

Soybean Efficiency: Agronomic to Economic

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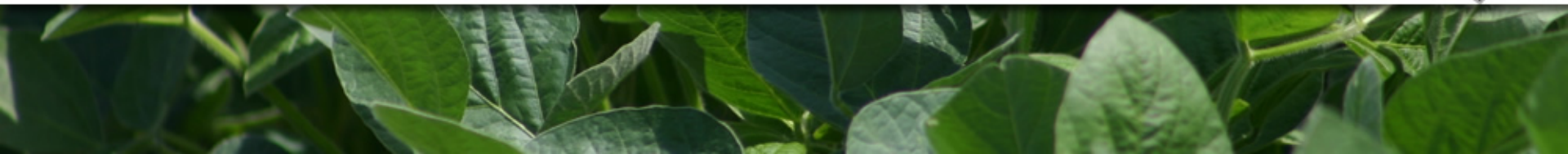
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www.soybeanstation.org



SOYBEAN STATION

DELIVERING FIRST CLASS SOYBEAN INFORMATION



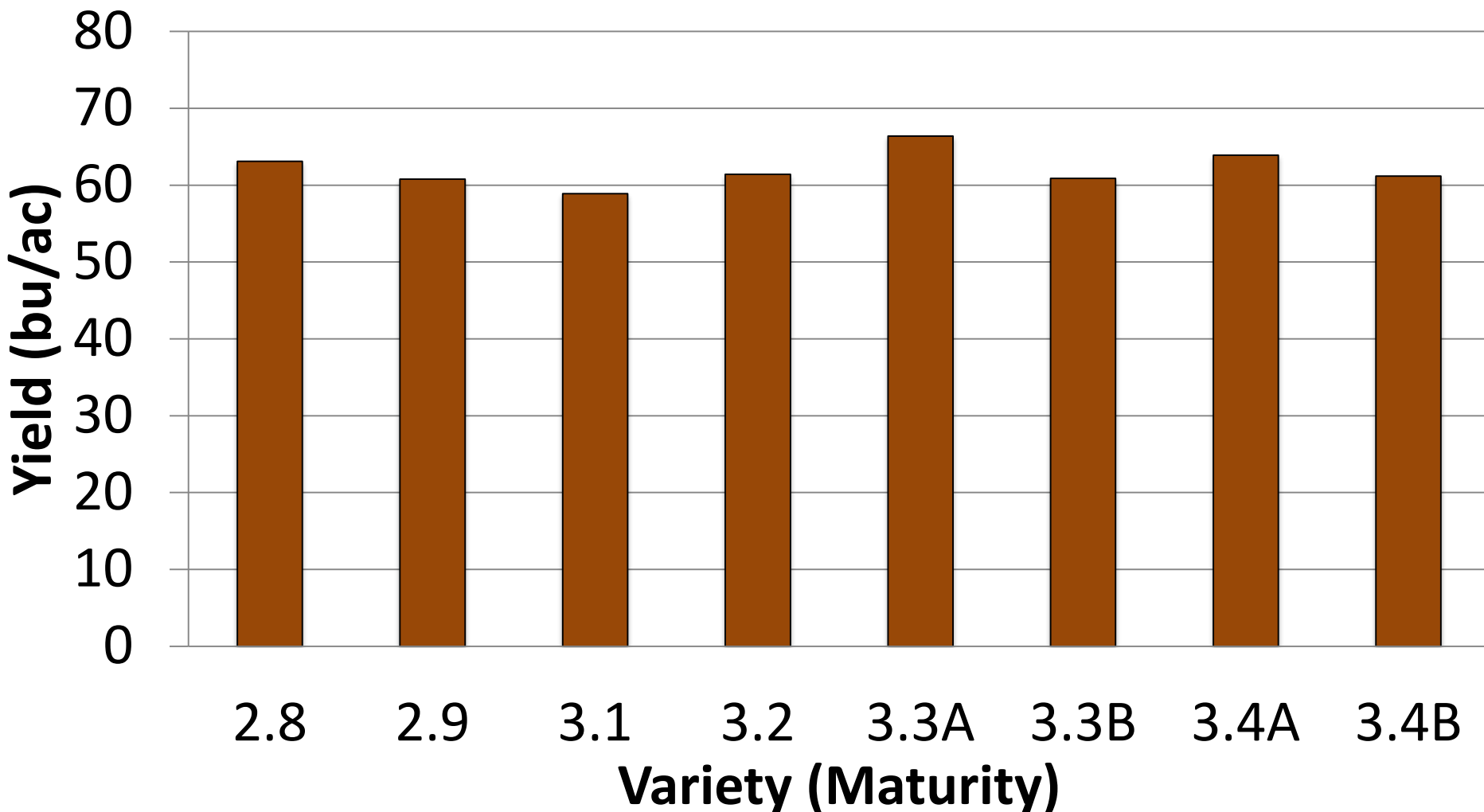
Variety

Selection

Intentional Soybean Management

Manage
Weeds Early

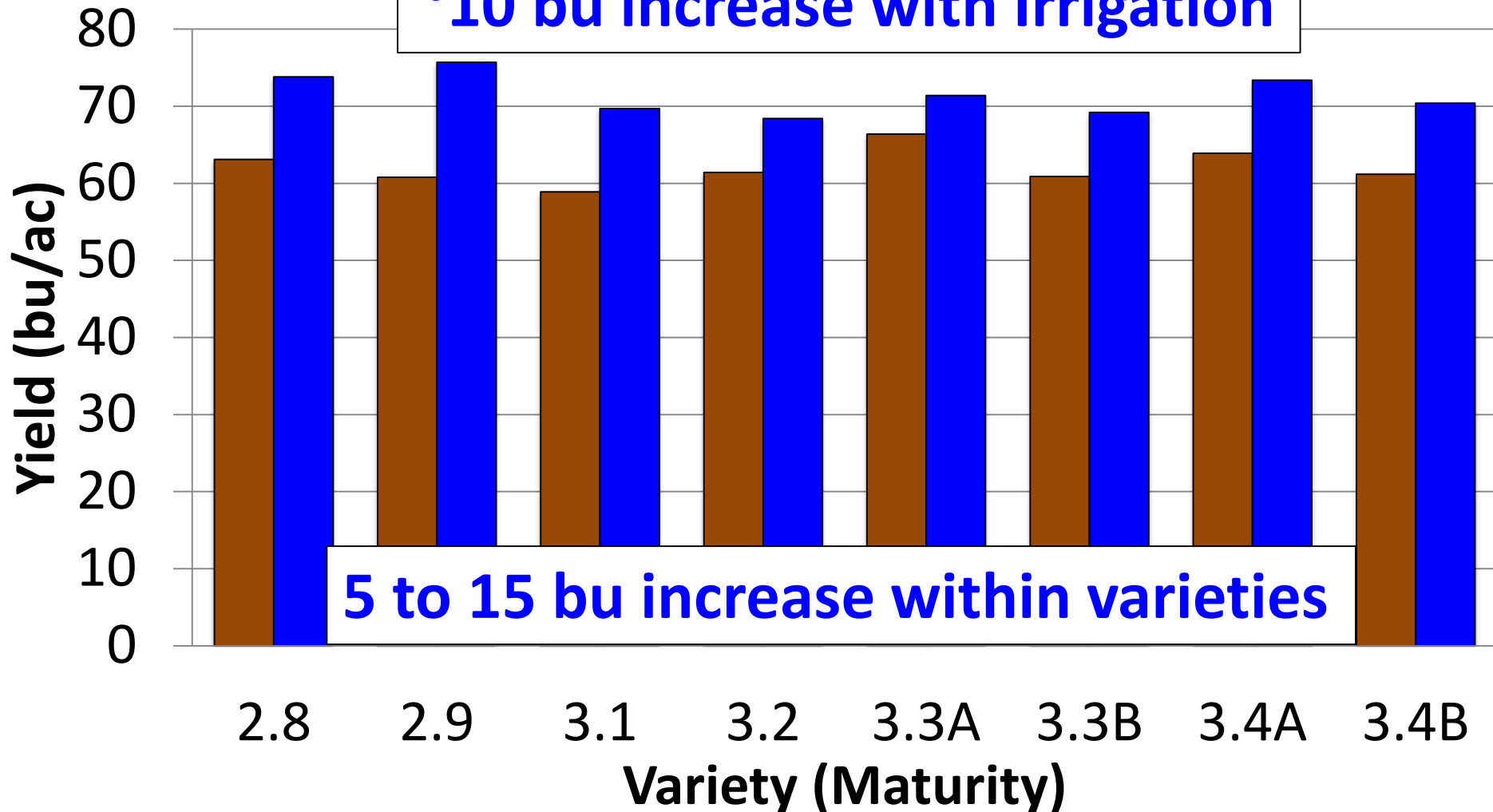
2015 Variety: Dryland v. Irrigated



2015 Dryland v. Irrigated

~7.5 bu range b/t varieties within each system

~10 bu increase with Irrigation



5 to 15 bu increase within varieties

2017 Considerations

- **Variety Selection:** can differ 6 to 12 bu
- **Timely Planting:** can differ 4 to 8 bu in May
 - In-season mgt can NOT recoup losses due to planting delay
- **Seed treatment** – fungicide if anything
 - No need for insecticide
- **Seed Rate** – depends on equipment
 - Plant stands of ~100,000 plts/ac optimal
 - How long can or should you go...
- **Scout!**

50,000 seeds/acre



Determining Seeding Rates

- **Seed Quality** – germination %, purity %
- **Variety** – disease pressure (white mold)
- **Equipment** – calibration, seed placement
 - drill, air-seeder, planter, row cleaners, etc
- **Soil conditions** – emergence % (crust, etc)
 - clean till, no-till, heavy residue
- **Seed Rate will change, but
Plant Population Target will not change.**

Seed Cost Alone

Seed Rate	Plant Pop.	\$40/ unit	\$50/ unit	\$60/ unit	\$70/ unit
1000s/ac		-----\$/ac -----			
100	90	29	34	41	49
125	113	35	43	52	61
150	135	42	52	63	73
175	158	49	61	73	85
200	180	56	69	83	97
225	203	63	78	94	109

