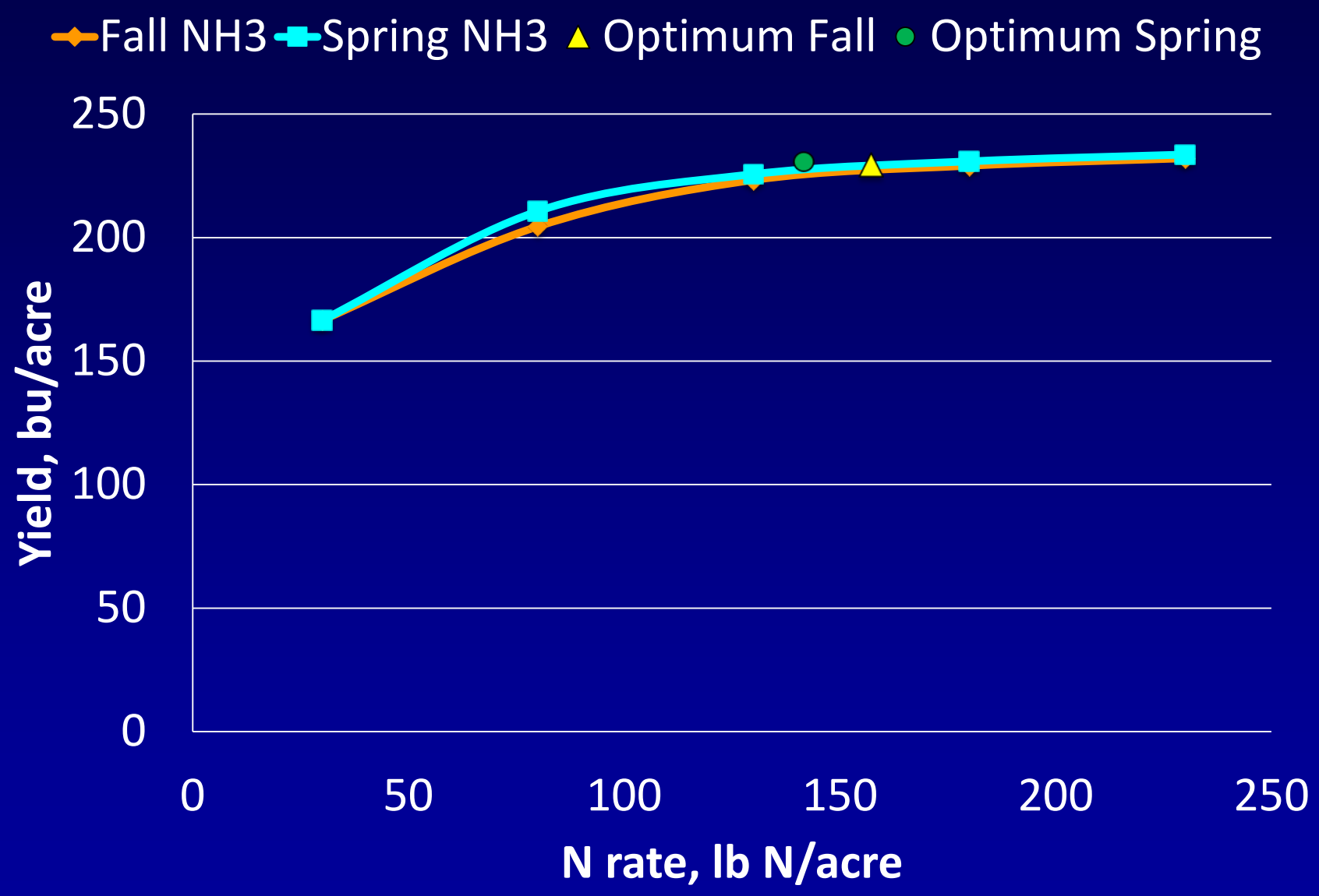


Current MRTN N rate guidelines from the N rate calculator

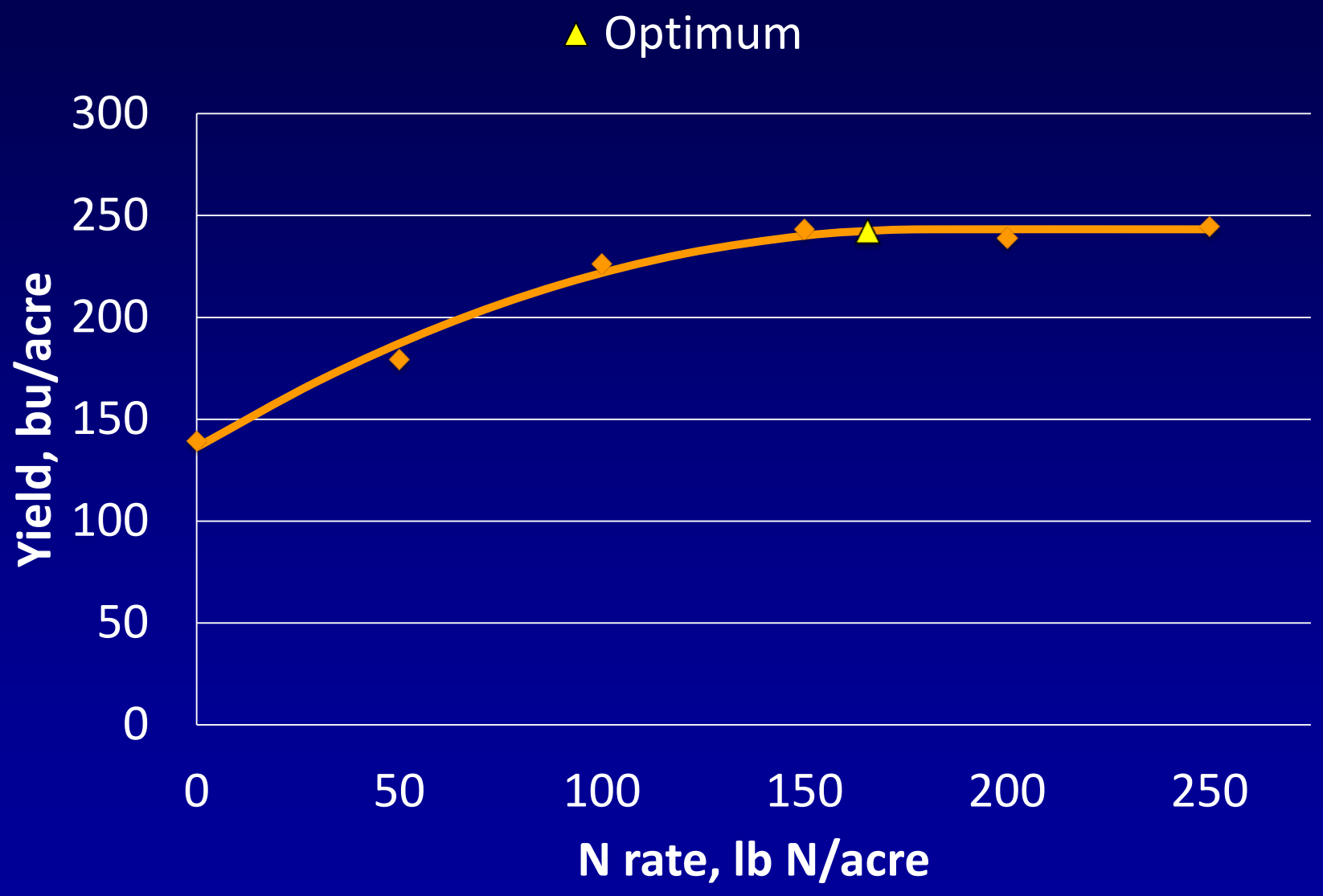
- Based on N price = $0.375/lb and corn price = $3.75/bu

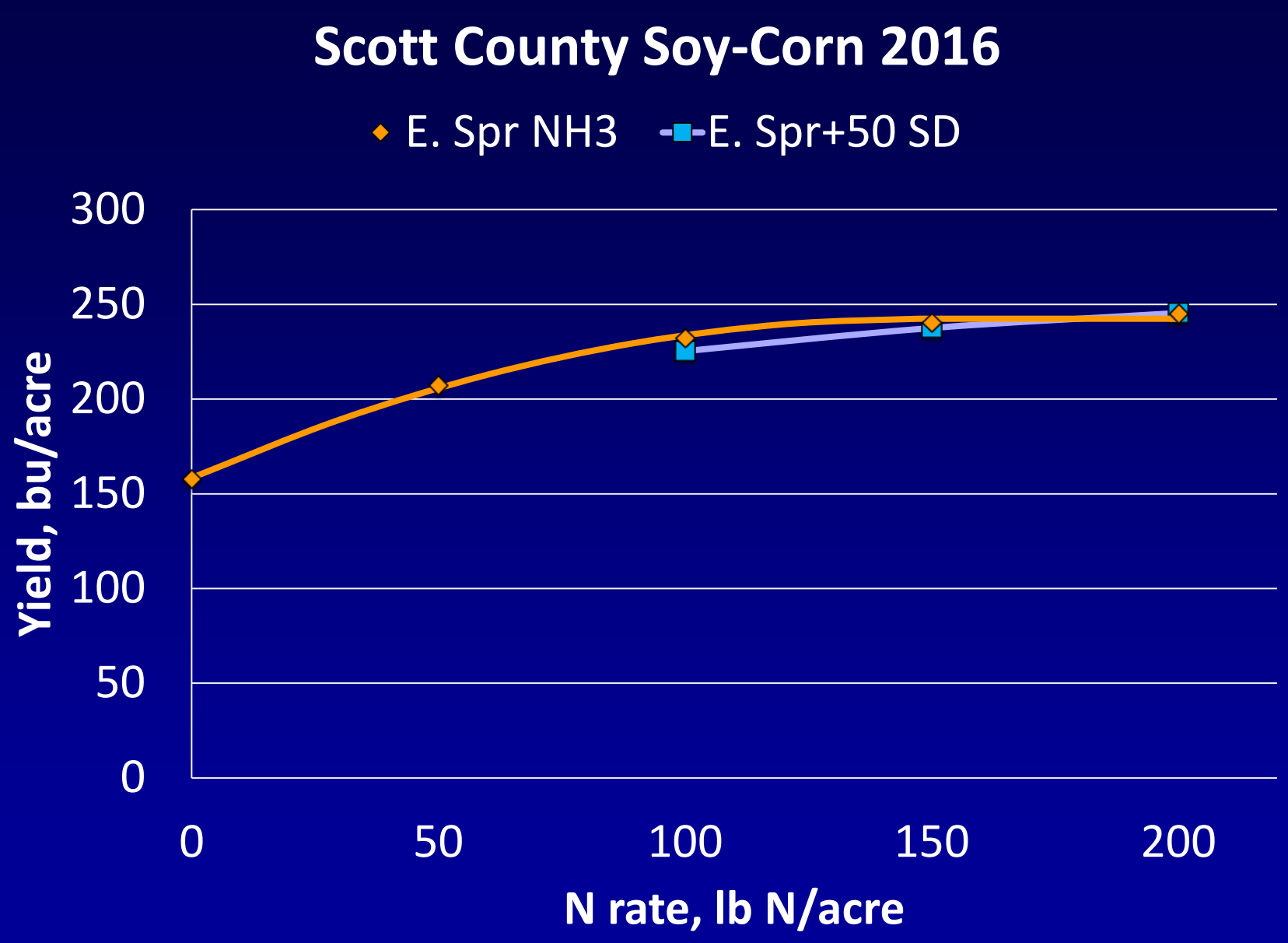
IL region	Soy-corn	Corn-corn
North	153 (78)	203 (89)
Central	175 (214)	200 (155)
South	180 (113)	189 (47)

DeWitt County Soy-Corn 2016

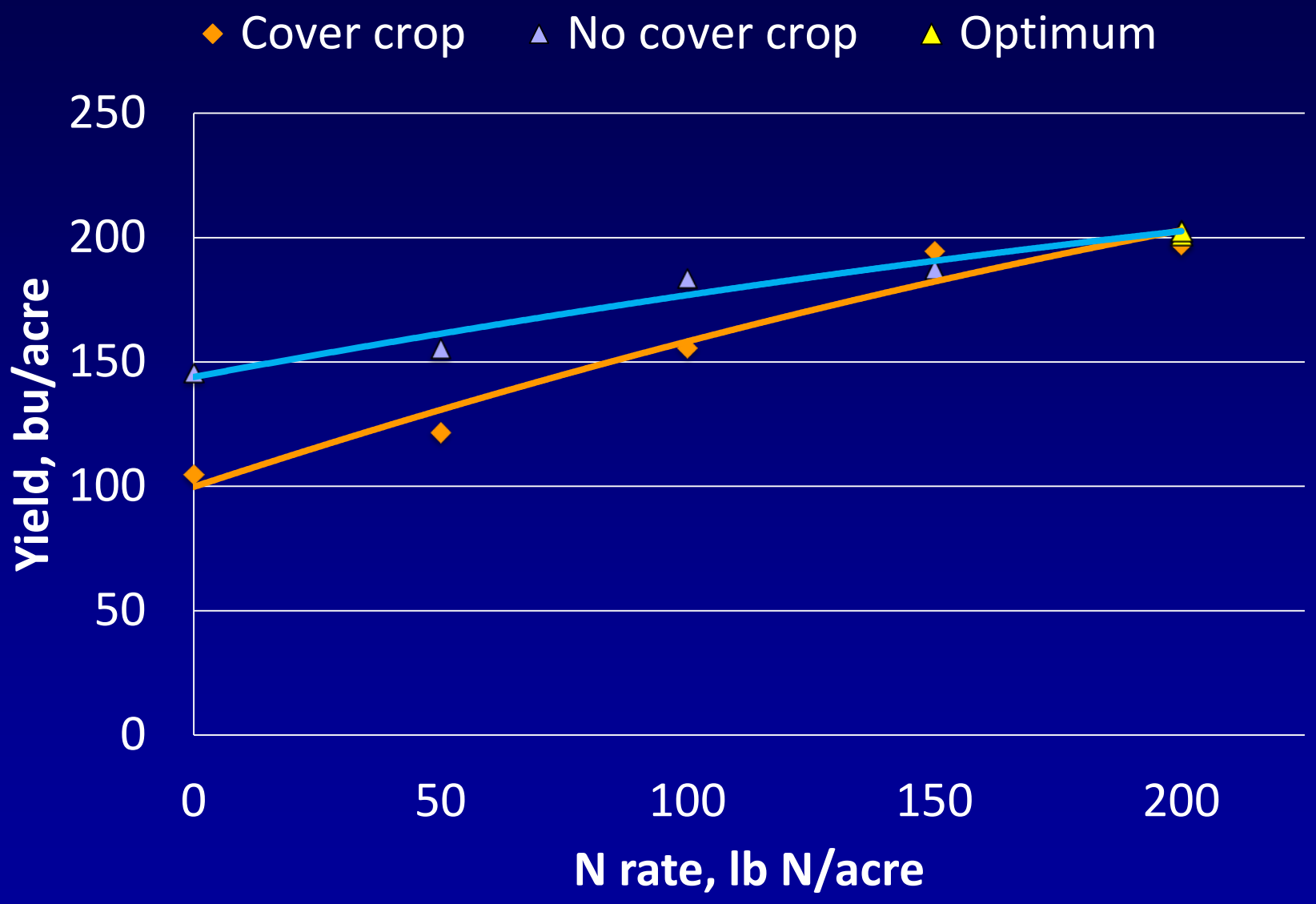


McLean County Soy-Corn 2016

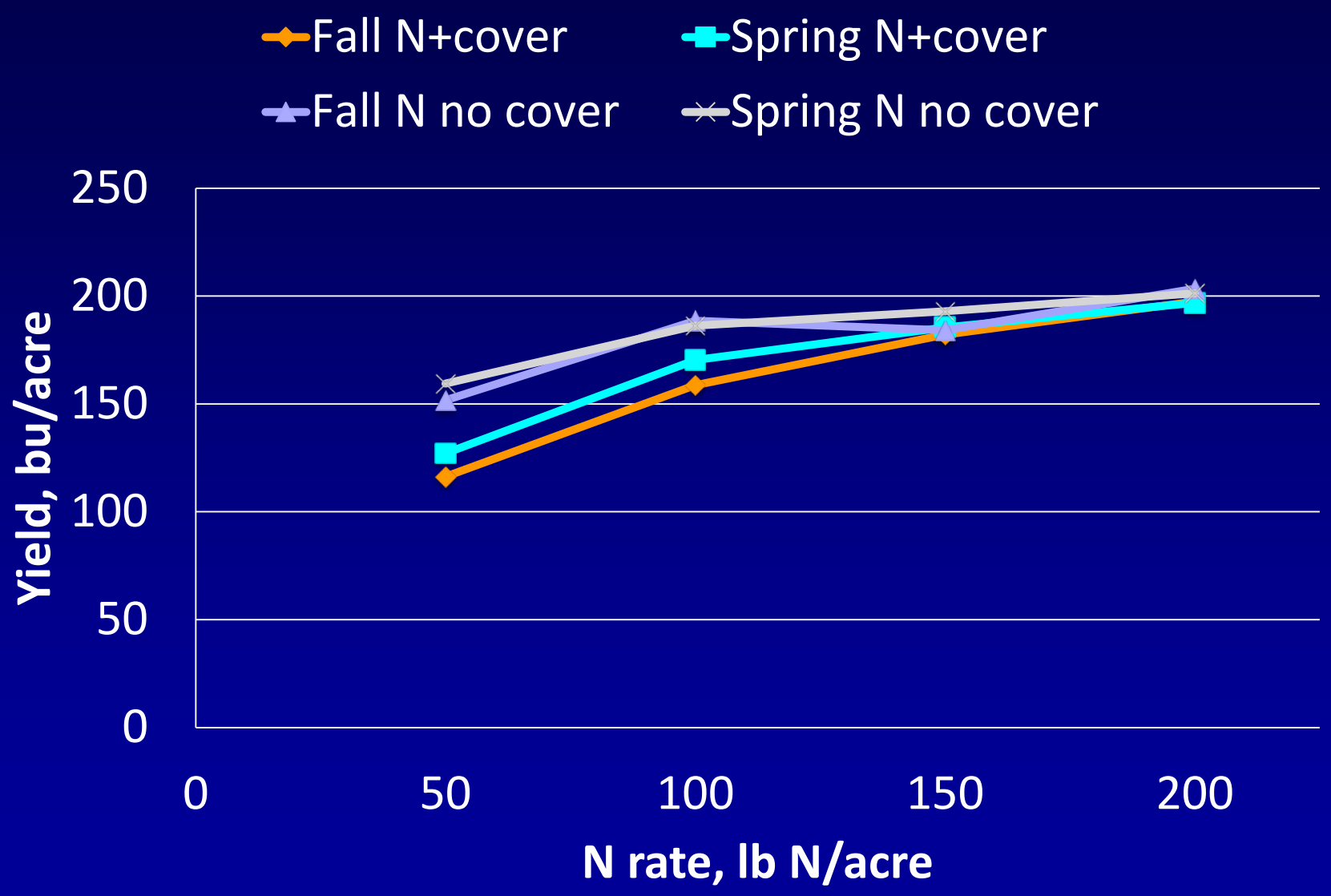



Scott County Soy-Corn 2016
E. Spr NH3
E. Spr+50 SD
300
250
200
150
100
50
0
Yield, bu/acre
0
50
100
150
200
N rate, lb N/acre