Assume 2800 seeds/lb and 90% germination

Seed Cost Alone

Seed Rate	Plant Pop.	\$40/ unit	\$50/ unit	\$60/ unit	\$70/ unit
1000s/ac	-----\$/ac -----				
100?	90	29	34	41	49
125	113	35	43	52	61
150	135	42	52	63	73
175	158	49	61	73	85
200	180	56	69	83	97
225	203	63	78	94	109
Reduce 50K, Save ~		\$14	\$18	\$21	\$24

Assume 2800 seeds/lb and 90% germination

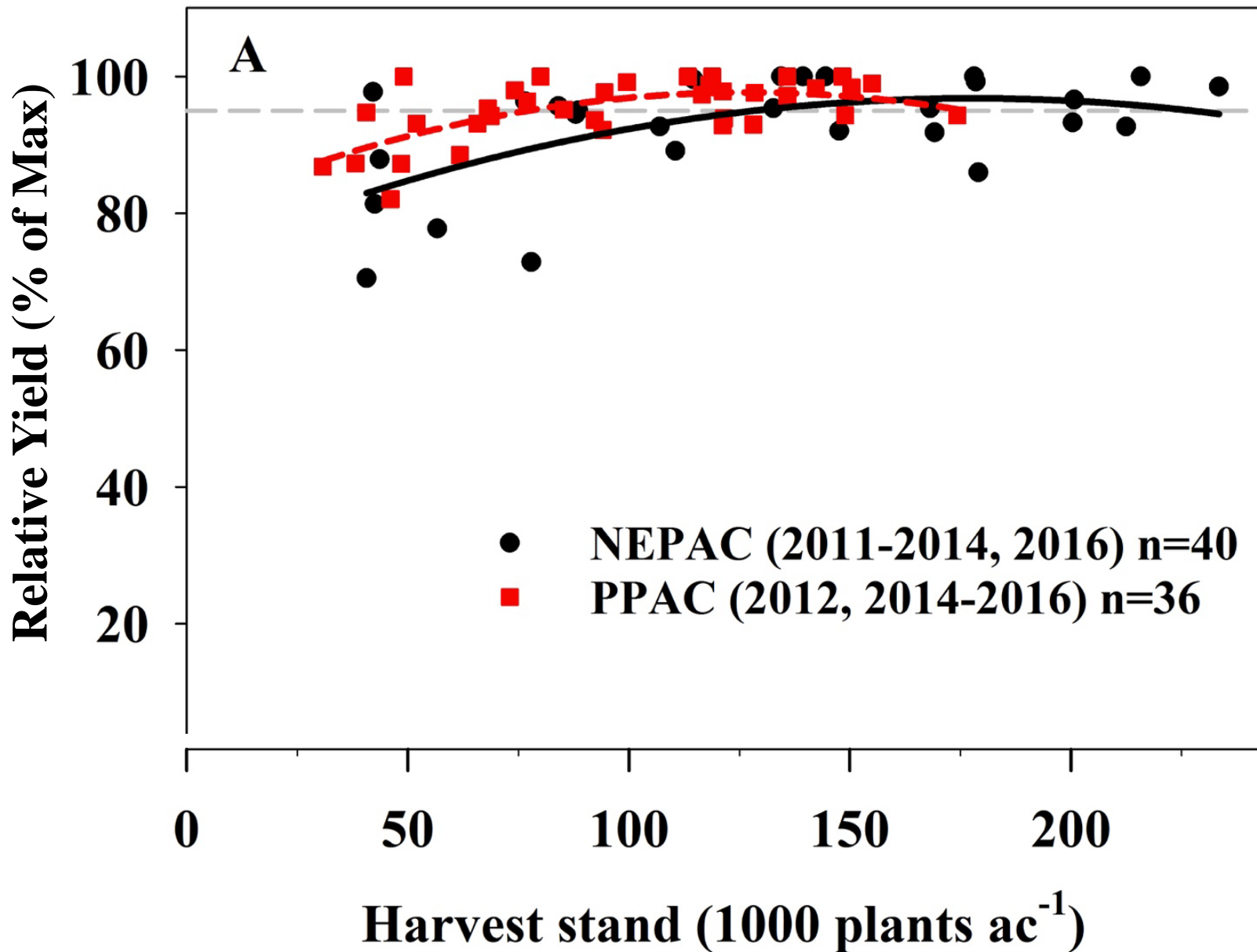
Seed Savings per Bushel: \$50, \$60, and \$70/unit

Reduce Seed	Unit Cost (\$)	42 bu	52 bu	62 bu	72 bu
		-----\$/bu -----			
20,000	\$50	0.17	0.14	0.12	0.10
	\$60	0.19	0.15	0.13	0.11
	\$70	0.23	0.18	0.15	0.13

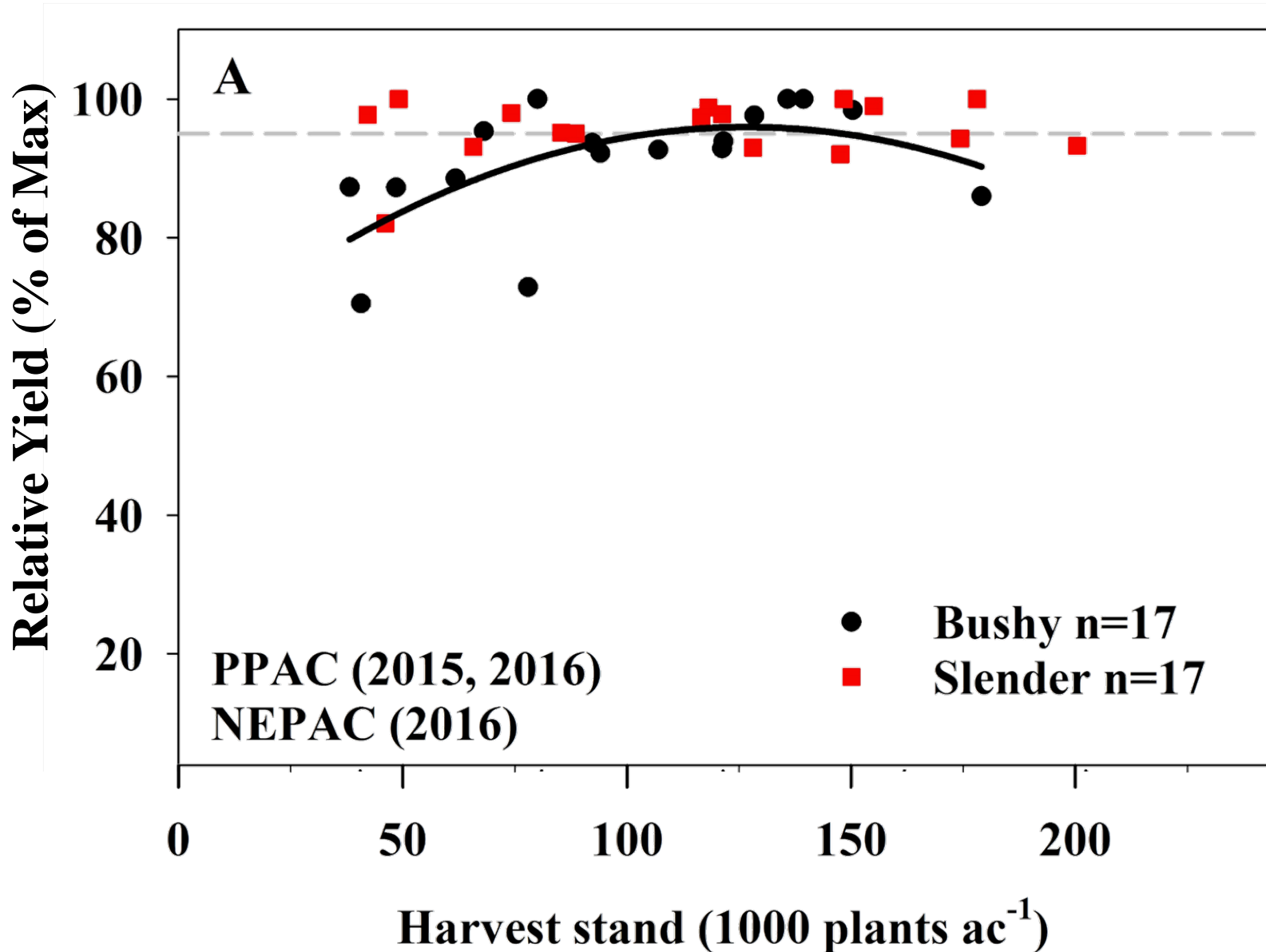
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	\$60	0.19	0.15	0.13	0.11
	\$70	0.23	0.18	0.15	0.13
40,000	\$50	0.34	0.28	0.23	0.20
	\$60	0.38	0.31	0.26	0.22
	\$70	0.46	0.37	0.31	0.27