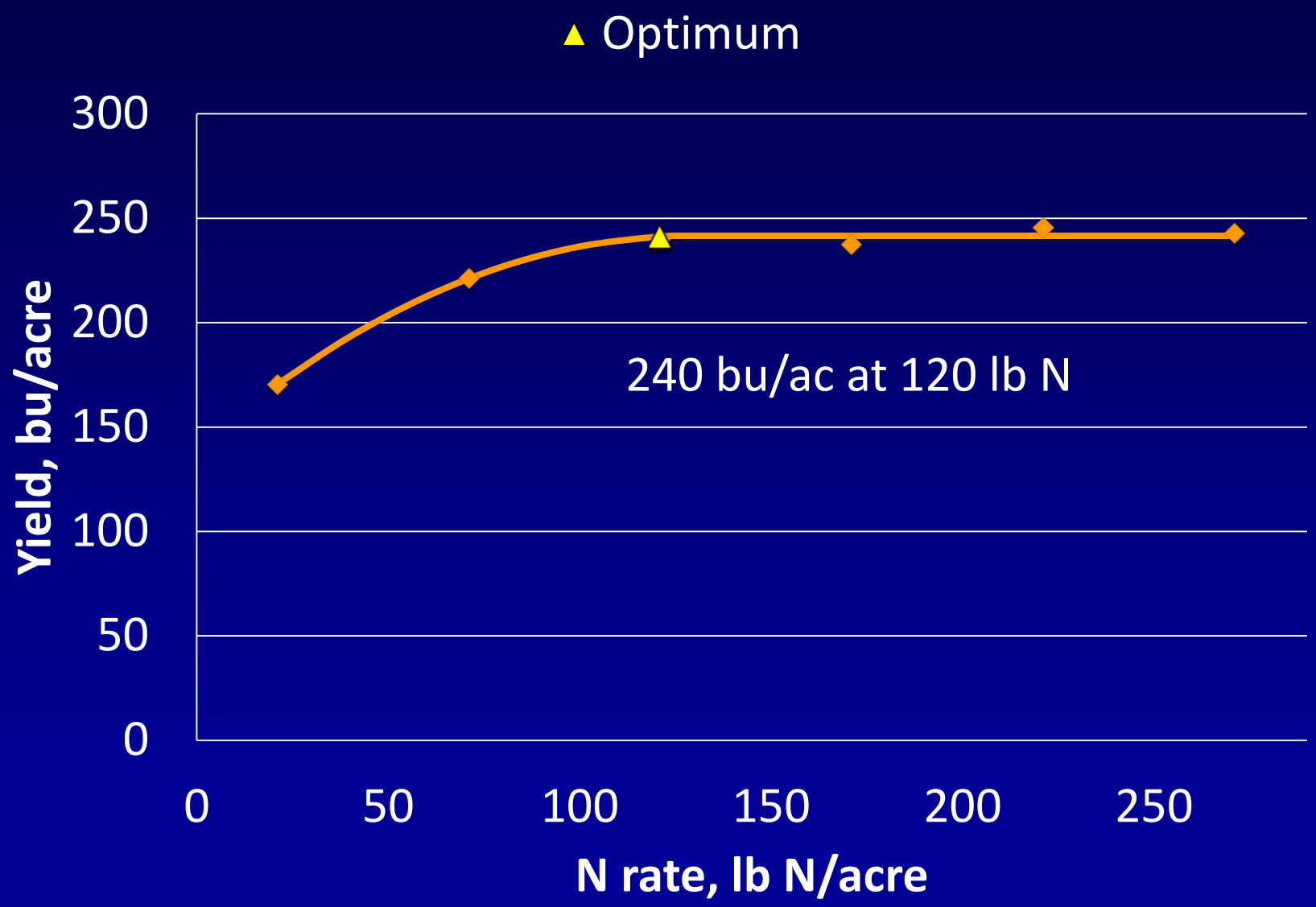
Menard County Soy-Corn 2016



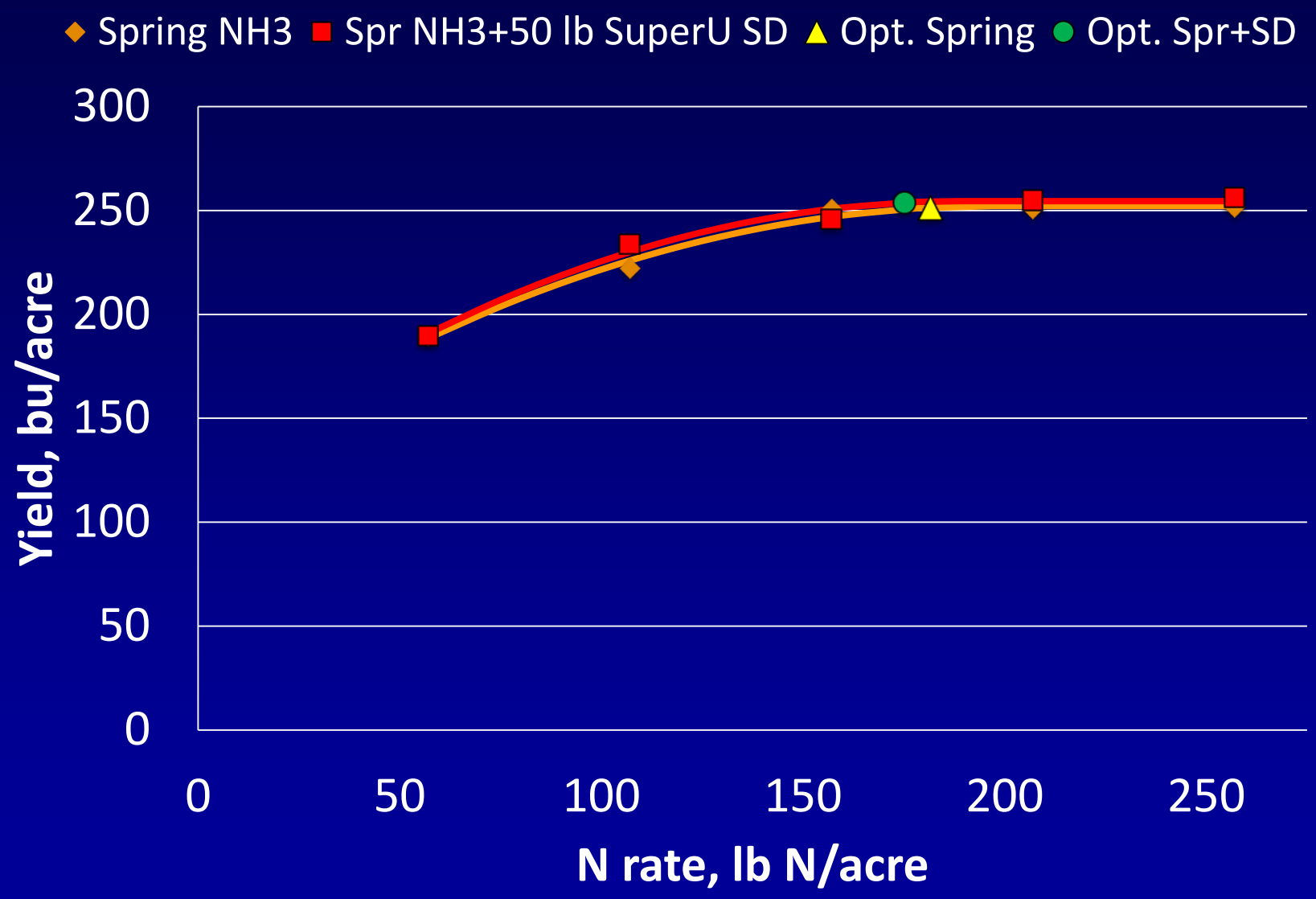
Menard County Soy-Corn 2016



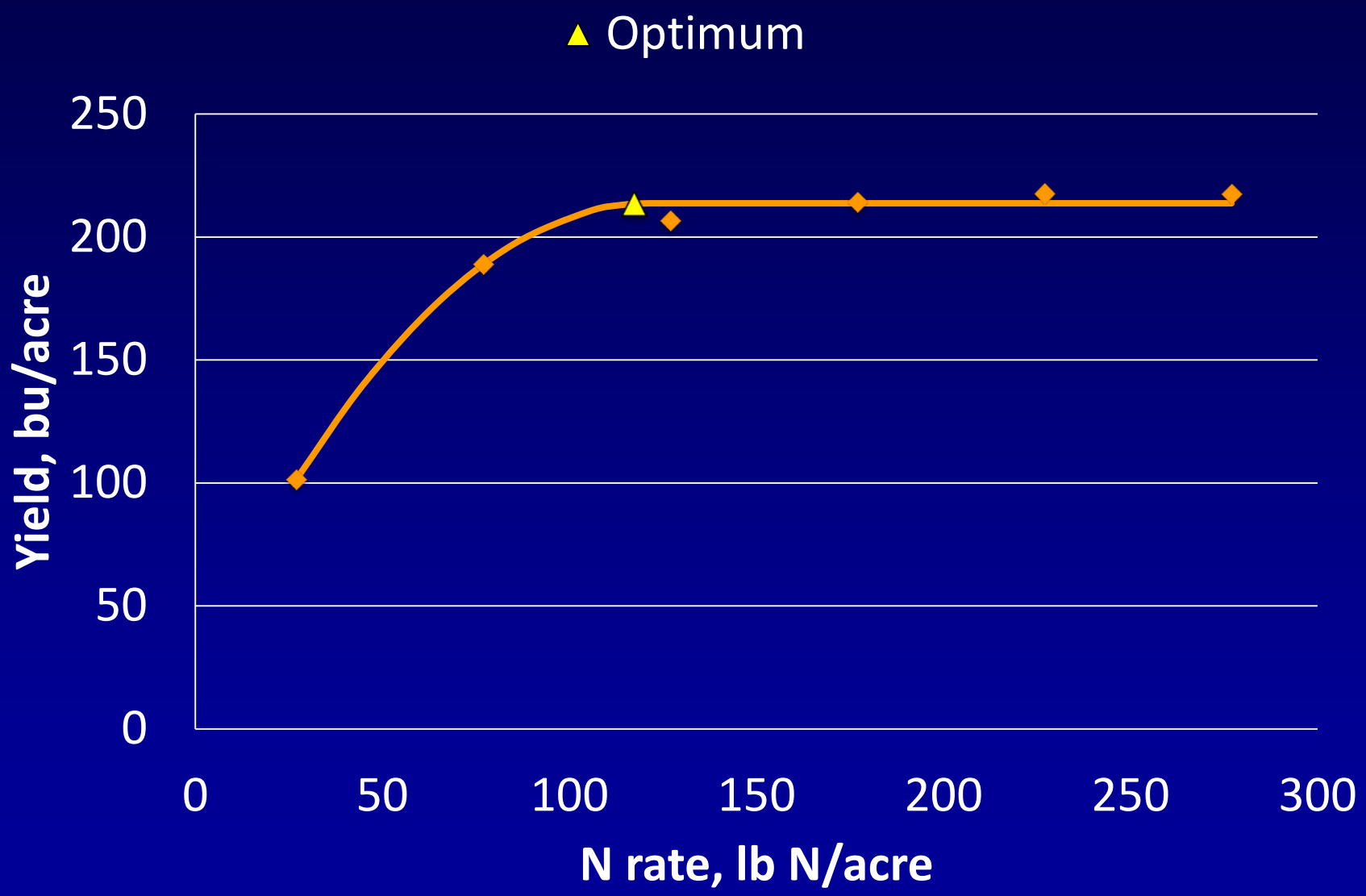
Sangamon County Soy-Corn 2016



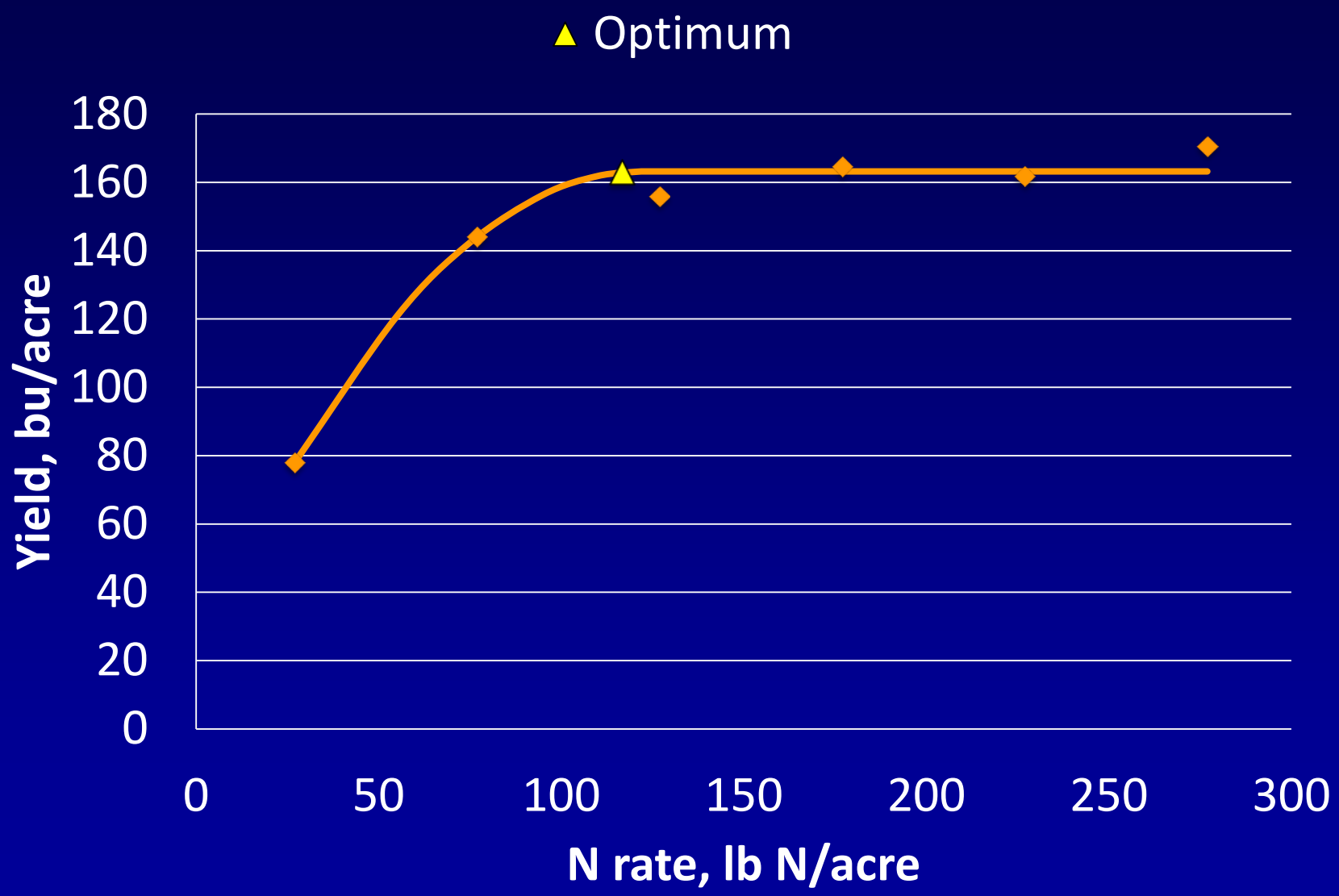
McLean County Soy-Corn 2016



Vermilion County Soy-Corn 2016



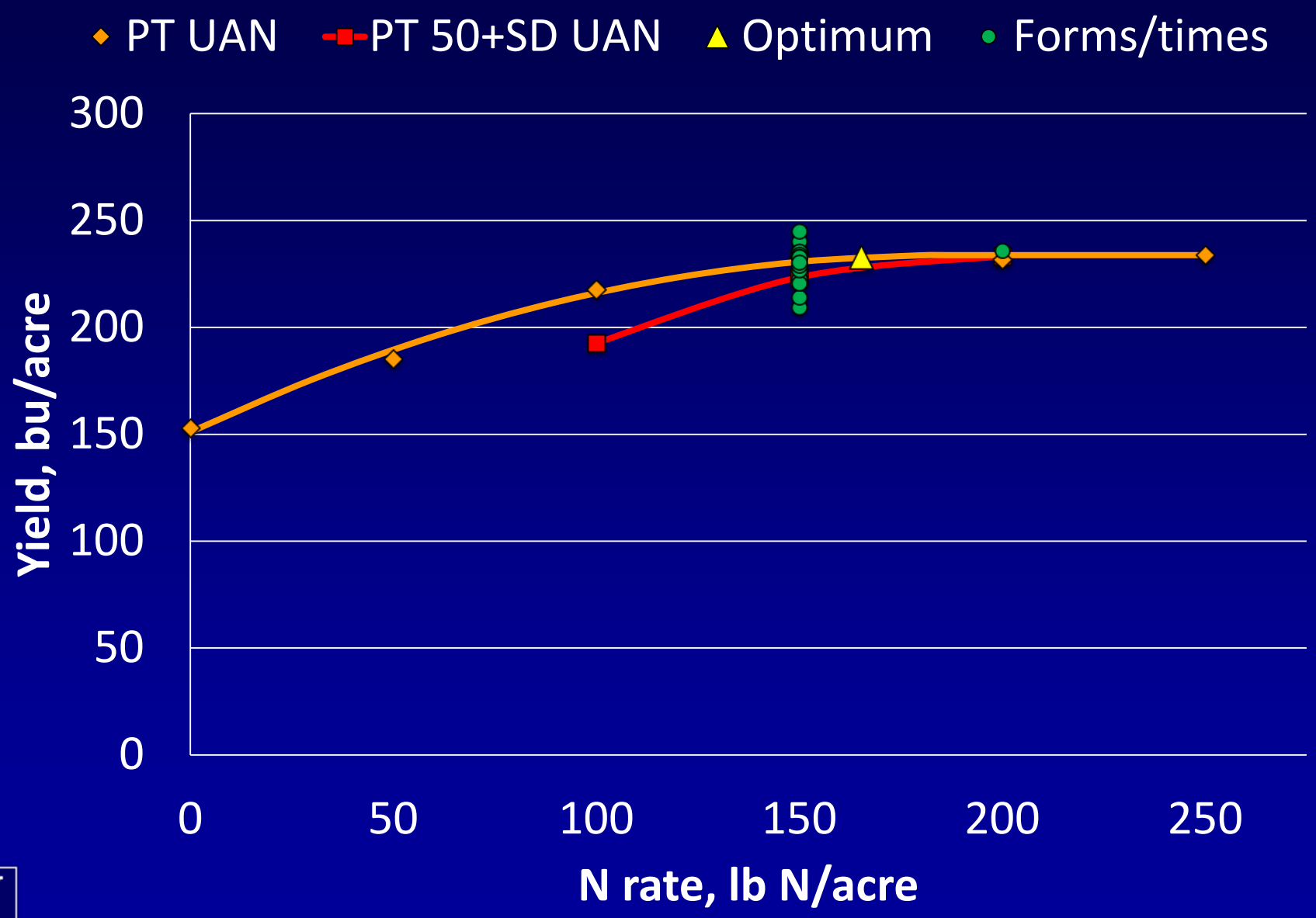
Crawford County Soy-Corn 2016



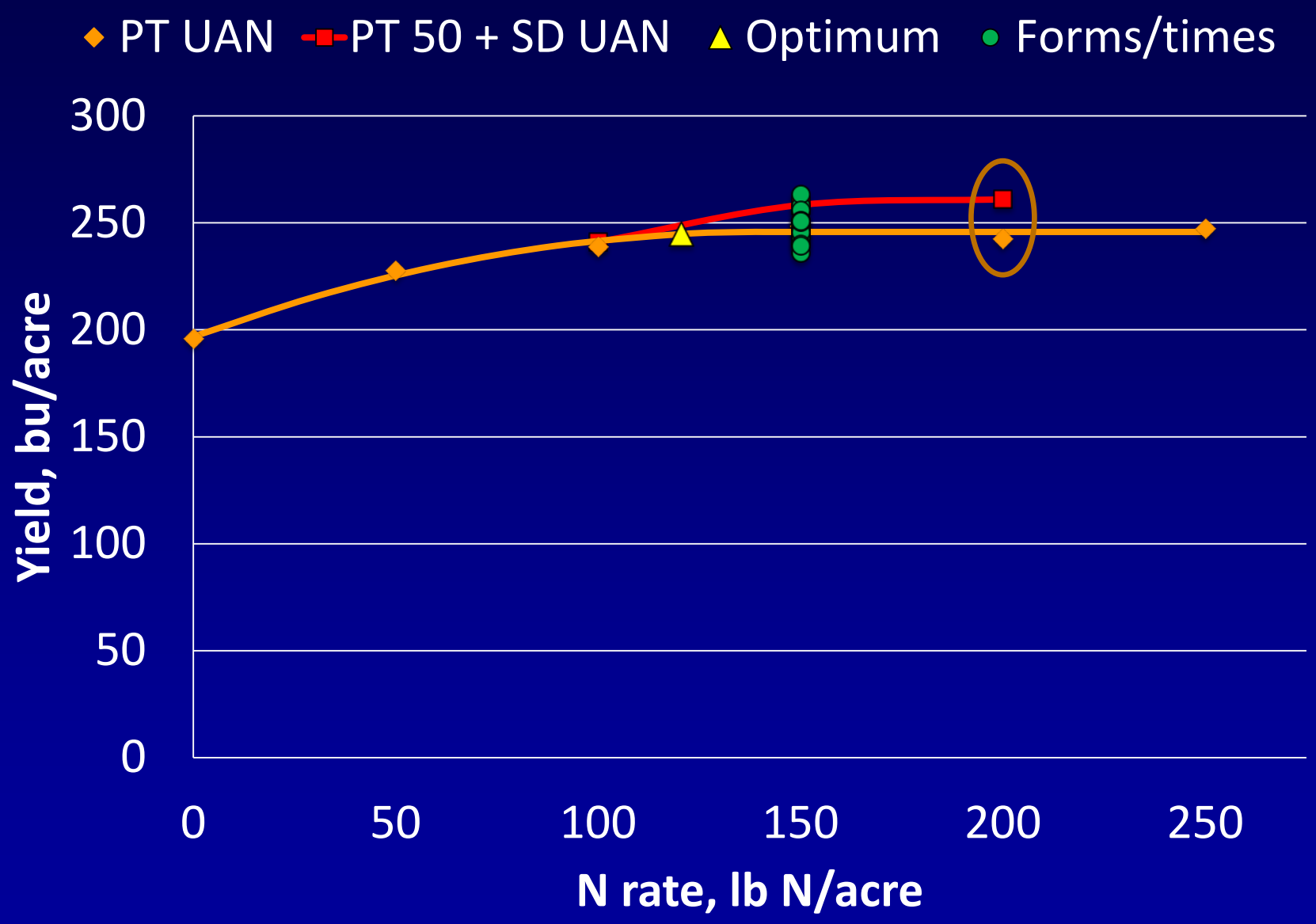
Small-plot trials

- At 5 research sites, corn following soybean
- Base rates of injected UAN: 0, 50, 100, 150, 200, 250
- Set of rates with 50 lb N as broadcast UAN at planting and 50, 100, 150 lb as injected UAN at sidedress
- And 20 different ways to apply 150 lb N

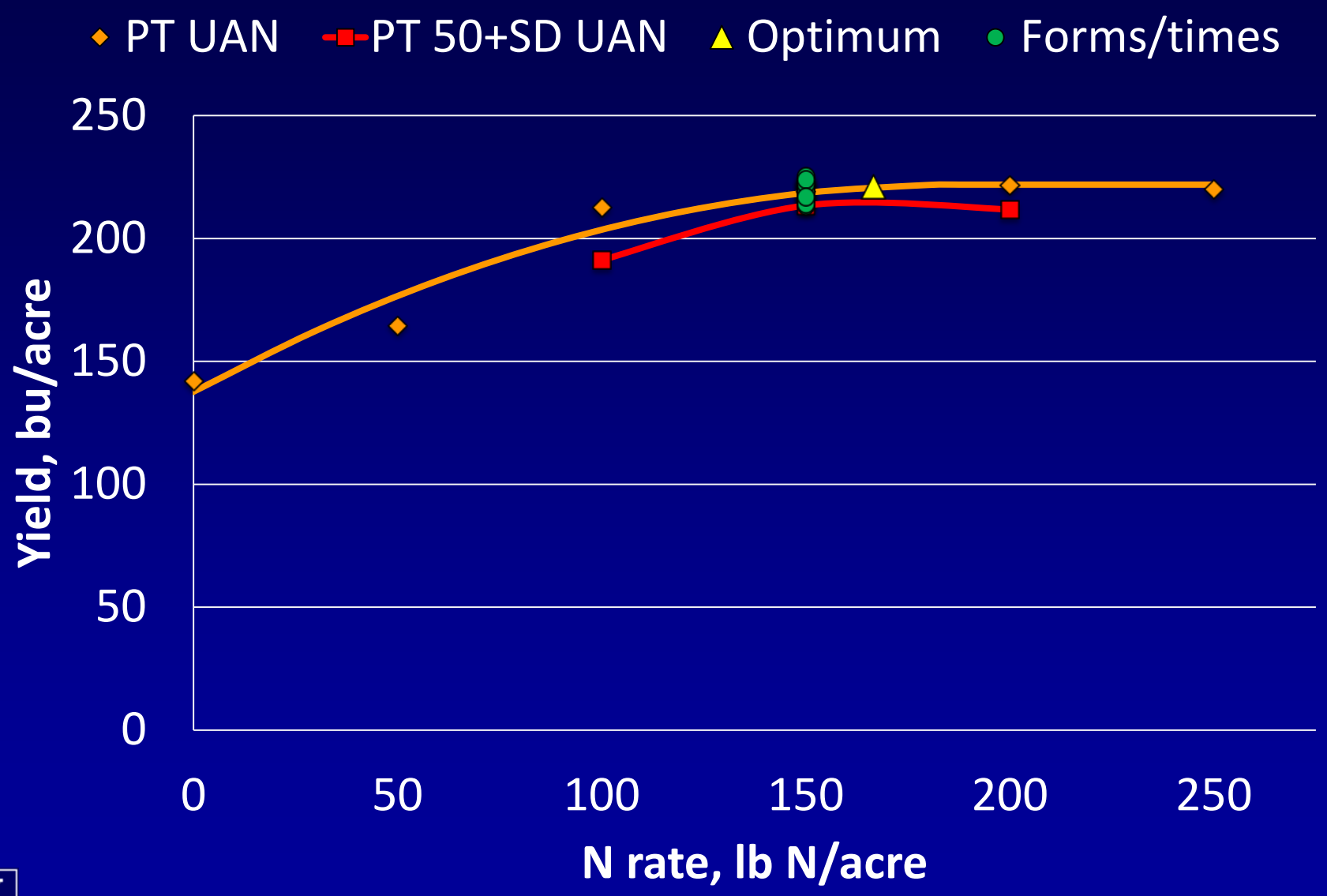
DeKalb 2016


PT UAN
PT 50+SD UAN
Optimum
Forms/times
300
250
200
150
100
50
0
Yield, bu/acre
0
50
100
150
200
250
N rate, lb N/acre