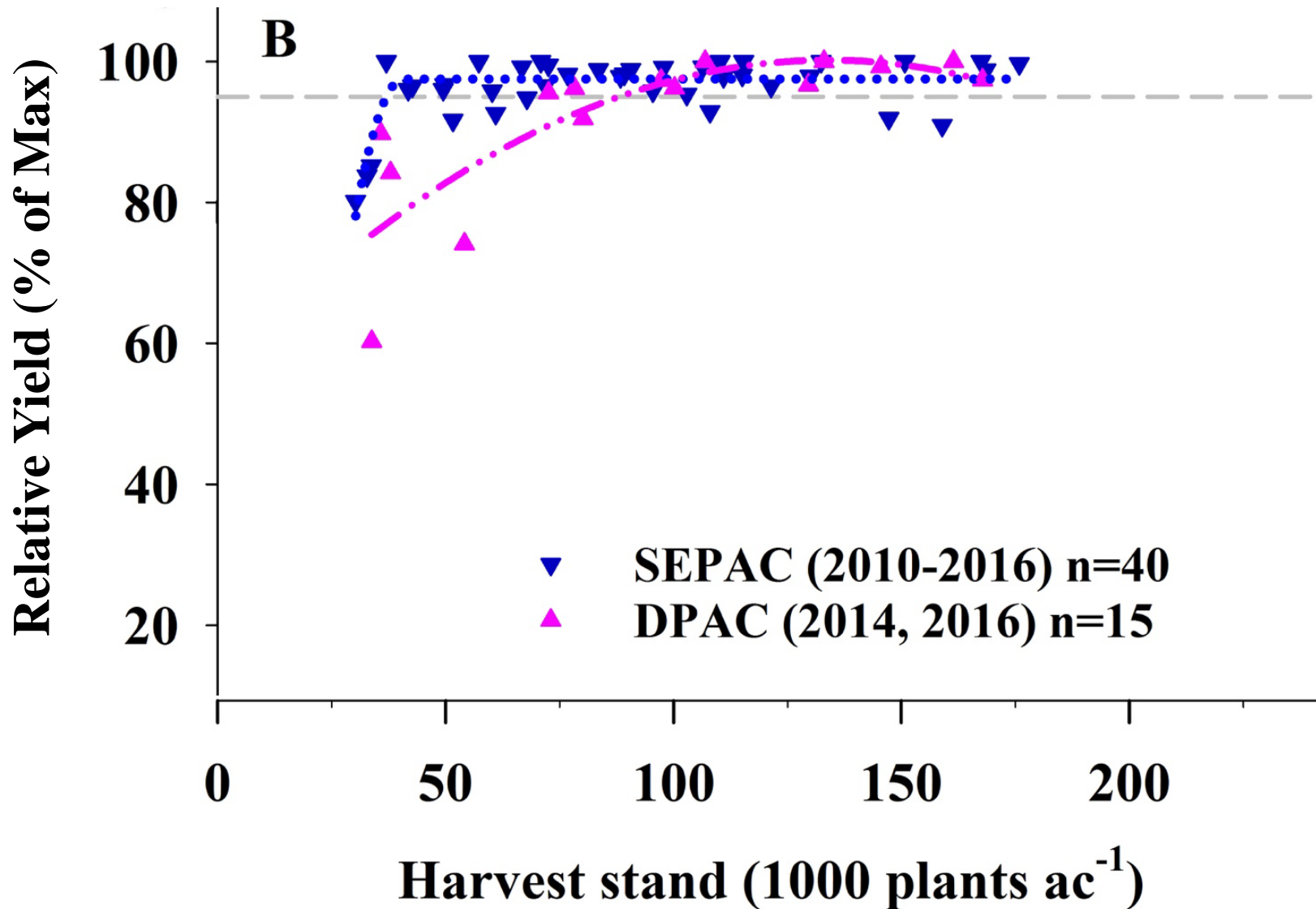
Pinney and Northeast PACs



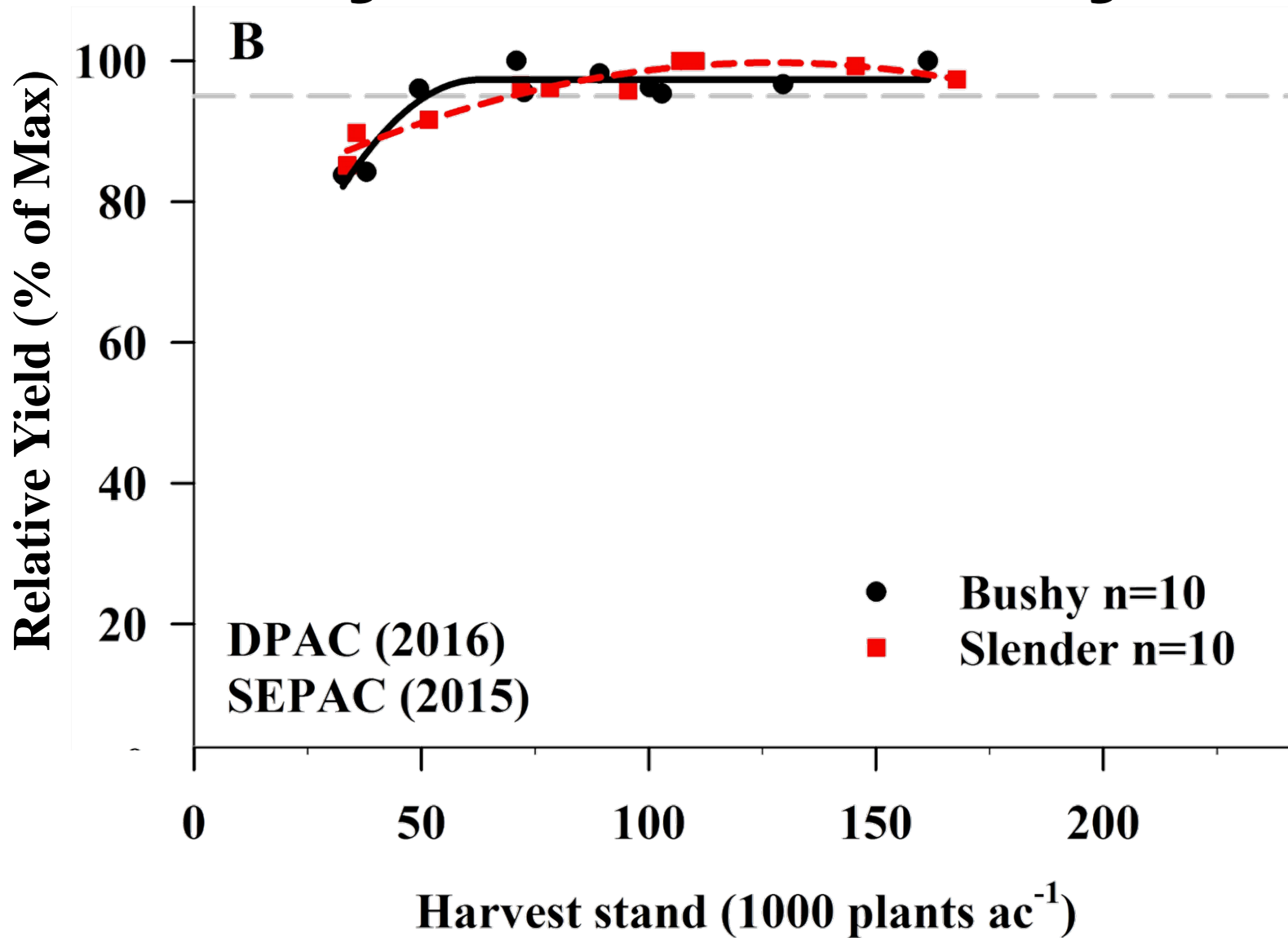
Bushy vs. Slender Soybean



Southeast and Davis PAC



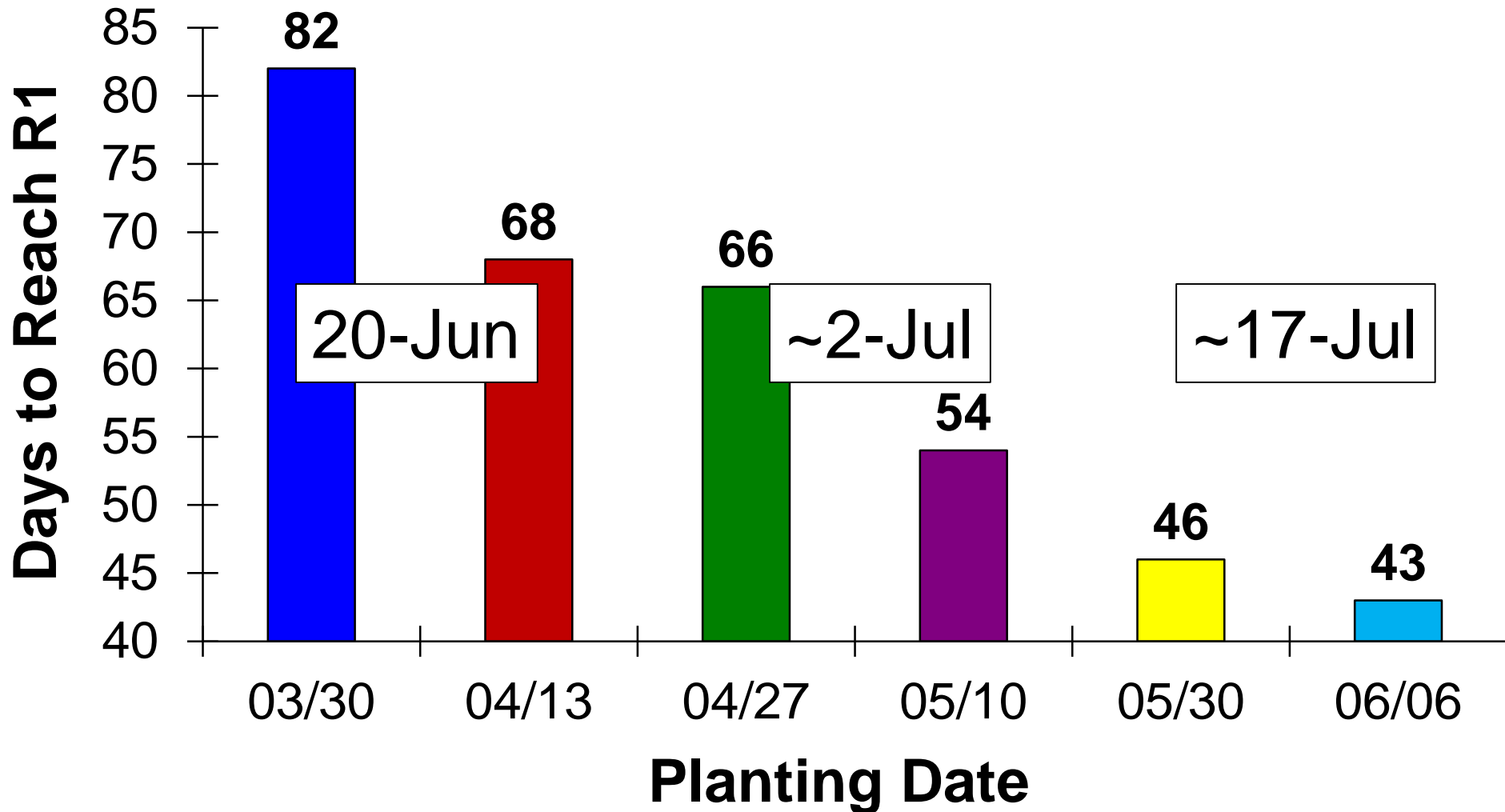
Bushy vs. Slender Soybean



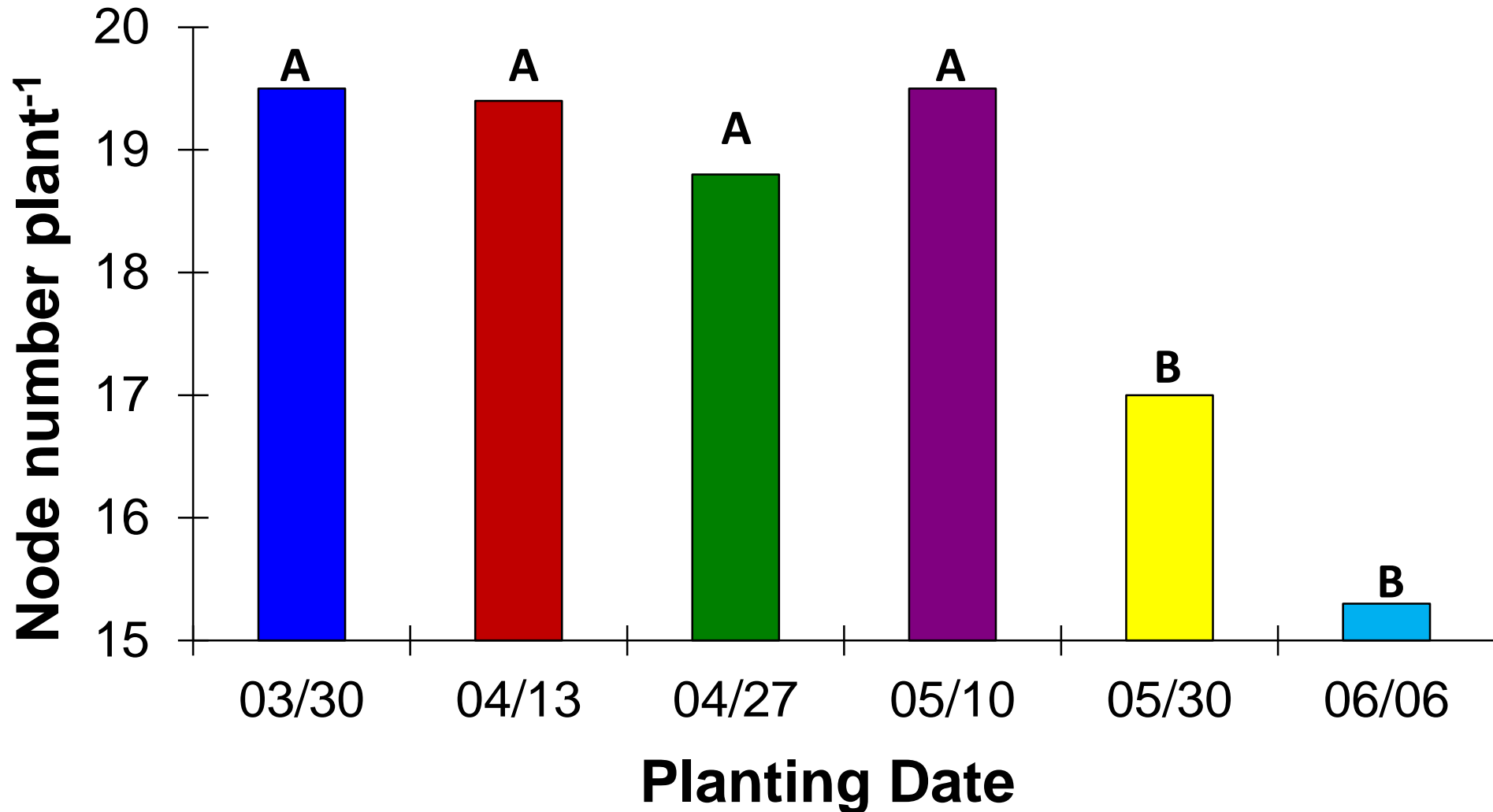
TIMELY PLANTING of Soybeans

- Best combination of **heat unit accumulation** and **light interception** to maximize:
 - Nodes
 - Pods
 - Reproductive branches
 - Canopy closure
 - Reproductive duration
- **Late April to Early May**: general sweet spot
- **Loss of yield potential 0.3 to 0.4 bu/ac/day after mid-May** (even early May occasionally)

of Days from Planting to R1



Planting Date Effect on Node Number Plant⁻¹



Green to the eye by the 4th of July



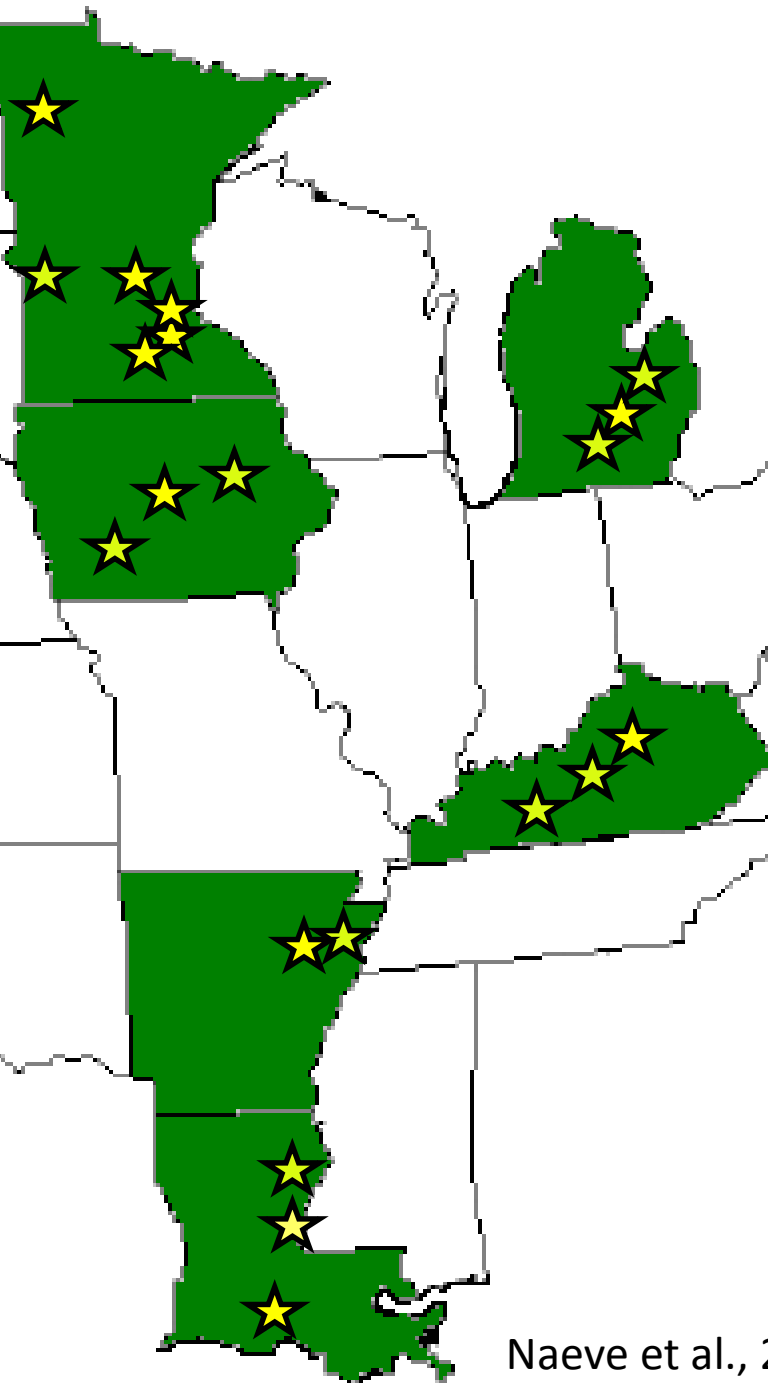
15-in Rows at Full Bloom (R2)