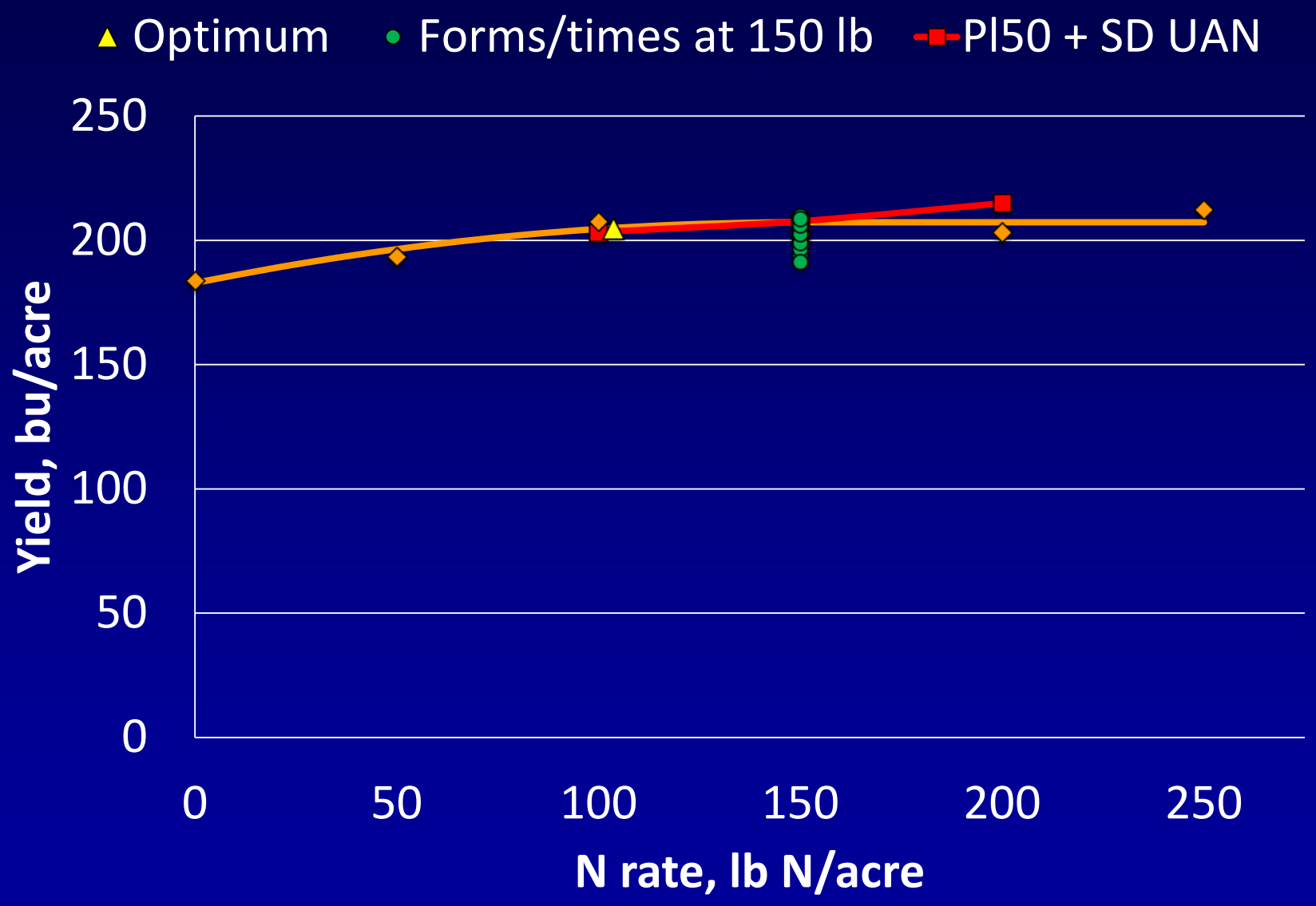
Monmouth Soy-Corn 2016



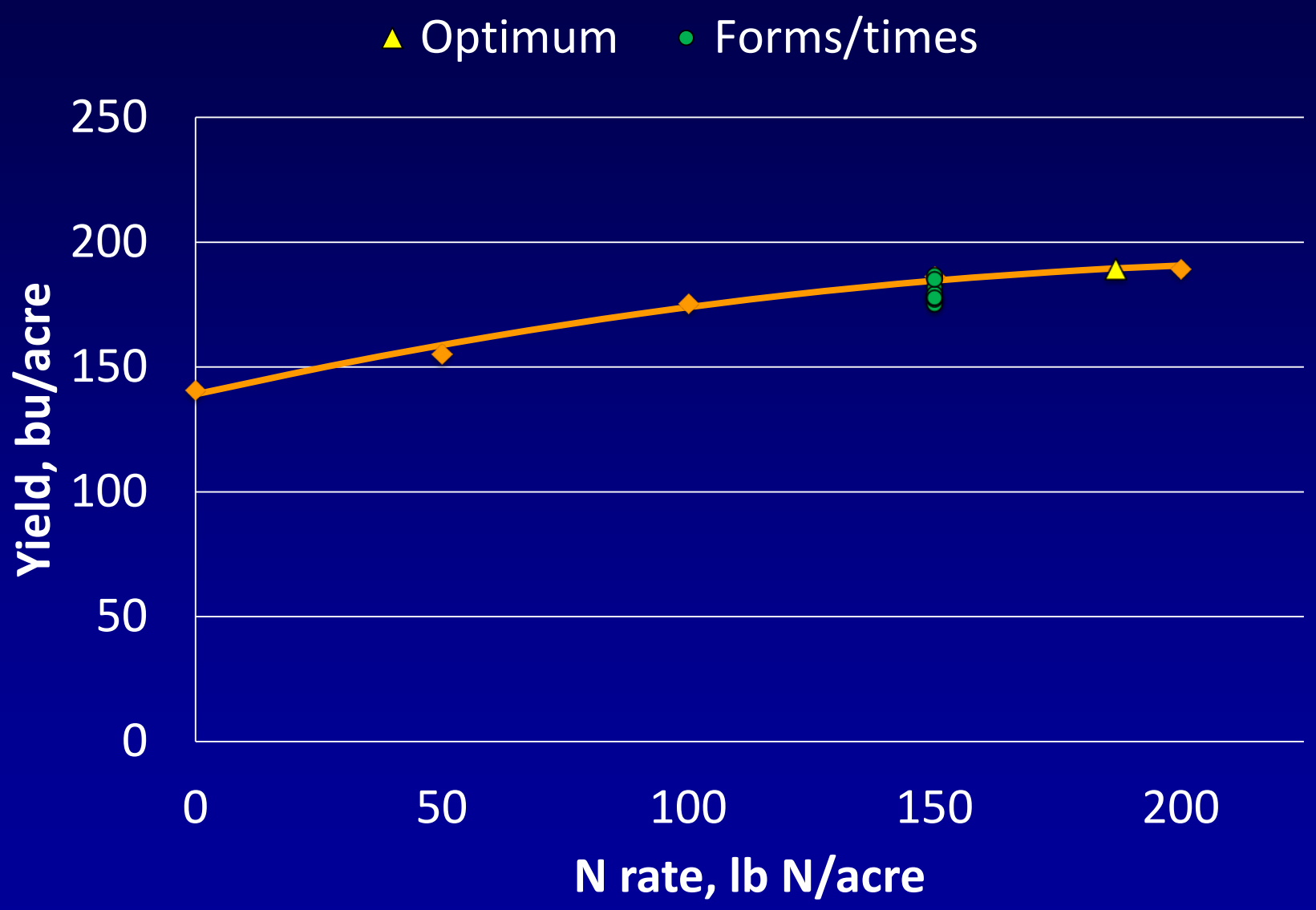
Urbana Soy-Corn 2016



Perry Soy-Corn 2016



Neoga Soy-Corn 2016



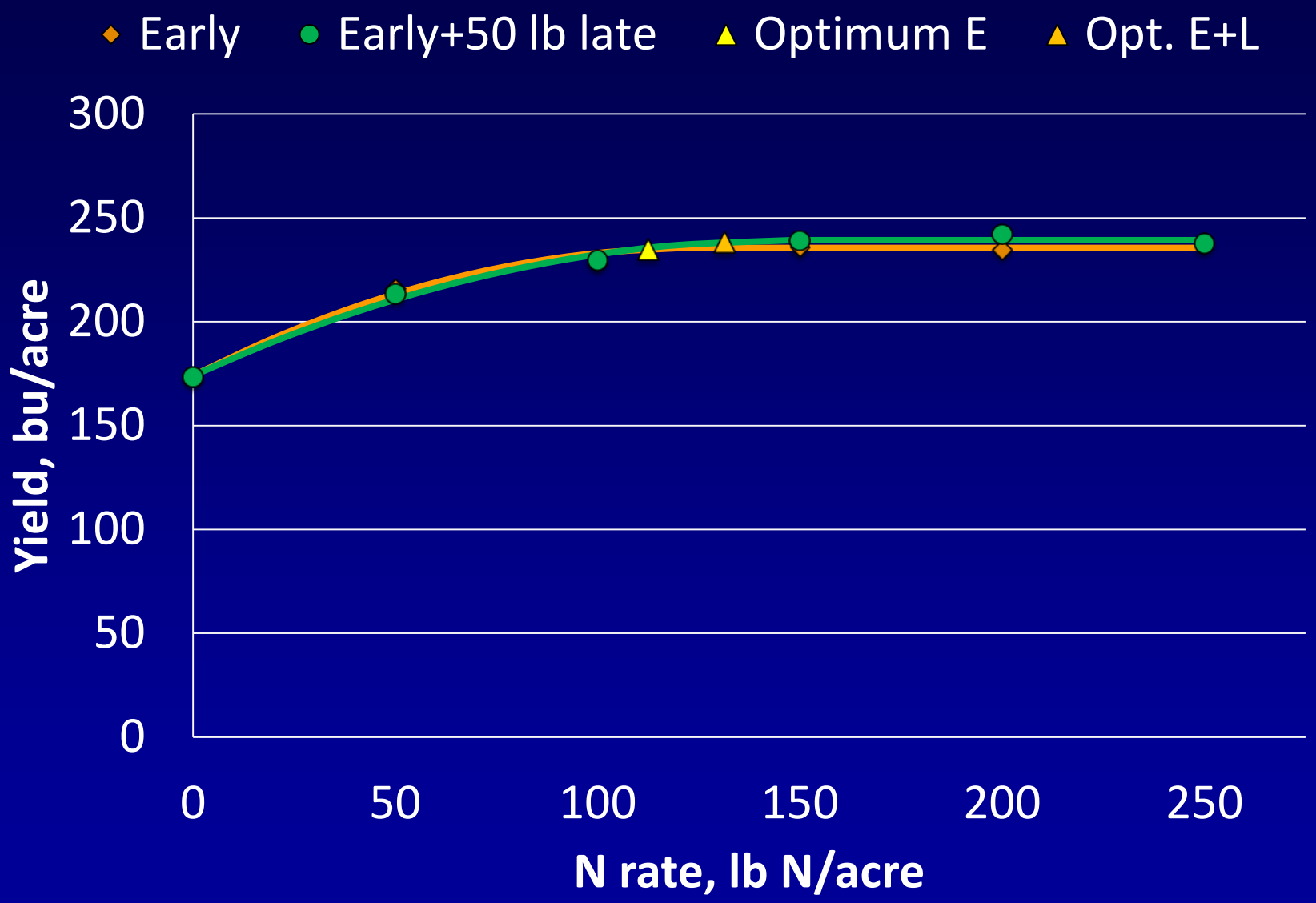
2016, 150-lb rate	DeKalb	Monmouth	Urbana	Perry	Avg
PT UAN injected (check)	234	248	219	205	226
PT UAN 50 bdcst + V5 UAN 100 inj	223	258	213	208	226
PT 0 + V5 UAN 150 inj row mid	223	245	218	202	222
PT 0 + V9 UAN 150 drbl row mid	209	236	216	194	214
PT UAN 100 inj + V5 UAN 50 inj	233	240	220	201	223
PT UAN 100 inj + V5 U/AT 50 bdcst	236	244	223	201	226
PT UAN 100 inj + V9 UAN 50 drbl row	240	247	222	202	228
PT UAN 100 inj + V9 U/AT 50 bdcst	235	243	223	205	226
PT UAN 150 drbl	235	248	216	197	224
PT Urea/Agrotain 150 bdcst	235	263	221	201	230
PT SuperU 150 bdcst	234	256	223	206	230
PT ESN 150 bdcst	245	250	214	210	230
PT UAN/AT 150 bdcst	214	251	219	191	219
PT NH_3 150 inj	221	251	222	210	225
PT NH_3/N-Serve 150 inj	---	247	219	199	223
PT UAN/Instinct 150 bdcst	227	246	214	203	222
PT UAN 100 inj + V9 UAN 50 drbl row	233	250	222	203	227
PT UAN 100 inj + VT UAN 50 row mid	233	251	225	206	229
PT UAN 100 inj + VT UAN 50 drbl row	229	240	224	209	225
PT UAN 150 inj + Nutrisphere	231	239	217	205	223

Strip trials with late N

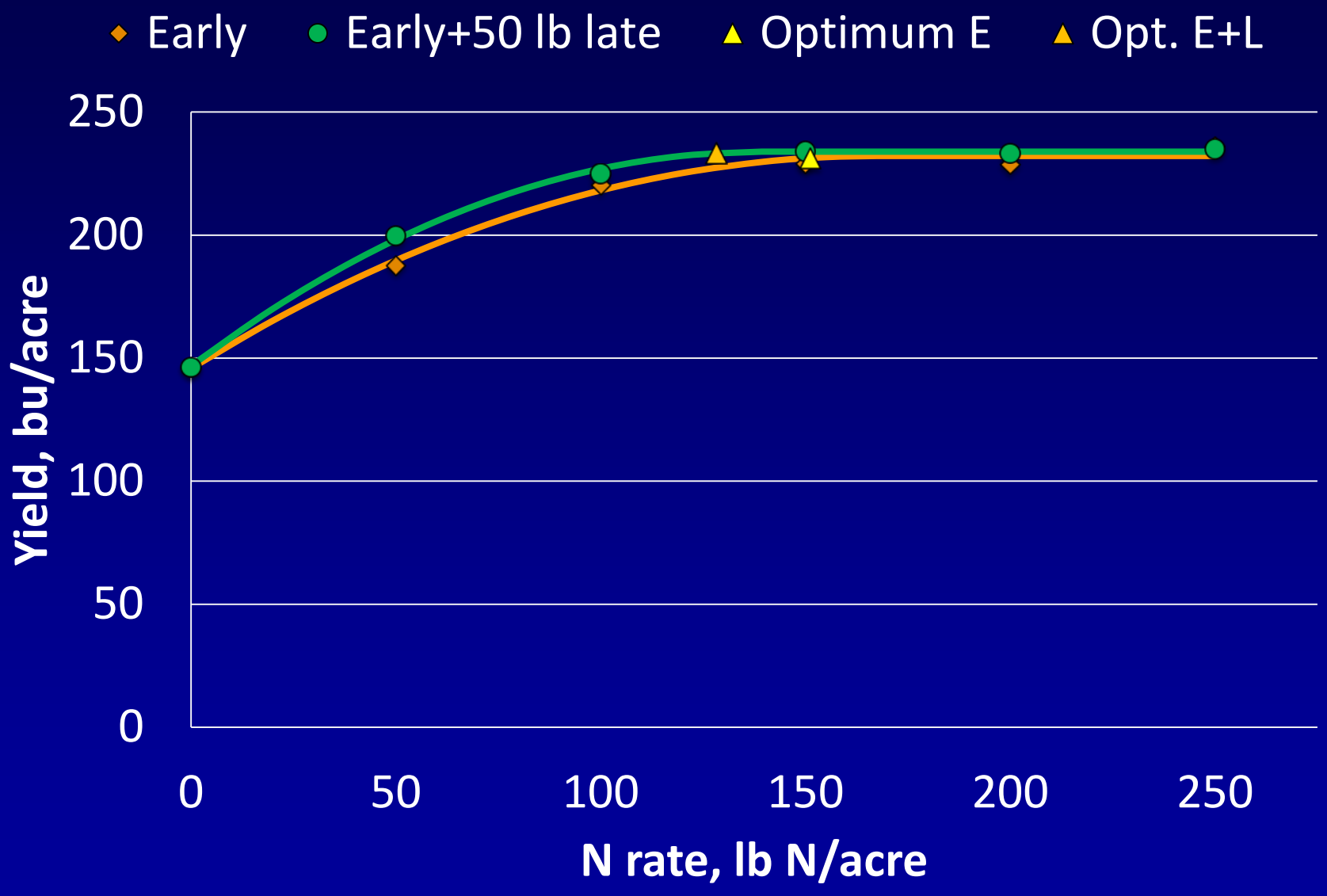
- 4 corn following soybean and 3 corn following corn trials on research centers
- Base rates of injected UAN: 0, 50, 100, 150, 200, 250
- Late N treatment split within rate, with rate - 50 lb applied at planting and 50 lb applied at VT (tassel) using a hand-boom to stream UAN near the base of the plants

DeKalb Soy-Corn 2016

Monmouth Soy-Corn 2016

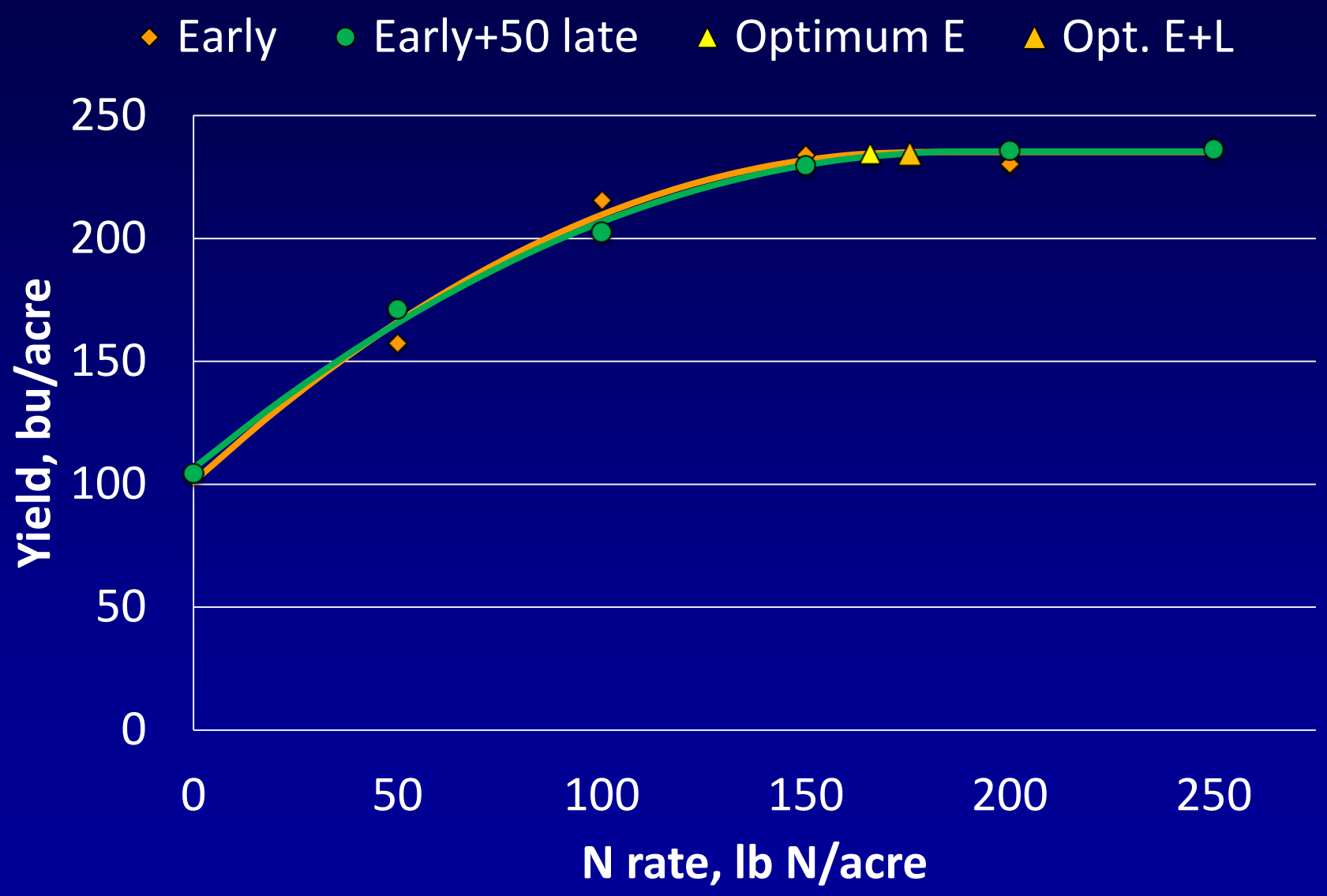


Monmouth Corn-Corn 2016

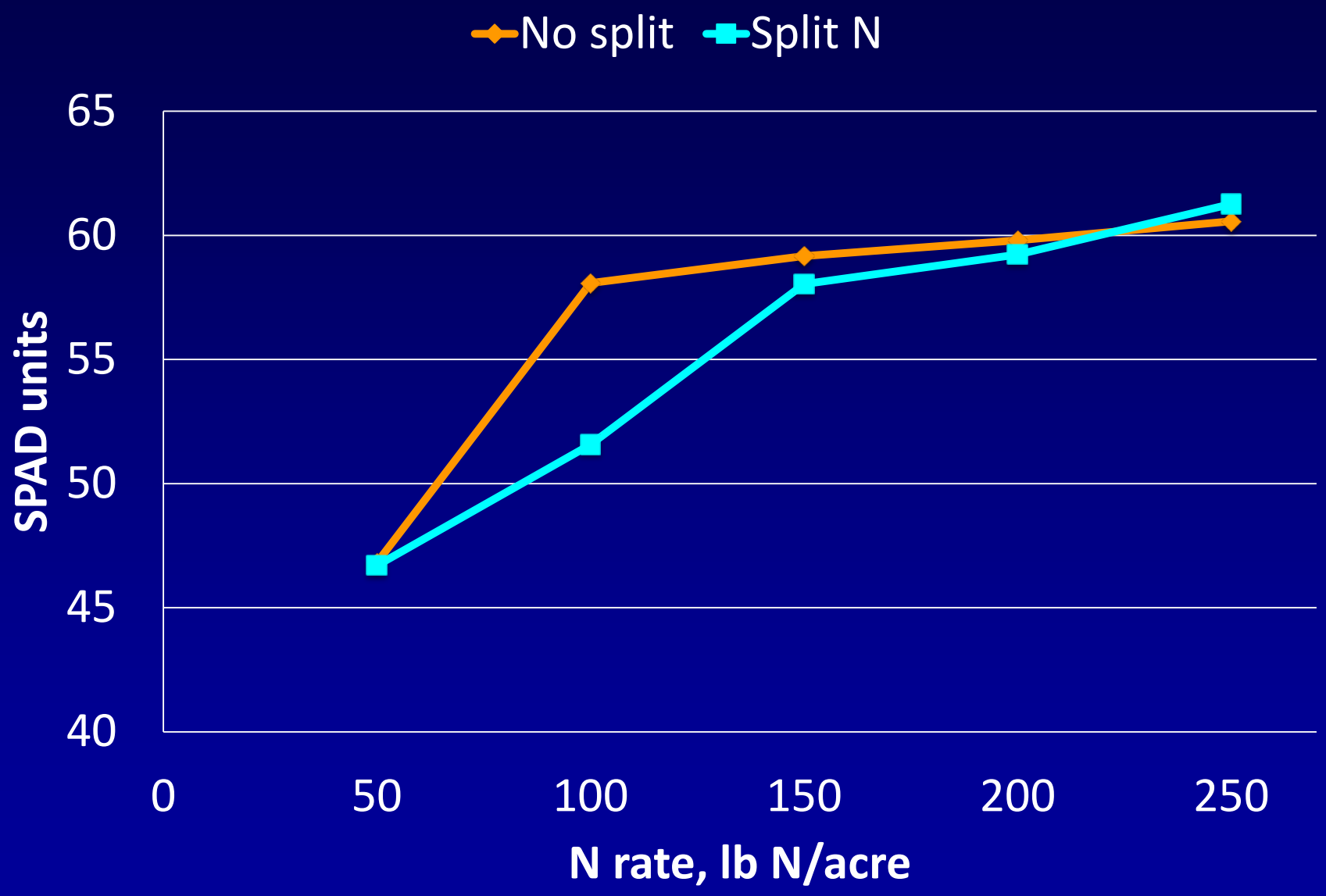


Urbana Soy-Corn 2016

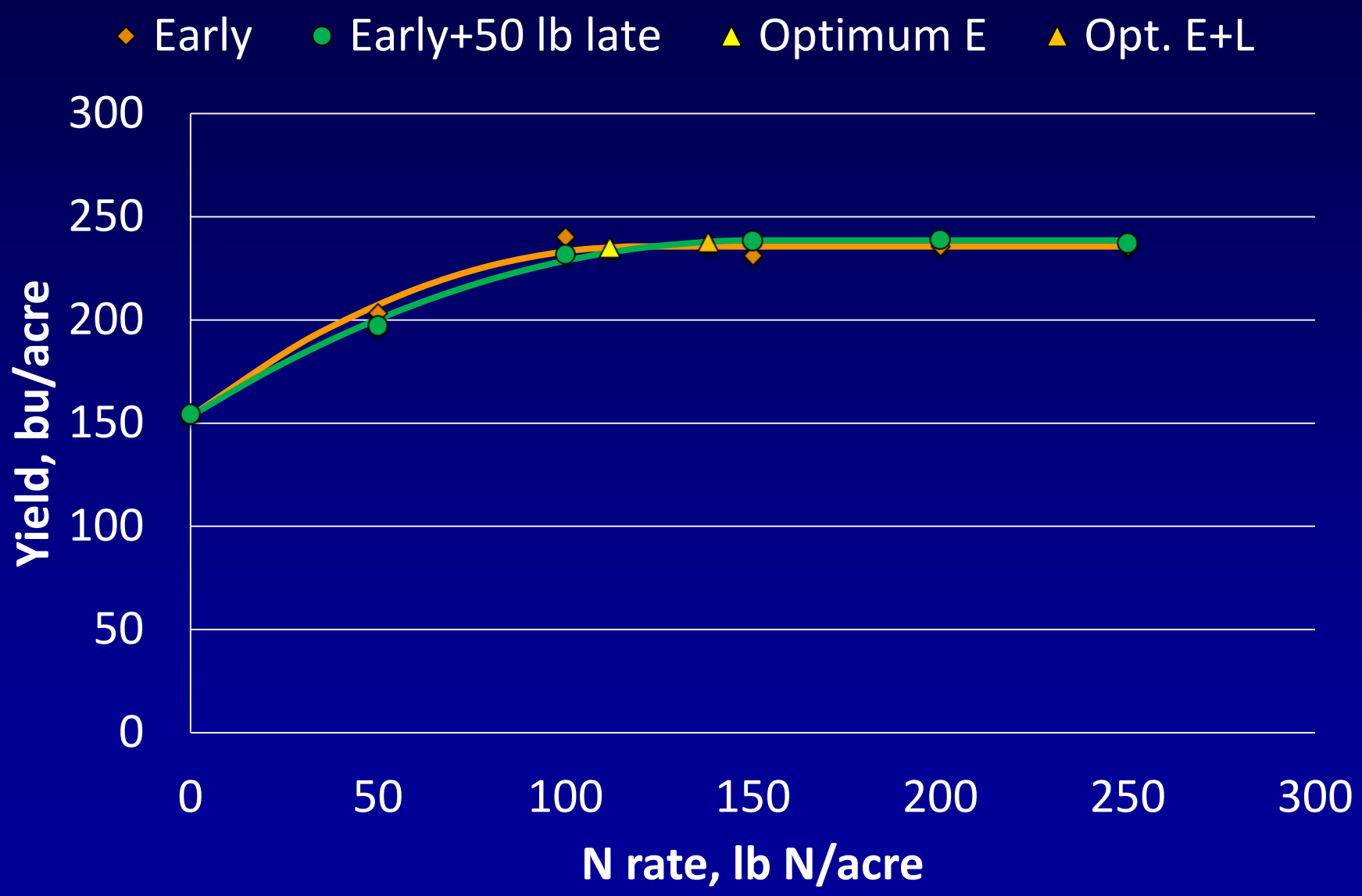
Urbana Corn-Corn 2016



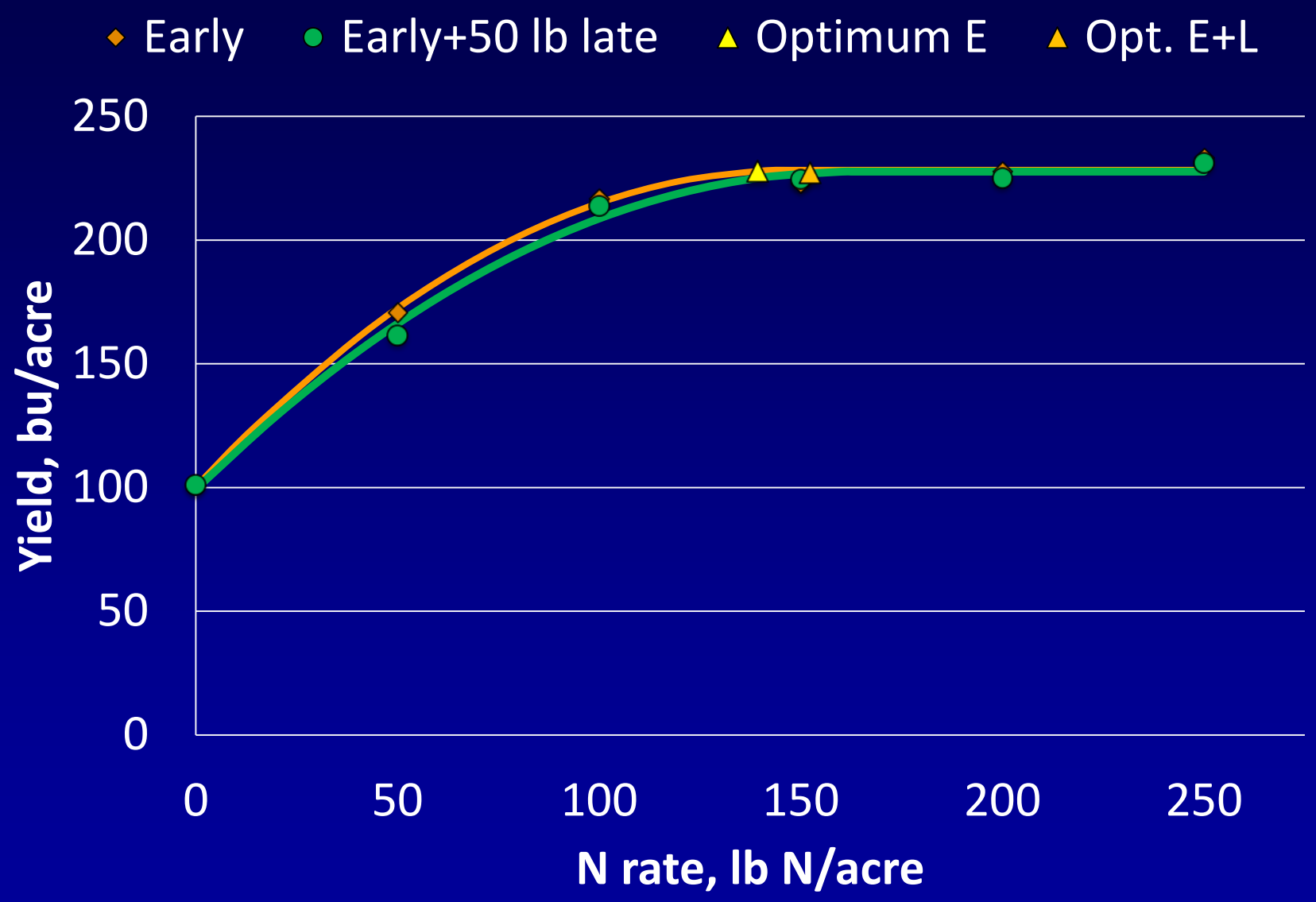
Urbana SPAD July 26 Corn-Corn



Perry Soy-Corn 2016



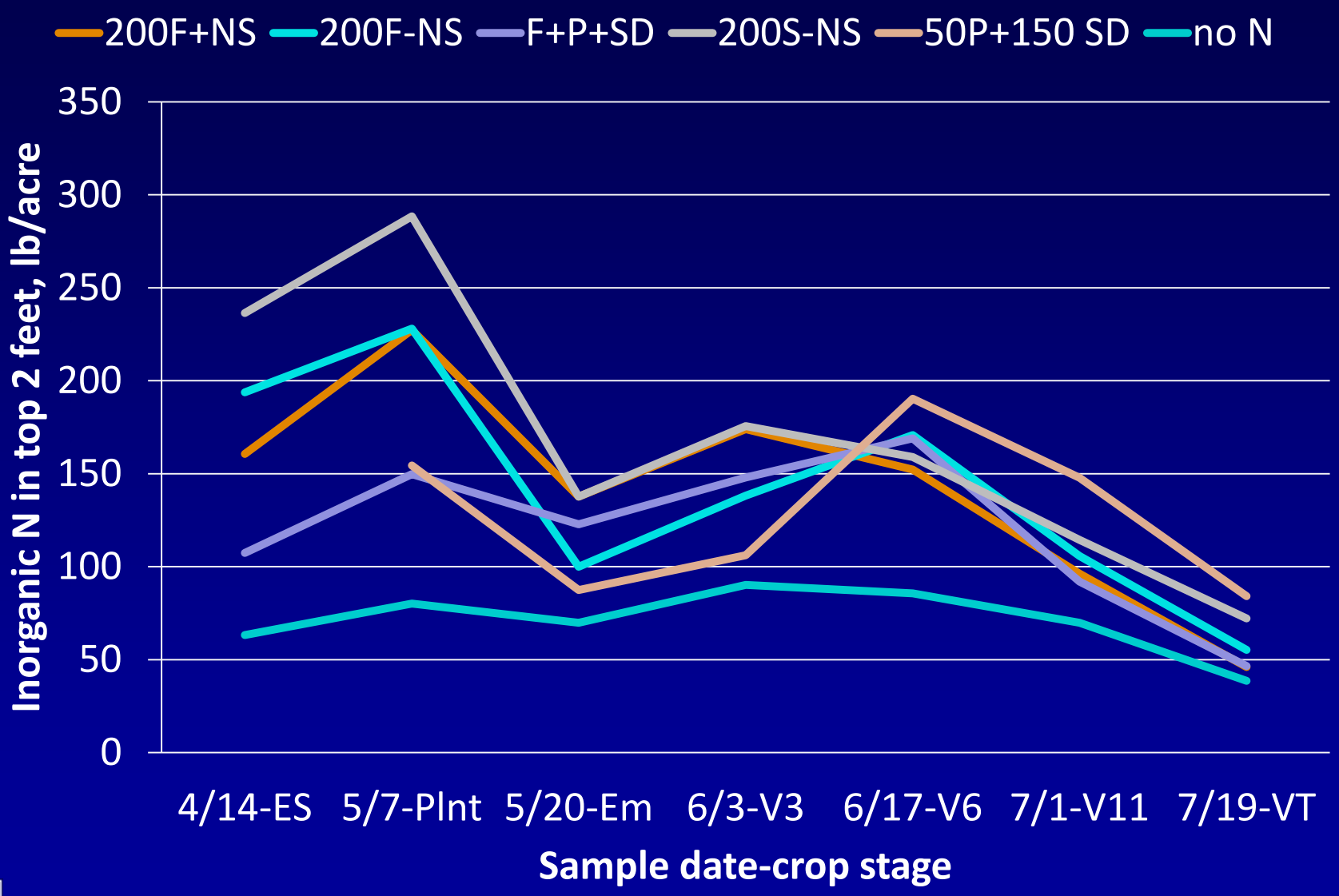
Perry Corn-Corn 2016

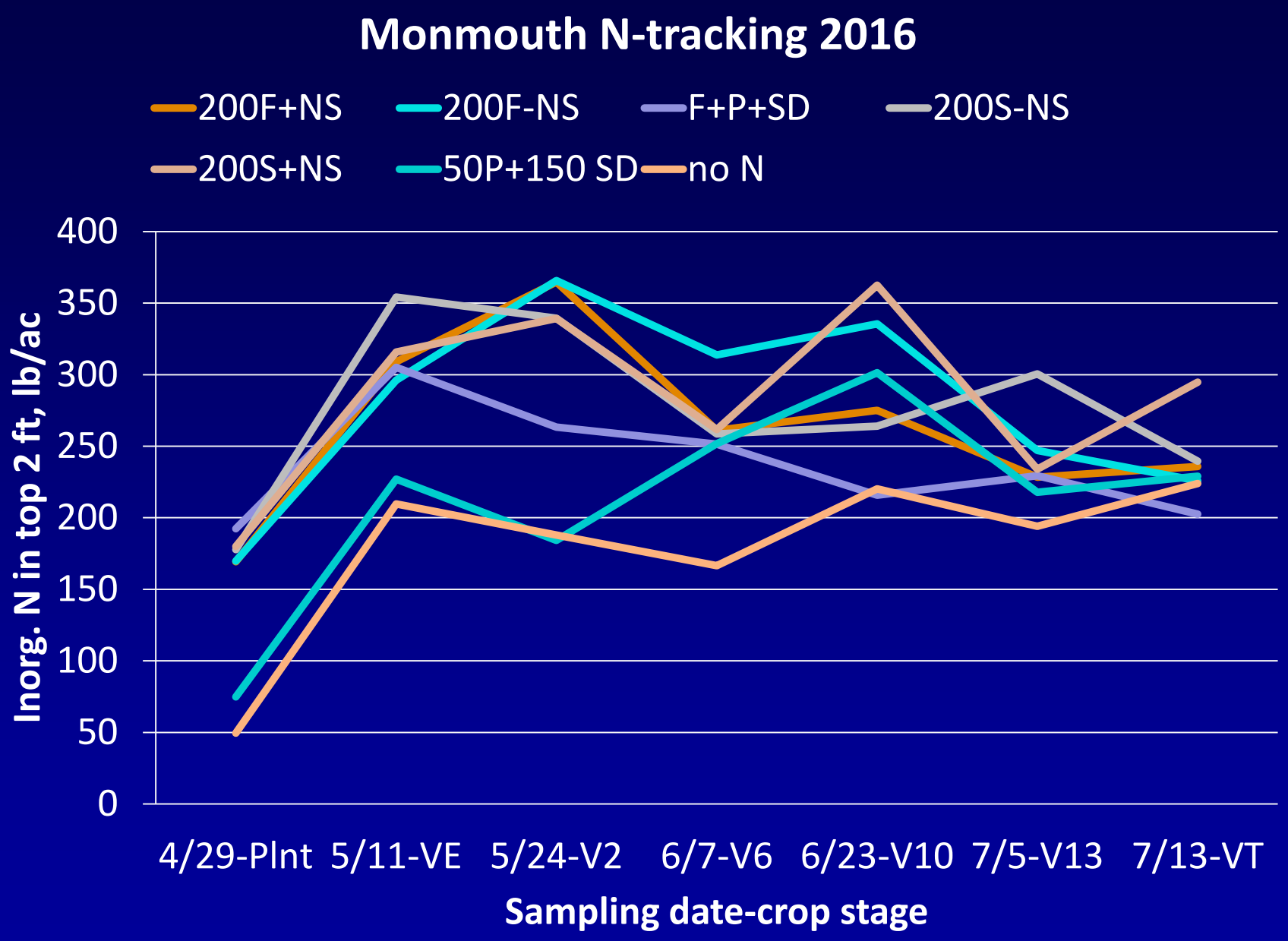