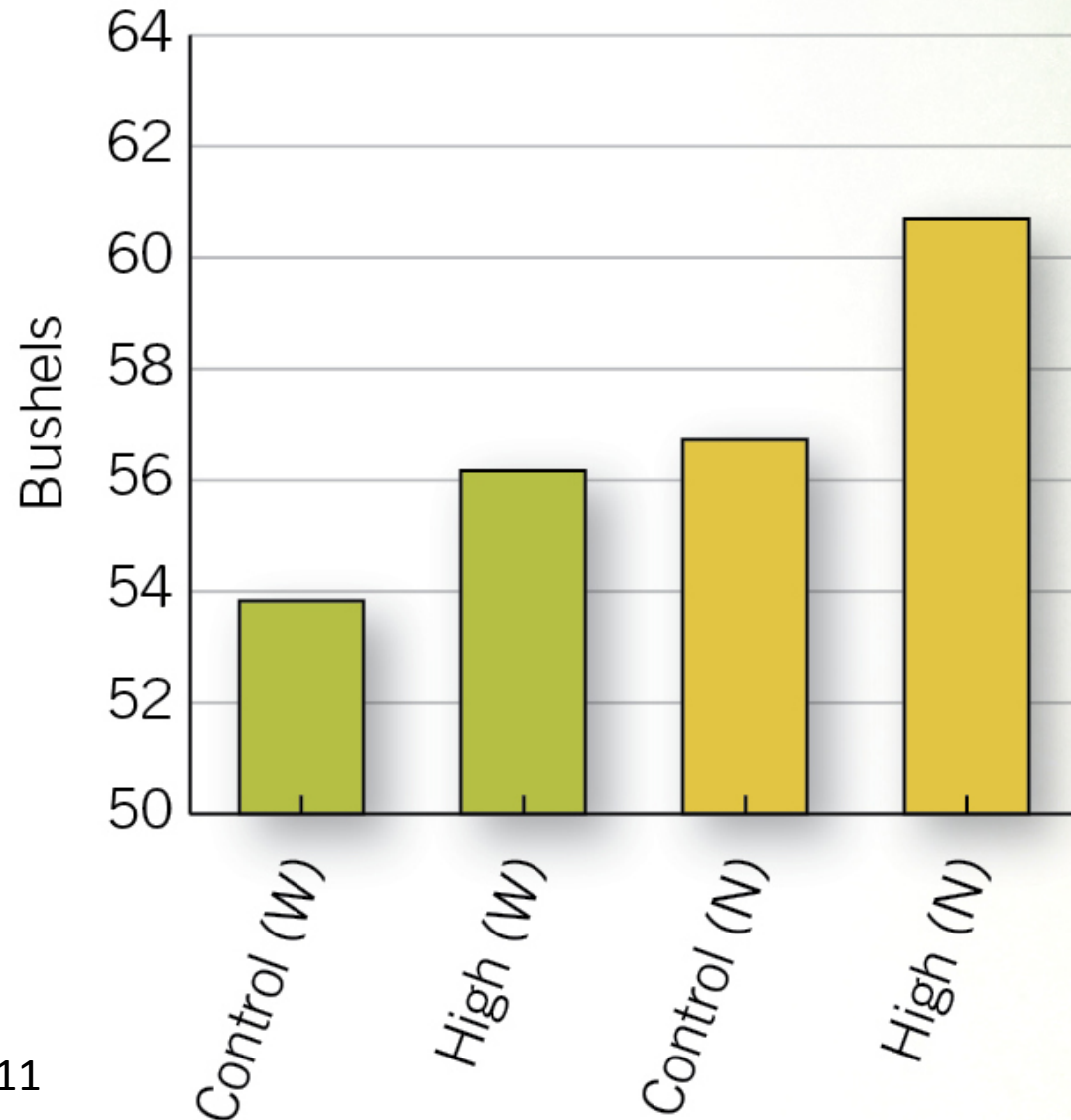
30-in Rows at Full Bloom (R2)

Yield Impact: Row Spacing

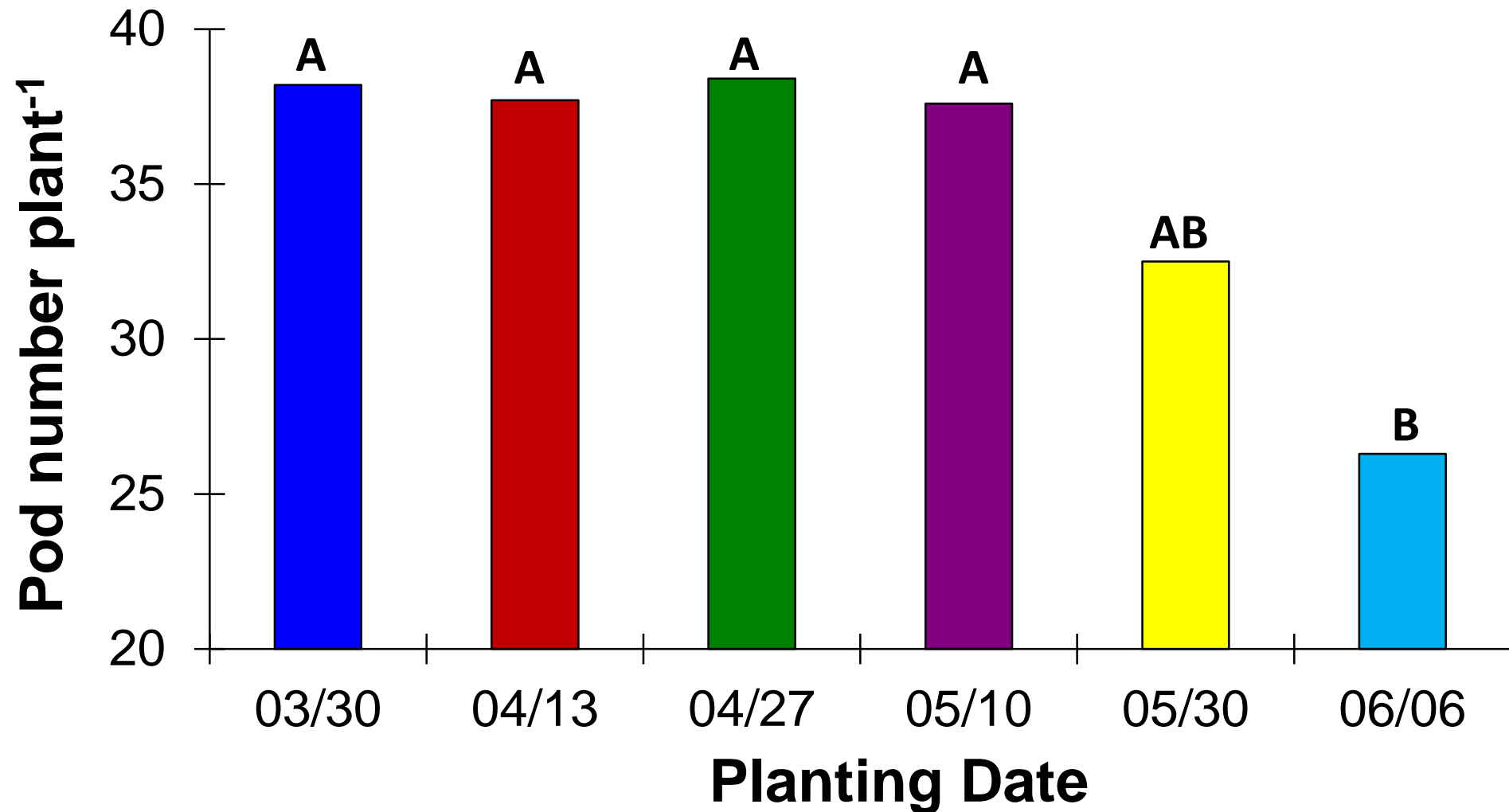
Narrow rows delivered the biggest yield increase.