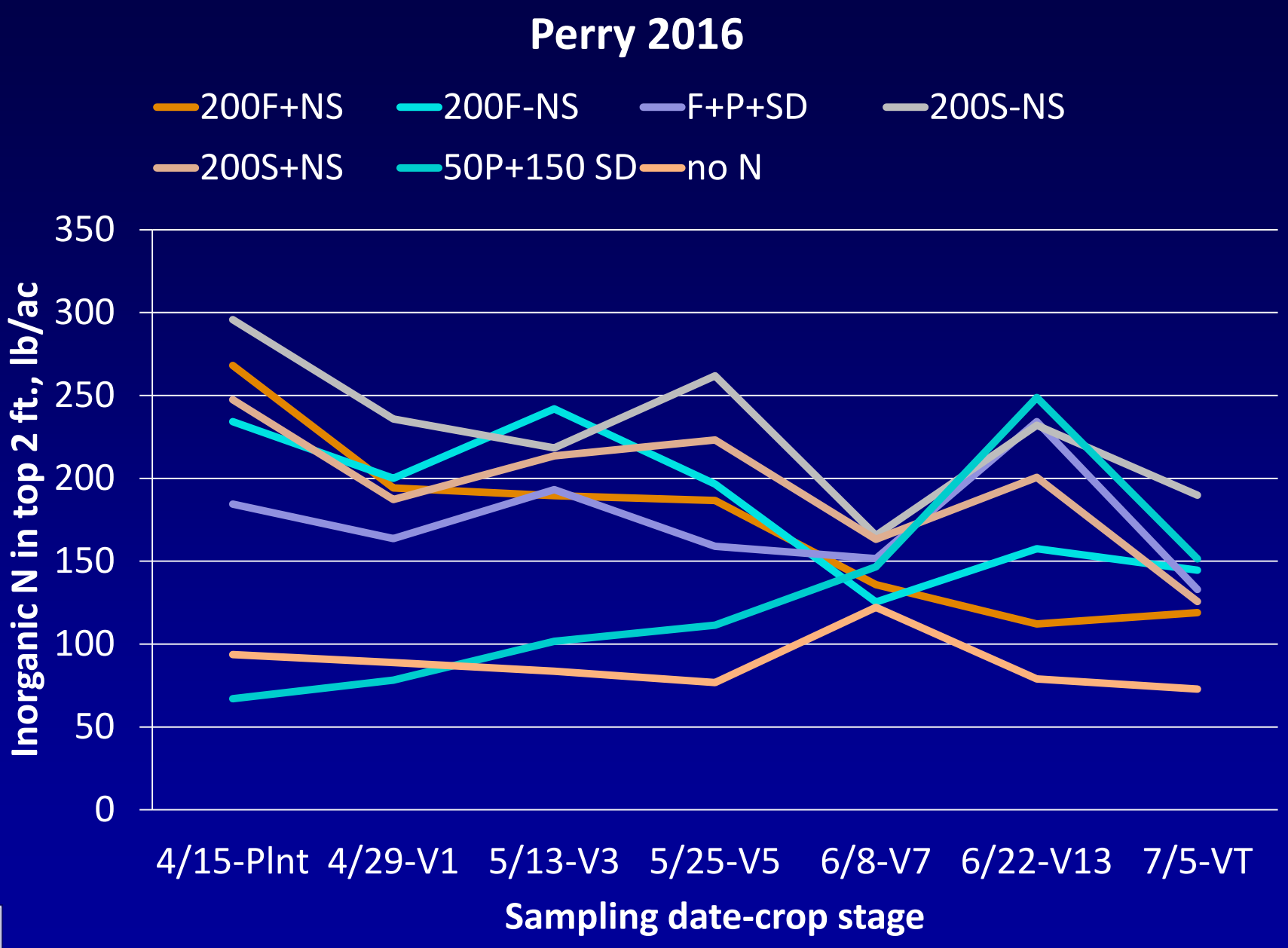
Delayed/late N?

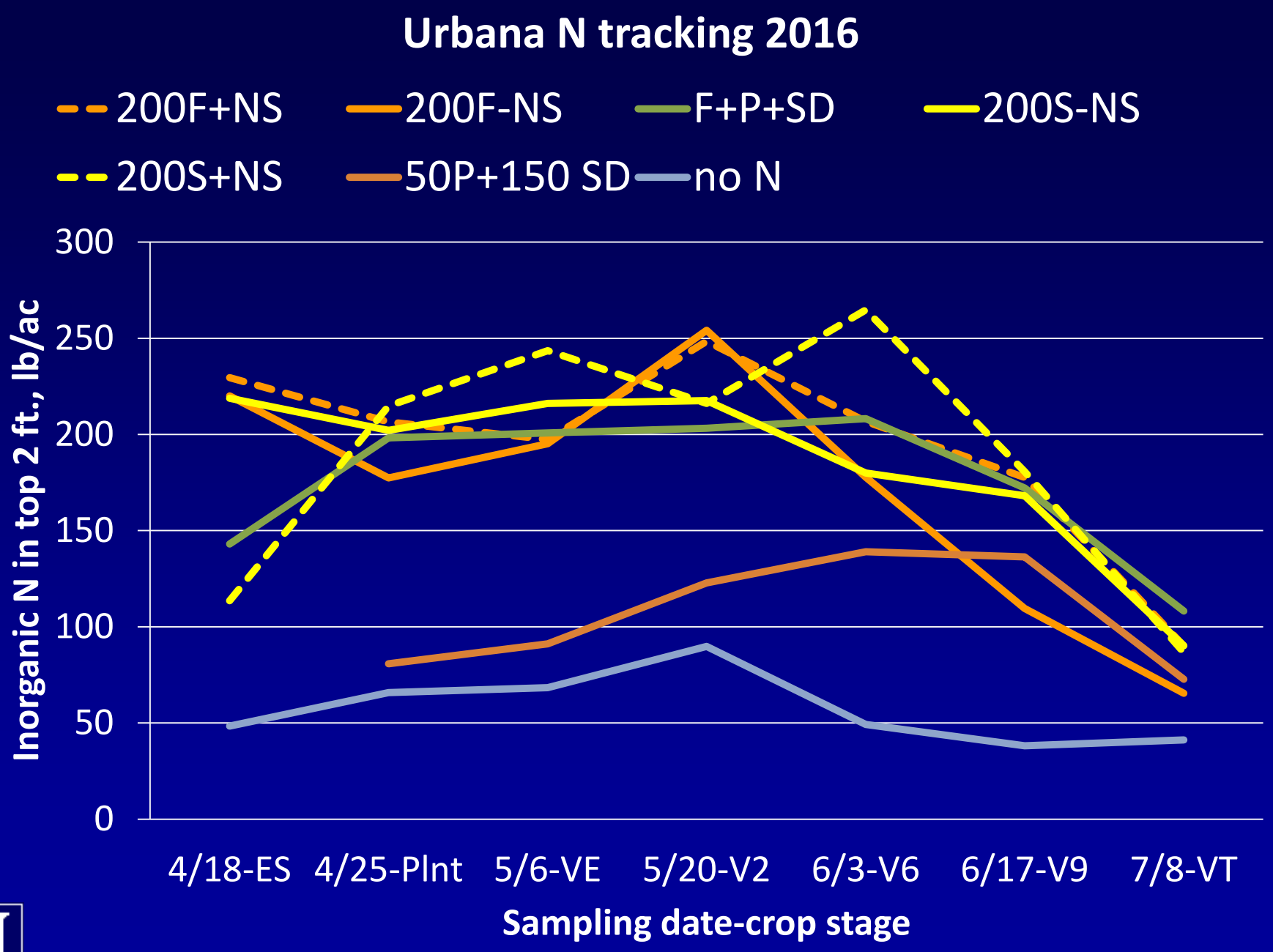
- With low-N-loss conditions, we found hardly any yield benefit to keeping back 50 lb of N to apply late – and so no way to pay the cost of doing this
- Without the ability to predict weather conditions, does it make more sense to consider late application for “rescue” rather than as a planned application?

DeKalb N-tracking 2016

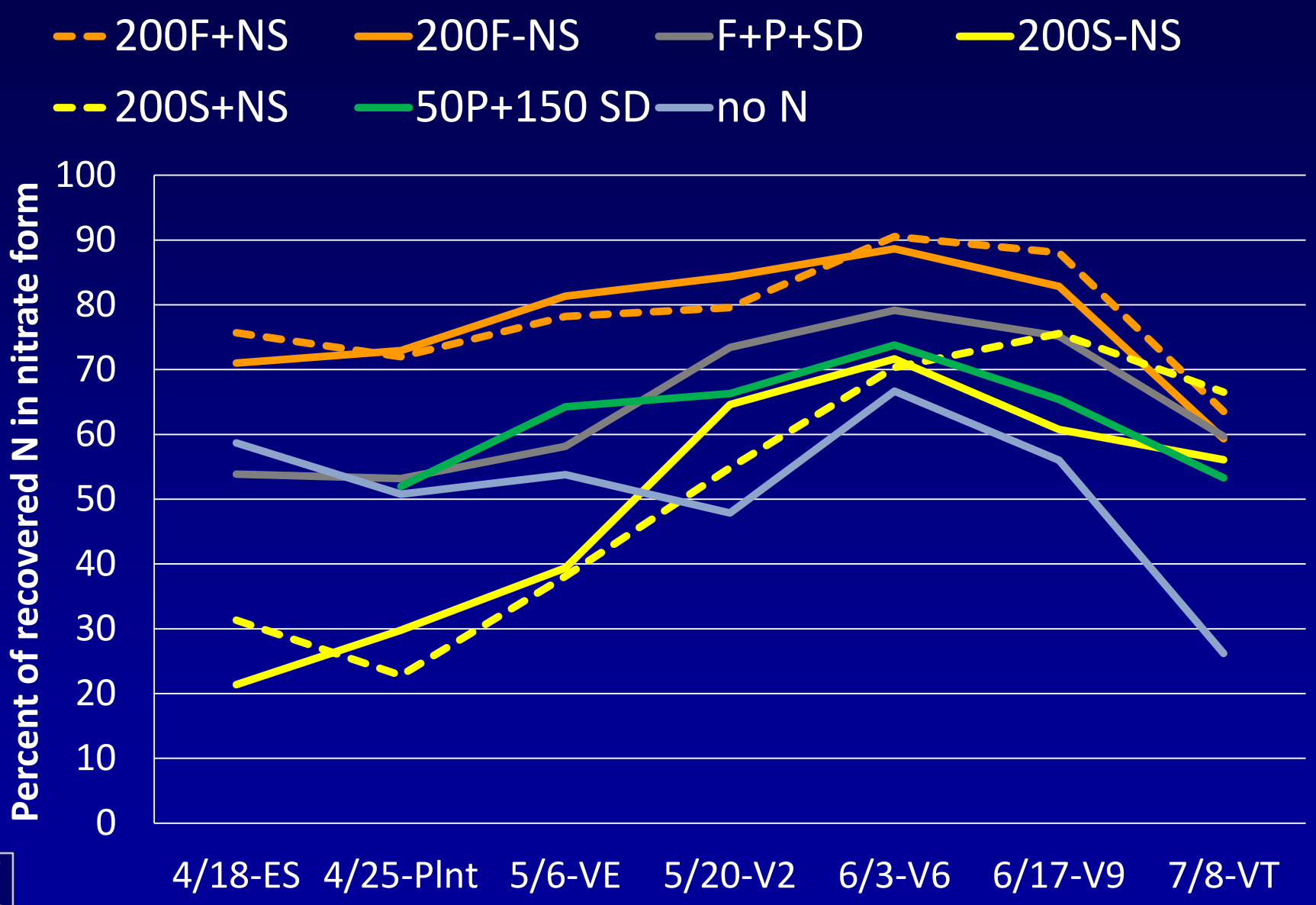


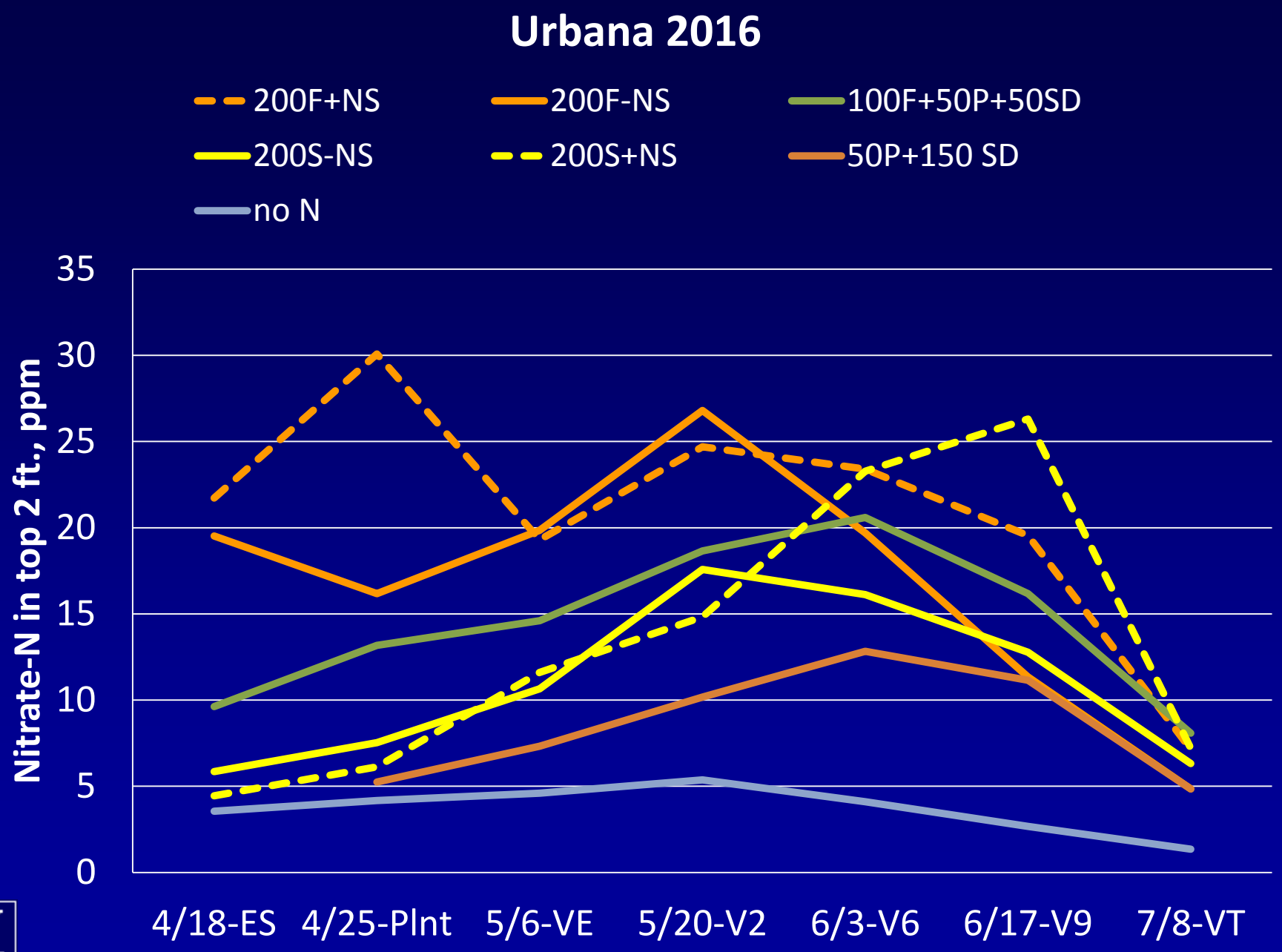

Monmouth N-tracking 2016
200F+NS
200F-NS
F+P+SD
200S-NS
200S+NS
50P+150 SD
no N
400
350
300
250
200
150
100
50
0
Inorg. N in top 2 ft, lb/ac
4/29-Plnt
5/11-VE
5/24-V2
6/7-V6
6/23-V10
7/5-V13
7/13-VT
Sampling date-crop stage


Perry 2016
200F+NS
200F-NS
F+P+SD
200S-NS
200S+NS
50P+150 SD
no N
350
300
250
200
150
100
50
0
Inorganic N in top 2 ft., lb/ac
4/15-Plnt
4/29-V1
5/13-V3
5/25-V5
6/8-V7
6/22-V13
7/5-VT
Sampling date-crop stage

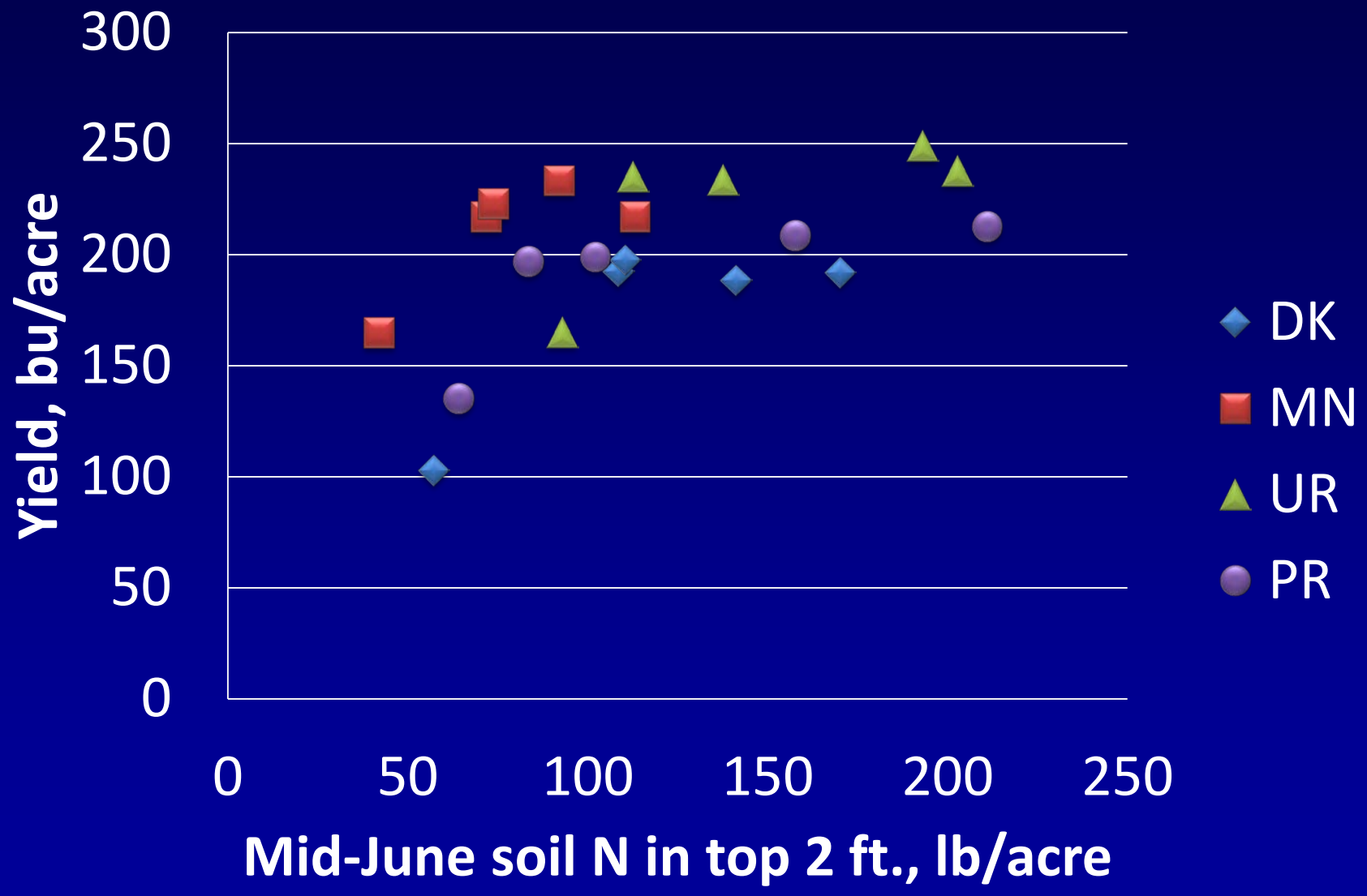

Urbana N tracking 2016
200F+NS
200F-NS
F+P+SD
200S-NS
200S+NS
50P+150 SD
no N
300
250
200
150
100
50
0
Inorganic N in top 2 ft., lb/ac
4/18-ES
4/25-Plnt
5/6-VE
5/20-V2
6/3-V6
6/17-V9
7/8-VT
Sampling date-crop stage

Urbana soil N tracking 2016

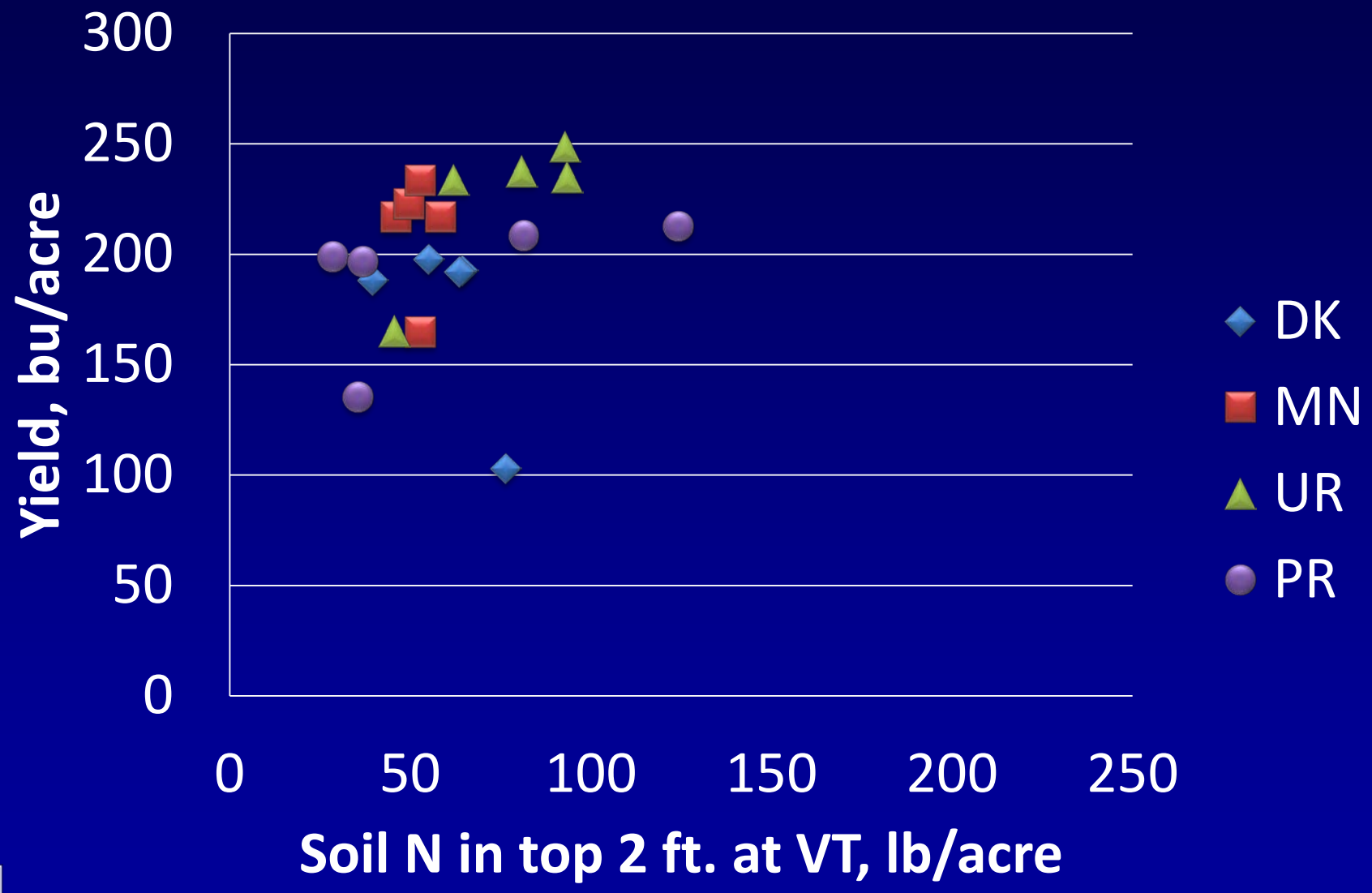



Urbana 2016
200F+NS
200F-NS
100F+50P+50SD
200S-NS
200S+NS
50P+150 SD
no N
Nitrate-N in top 2 ft., ppm
35
30
25
20
15
10
5
0
4/18-ES
4/25-Plnt
5/6-VE
5/20-V2
6/3-V6
6/17-V9
7/8-VT

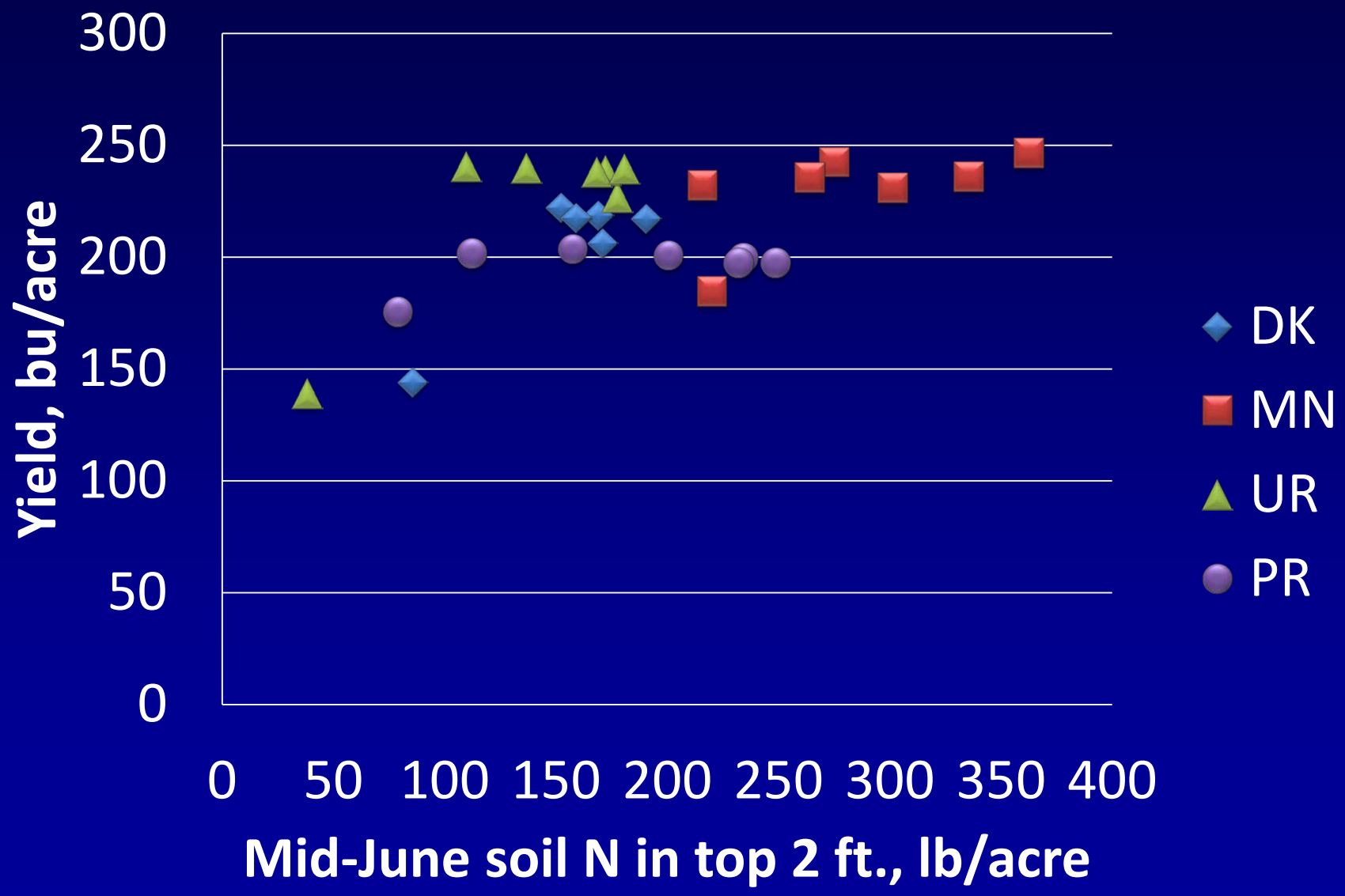
Mid-June soil N and yield, 2015 (wet)