Naeve et al., 2011



Planting Date Effect on Pod Number Plant⁻¹



1. Planting Date

Early May

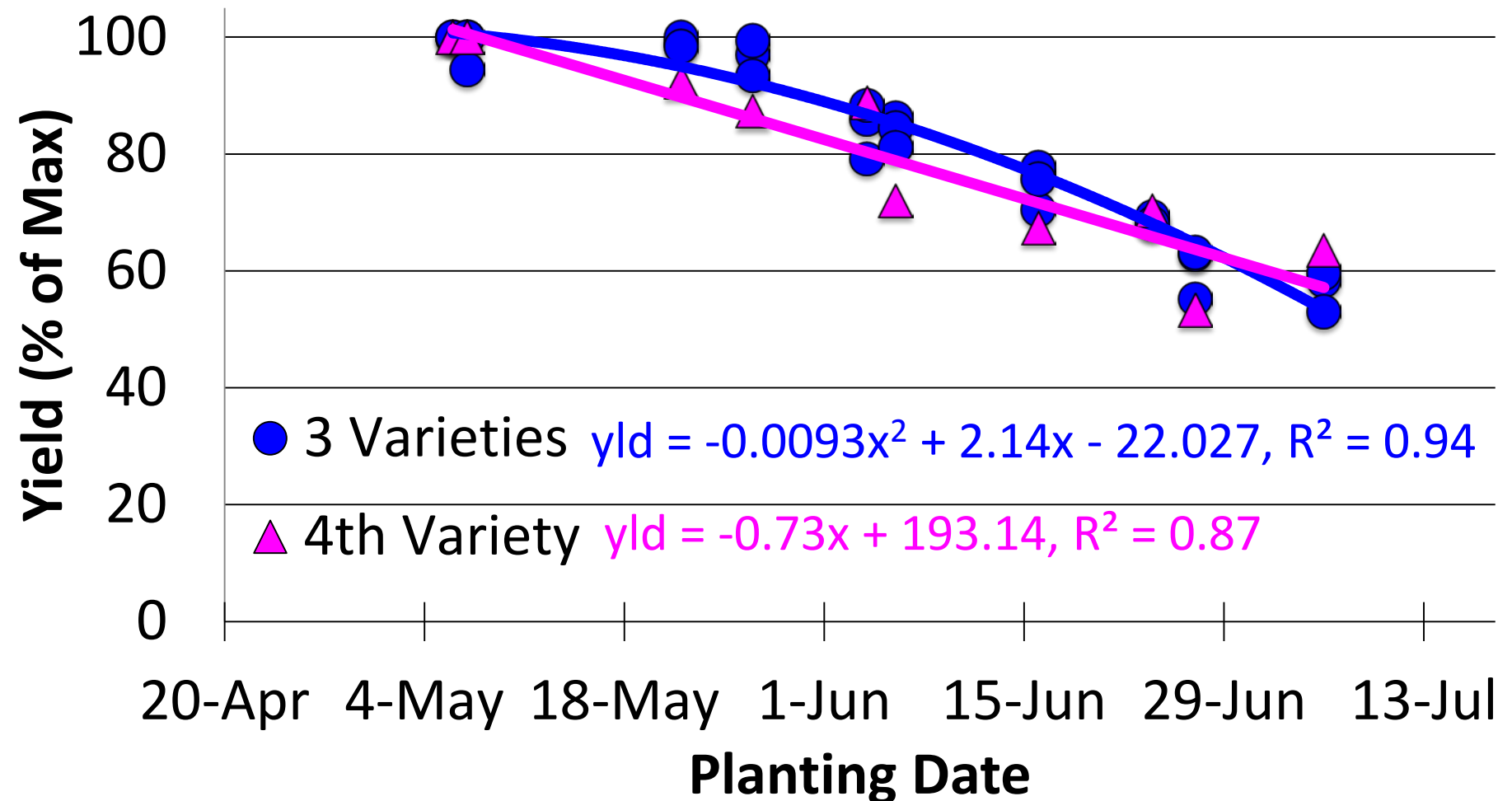


Early June



June 16, 2010 Lafayette IN

2014 & 2015 Plantings: 4 Varieties



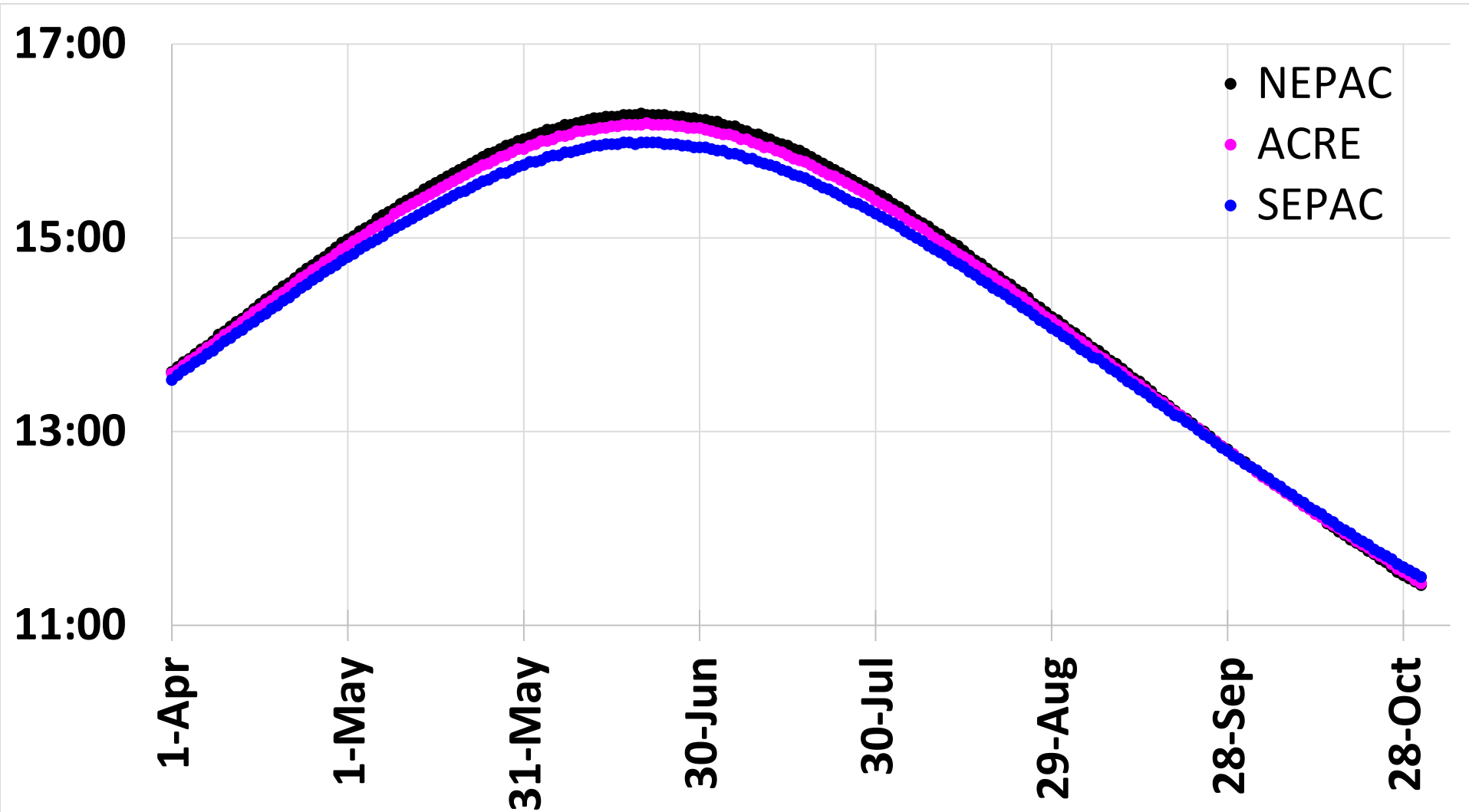
2015 Planting Date Effect on Reproductive Duration

2015 Planting	Days R3_R7
7-May	55
22-May	54
4-Jun	52
24-Jun	48
6-Jul	46

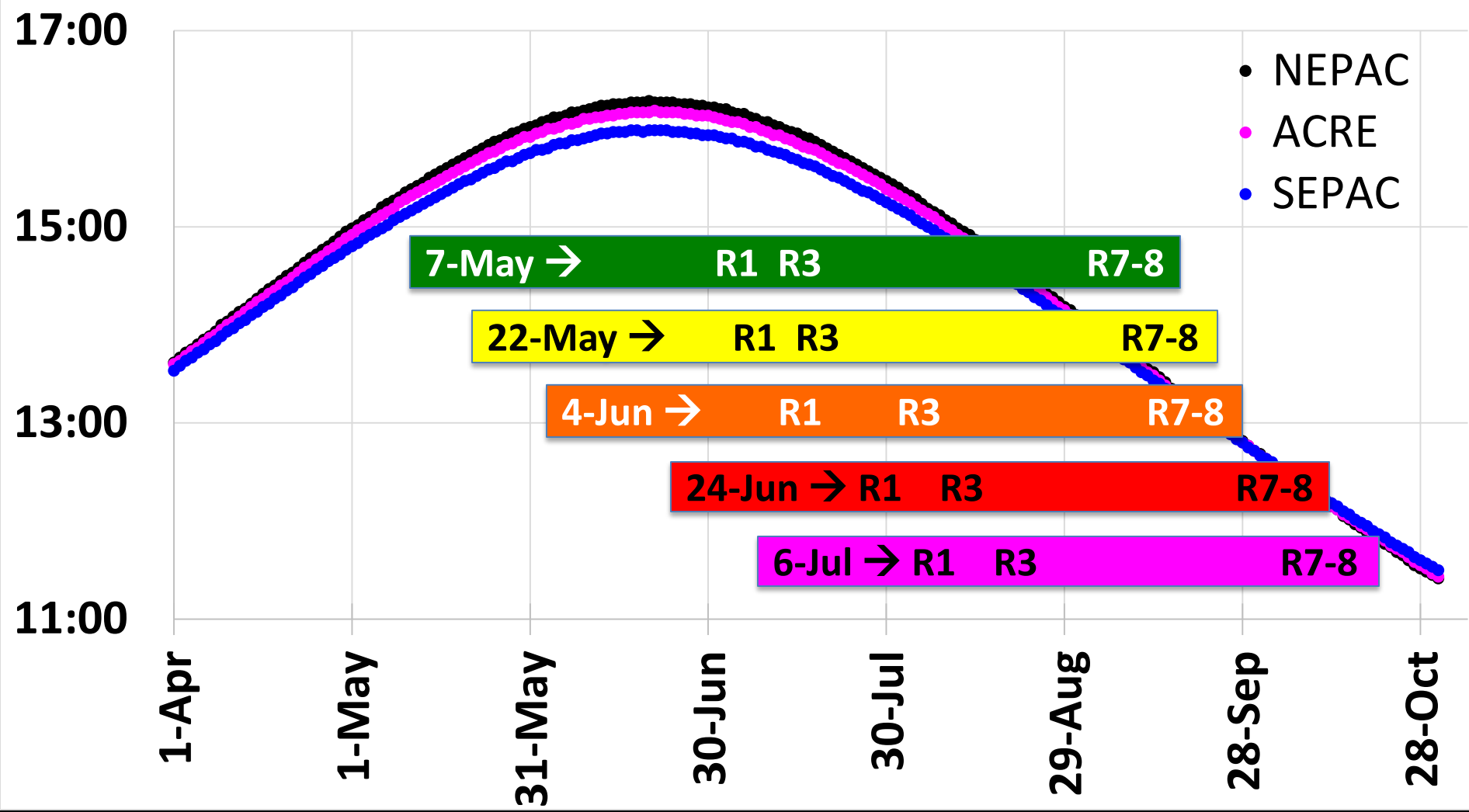
2015 Planting Date Effect on Reproductive Duration

2015 Planting	Days R3_R7	GDUs R3_R7
7-May	55	1213
22-May	54	1145
4-Jun	52	1072
24-Jun	48	912
6-Jul	46	832

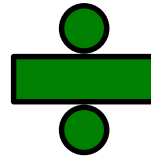
Hours of Sunlight



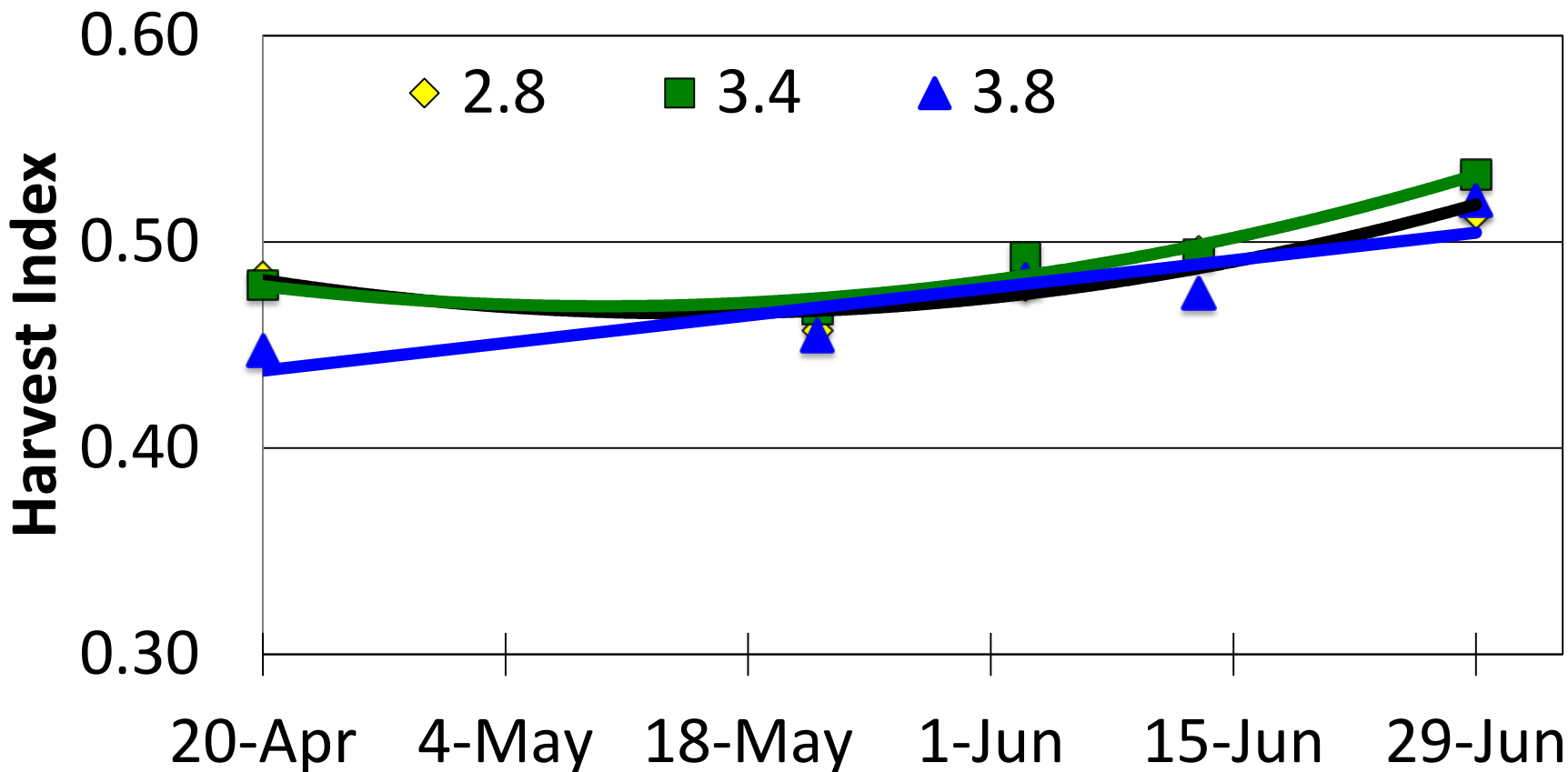
Hours of Sunlight x Planting Date



Harvest Index



Harvest Index = seed/whole plant



TIMELY PLANTING of Soybeans

- Best combination of **heat unit accumulation** and **light interception** to maximize:
 - Nodes
 - Pods
 - Reproductive branches
 - Canopy closure
 - Reproductive duration
- **Late April to Early May**: general sweet spot
- **Loss of yield potential 0.3 to 0.4 bu/ac/day after mid-May** (even early May occasionally)

Systematic Optimization of Yield-Enhancing Applications (SOYA)



20 Locations Each Year from 2012 to 2014

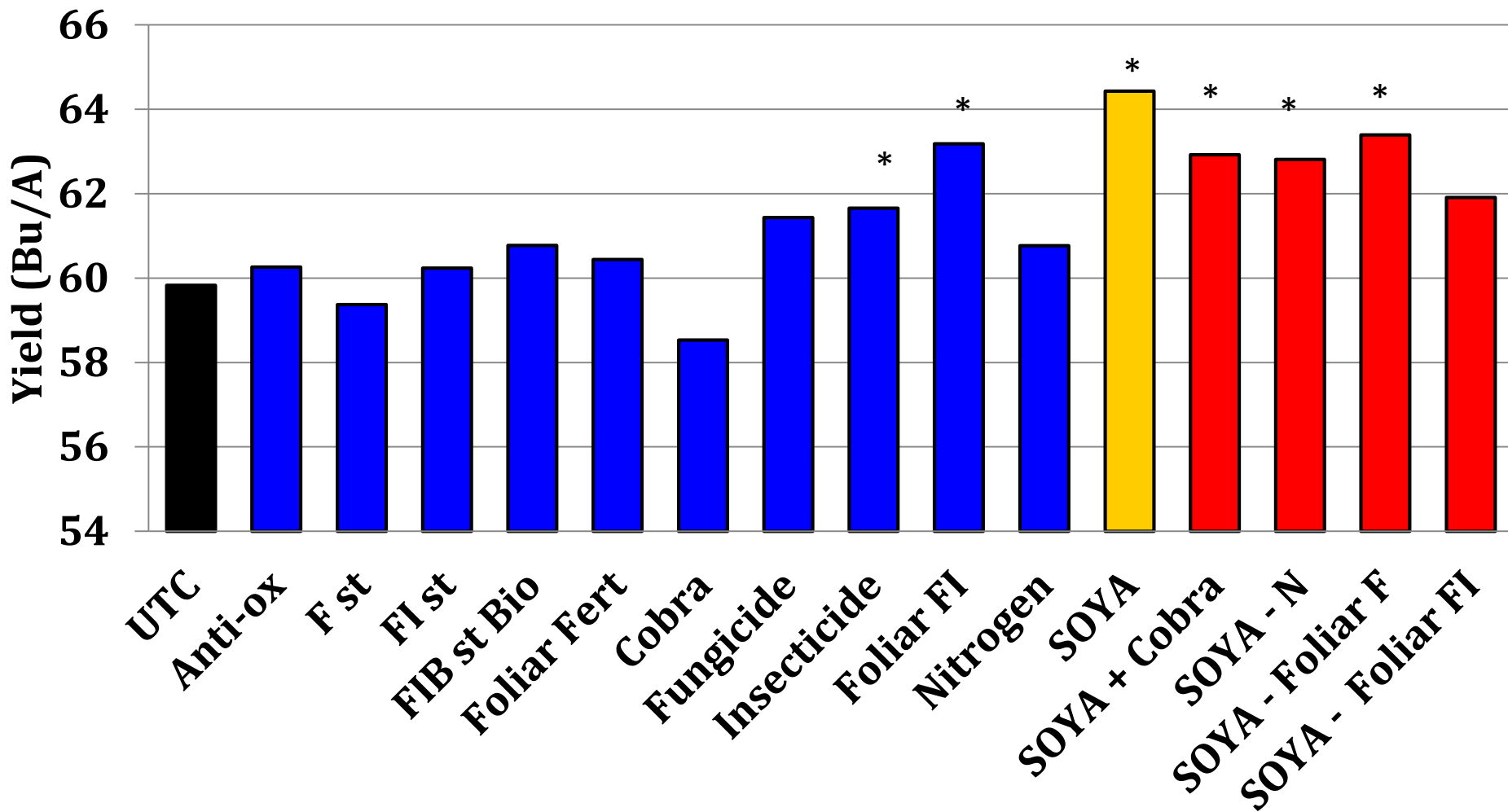


<u>color</u>	<u>MG</u>
pink	2.0
green	2.5
blue	3.0
orange	3.5
red	4.0
yellow	4.5



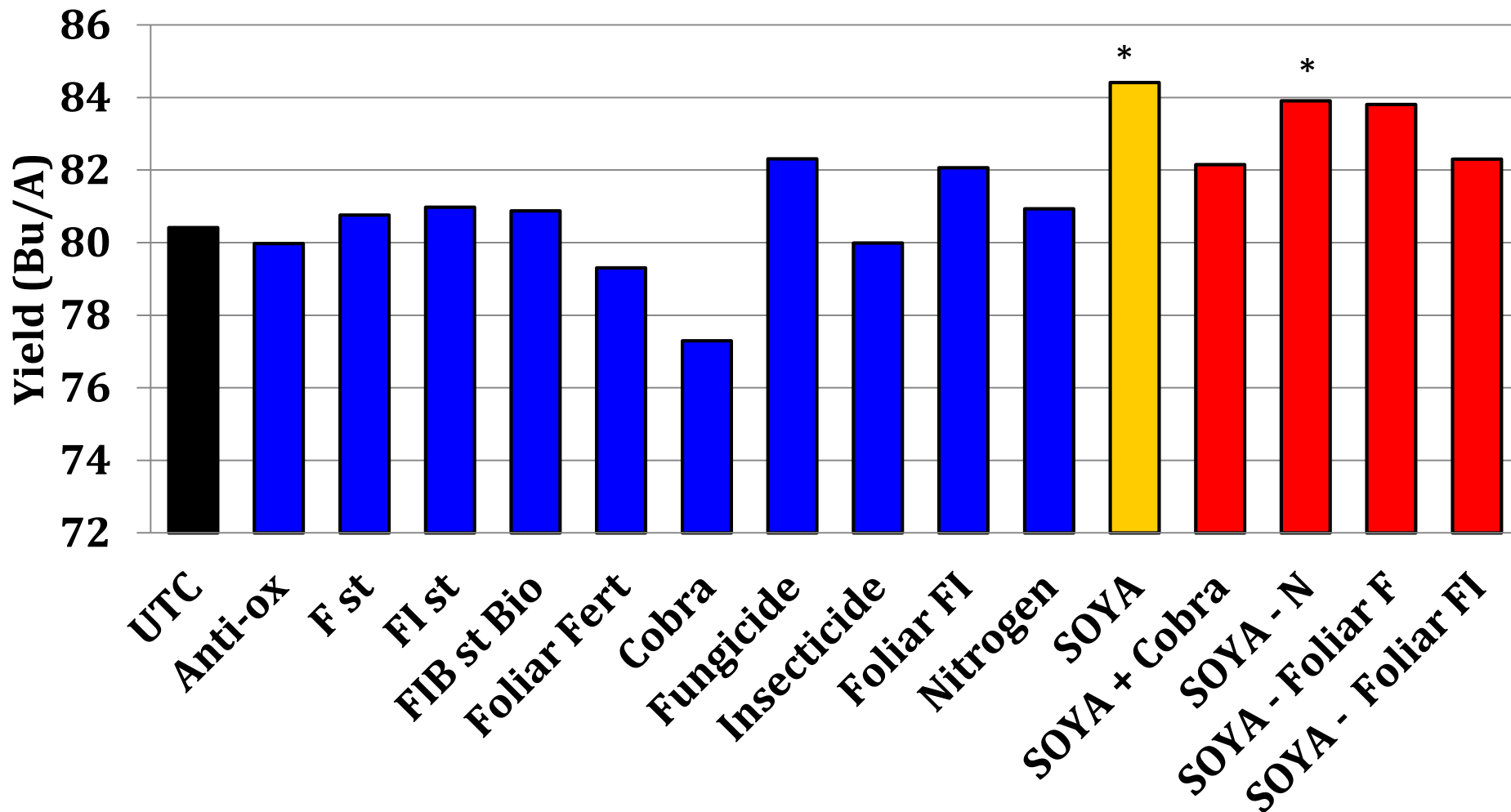
		Seed	—V4—		R1	—R3—			
TREATMENT		F, I, B	Bio	Def	N	Fert	Anti	Fung	Insect
1	UTC	.	.	.	.	.	.	.	.
2	Antioxidant	.	.	.	.	.	A	.	.
3	Fung: seed	F	.	.	.	.	.	.	.
4	F + Insect	FI	.	.	.	.	.	.	.
5	F + I + Biological	FIB	B	.	.	.	.	.	.
6	Foliar Fert	.	.	.	.	x	.	.	.
7	Defoliant	.	.	D	.	.	.	.	.
8	Fung: foliar	.	.	.	.	.	.	F	.
9	Insect: foliar	.	.	.	.	.	.	.	I
10	F + I: foliar	.	.	.	.	.	.	F	I
11	Nitrogen	.	.	.	N	.	.	.	.
12	SOYA (no def)	FIB	B	.	N	x	A	F	I
13	SOYA + def	FIB	B	D	N	x	A	F	I
14	SOYA - N	FIB	B	.	.	x	A	F	I
15	SOYA - Fung	FIB	B	.	N	x	A	.	I
16	SOYA - F and I	FIB	B	.	N	x	A	.	.