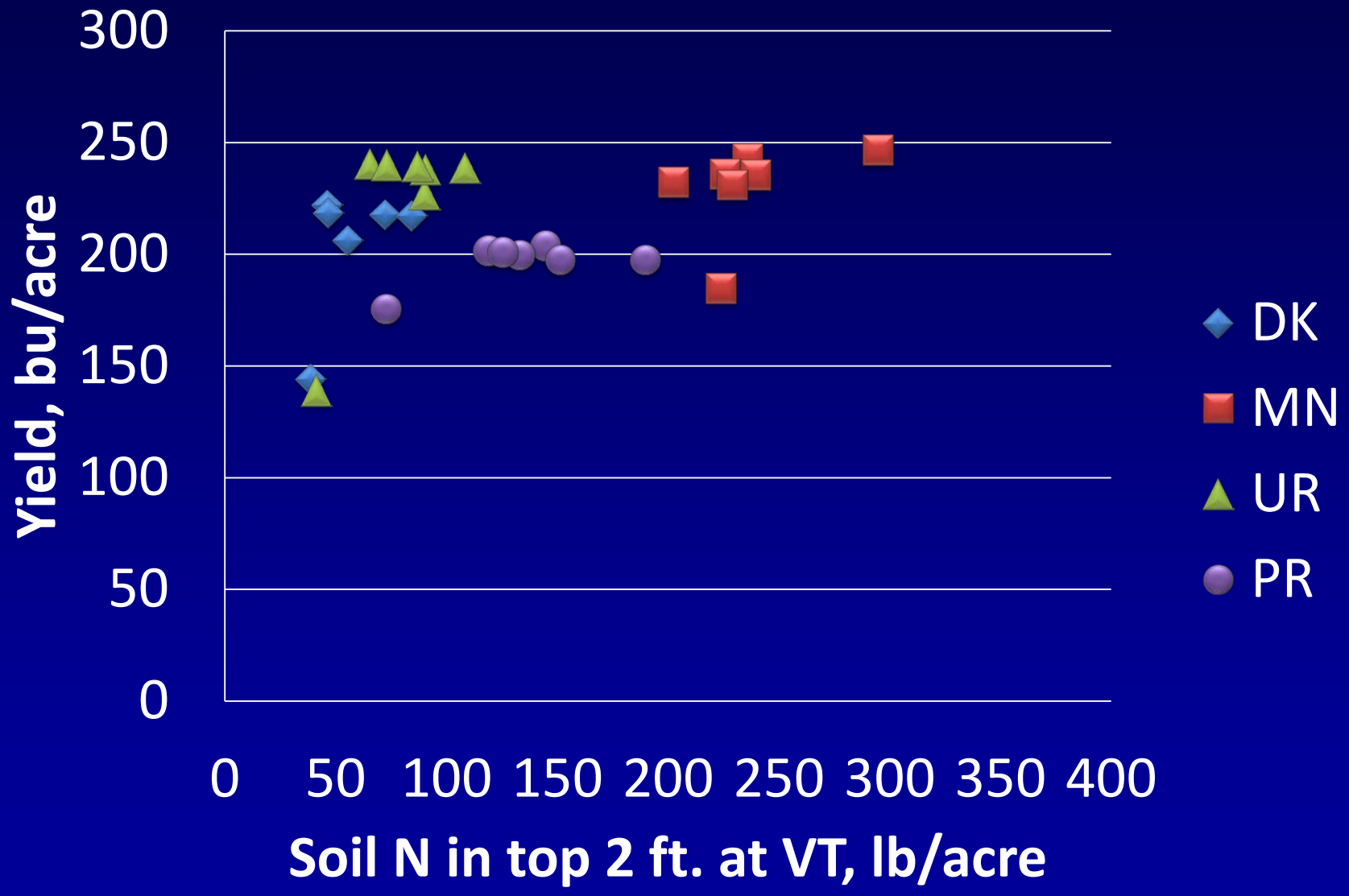
Soil N at VT and yield, 2015 (wet)

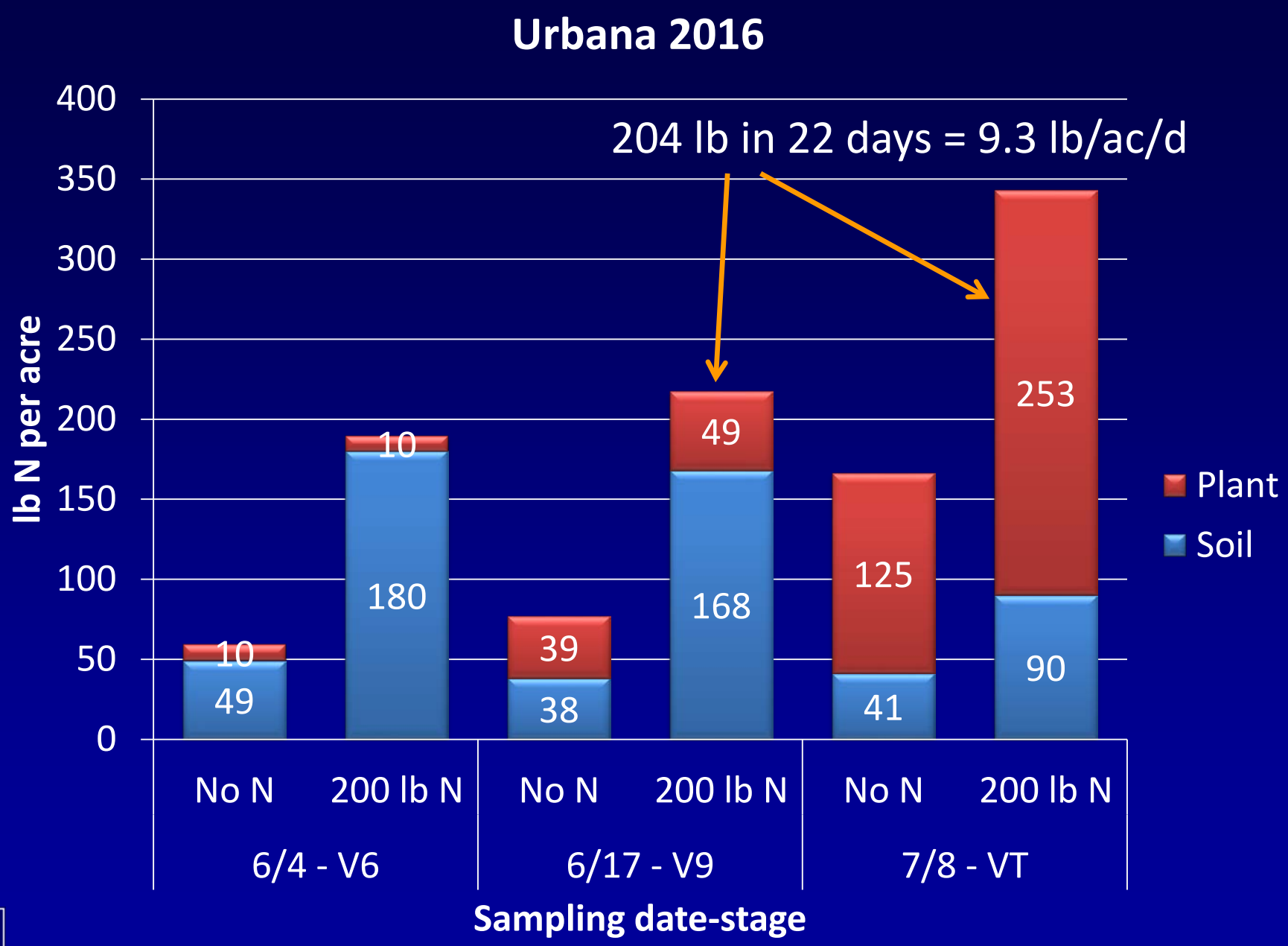


Mid-June soil N and yield, 2016 (dry)

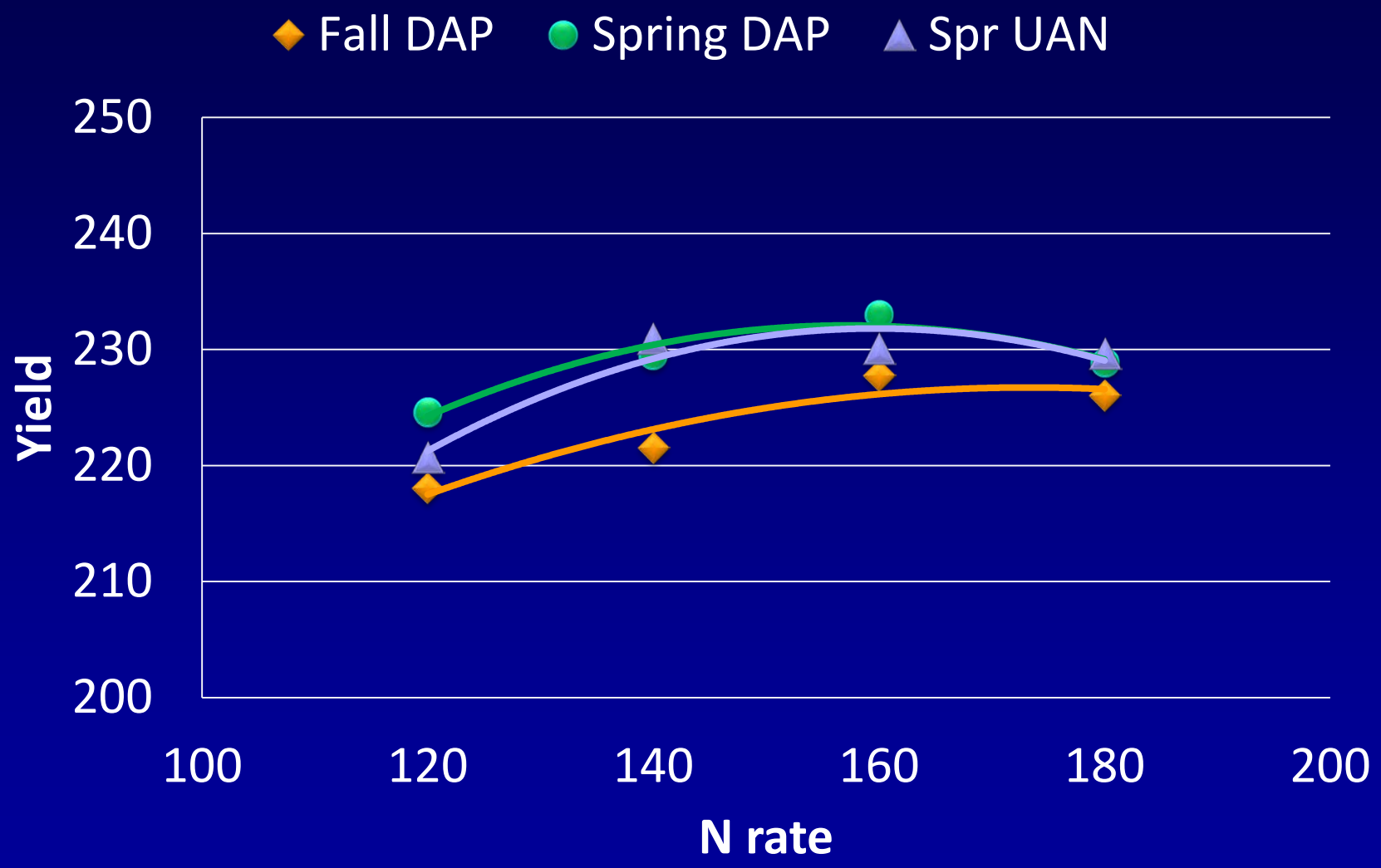


Soil N at VT and yield, 2016 (dry)

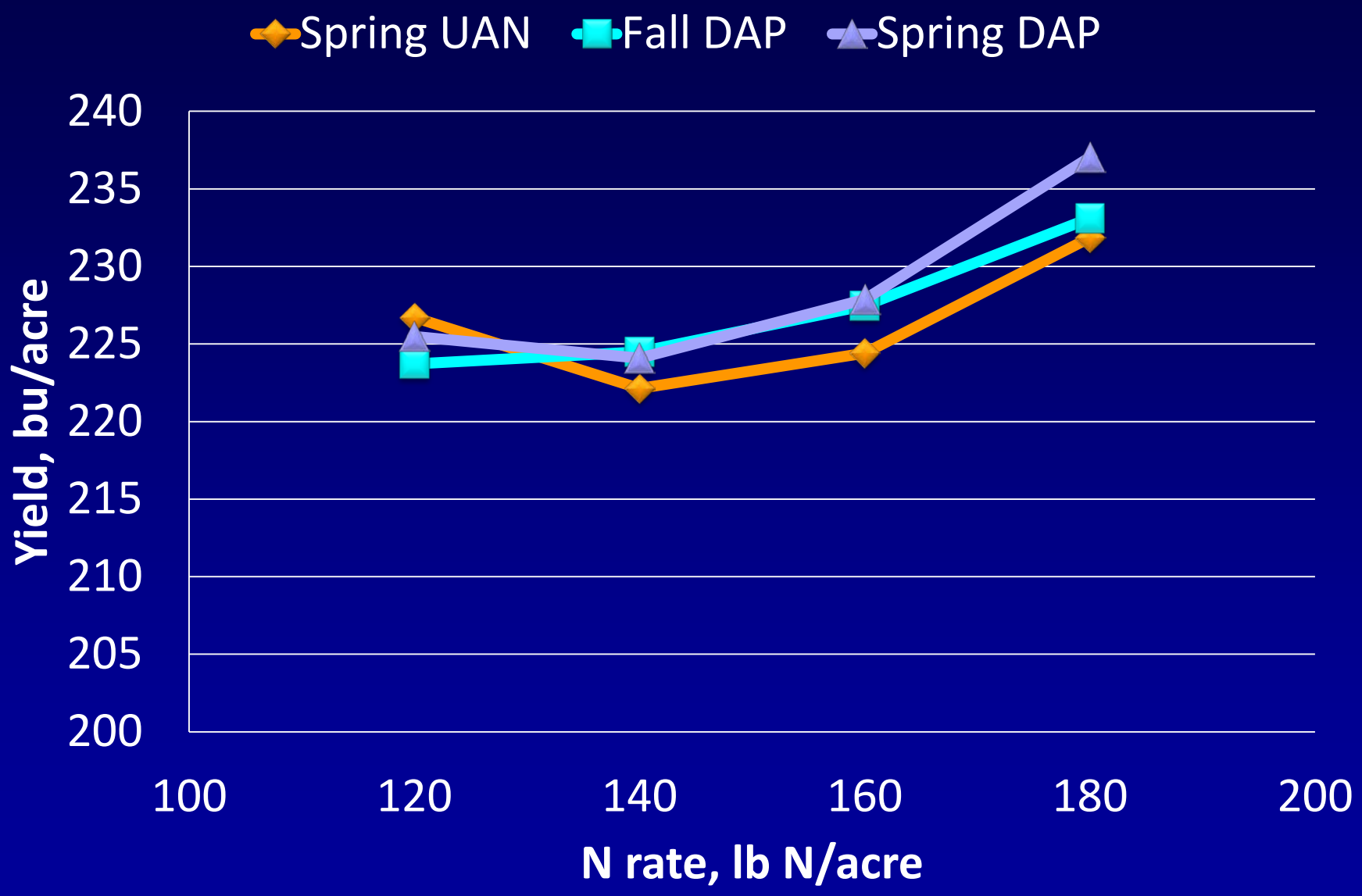



Urbana 2016
204 lb in 22 days = 9.3 lb/ac/d
lb N per acre
400
350
300
250
200
150
100
50
0
10
49
10
180
39
38
49
168
125
41
253
90
Plant
Soil
No N
200 lb N
No N
200 lb N
No N
200 lb N
6/4 - V6
6/17 - V9
7/8 - VT
Sampling date-stage

DAP as N source, Monmouth 2016



DAP as N Source Urbana 2016




THANK YOU