Average Yielding Environments



Linear contrasts with UTC: * Indicates statistically different from UTC at $p \leq 0.05$

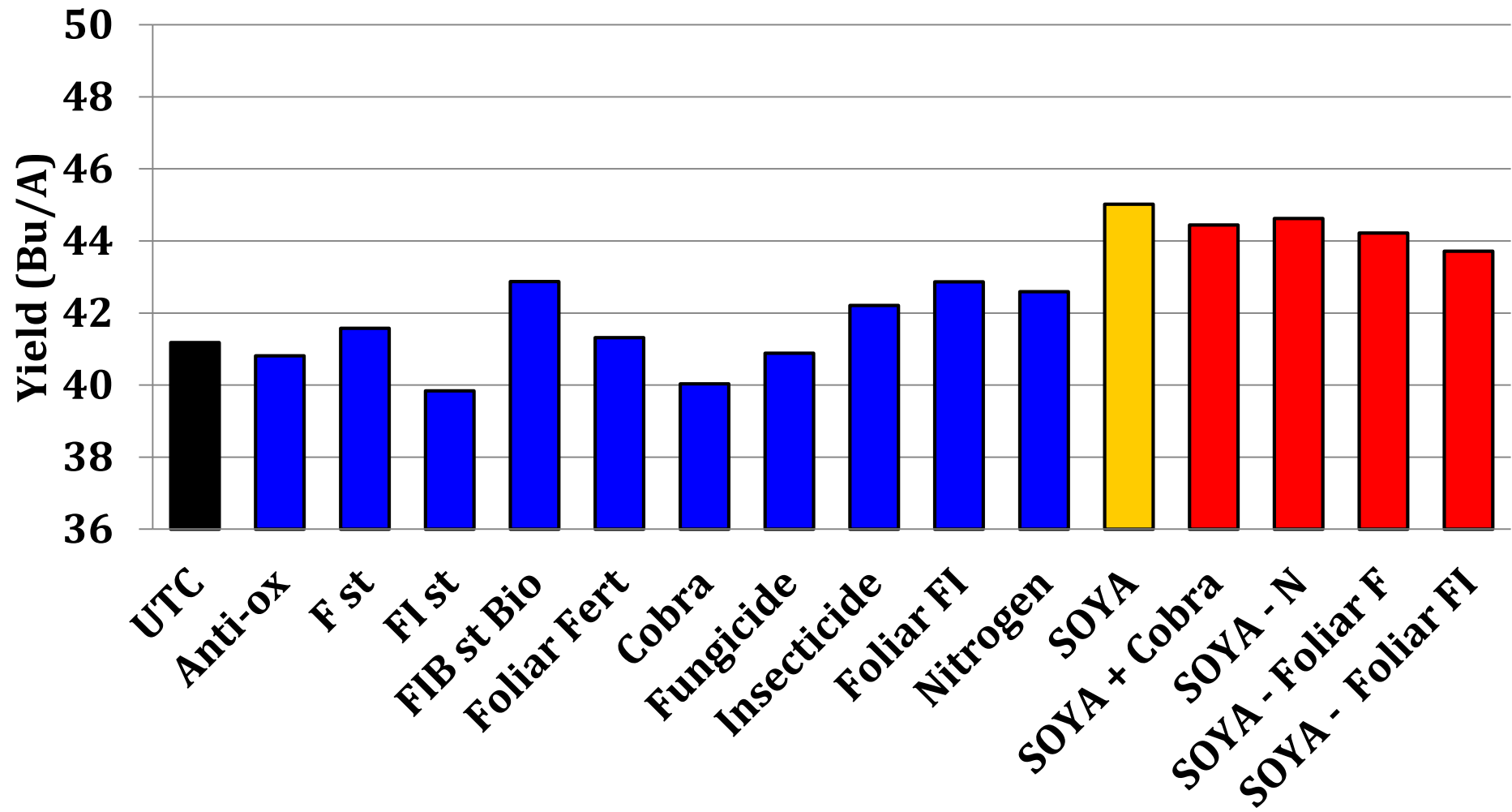
High-Yielding Environments (≥ 76 bu)



Linear contrasts with UTC: * Indicates statistically different from UTC at $p \leq 0.05$

ARcol13, ARcol14, ARnew14, ILurb14, INwla14, KYlex13, WIjan13, WIjan14

Low Yielding Environments (< 48.5 bu)



Linear contrasts with UTC: * Indicates statistically different from UTC at $p \leq 0.05$

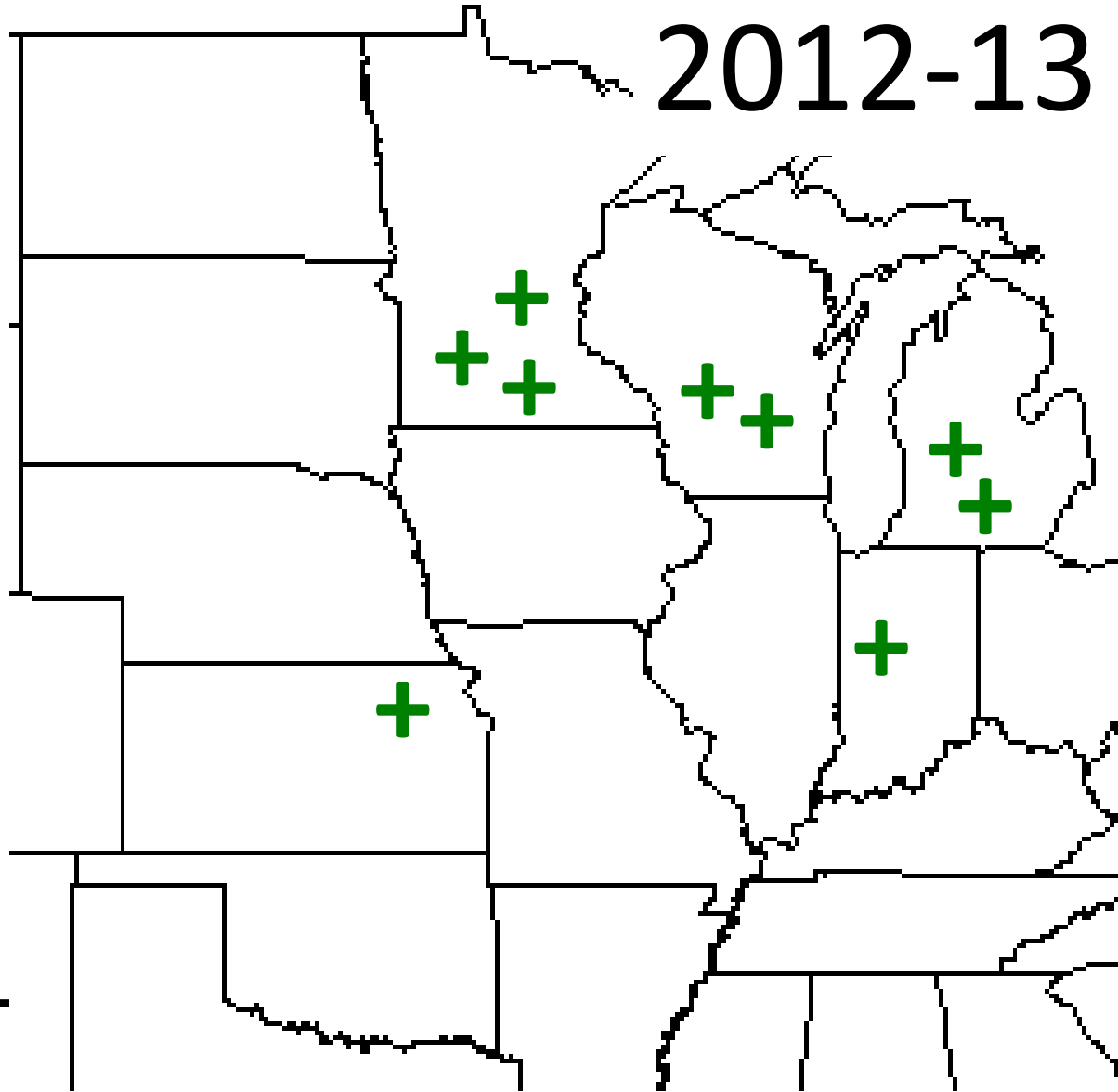
ARnew12, ILurb12, IAhum13, KSros13, MIela12, MIela14

SOYA 1 Summary

- 60 total site years of data
 - 28 showed significant treatment effects
 - 2012: 5 locations
 - 2013: 11 locations
 - 2014: 12 locations
 - North: 15 out of 21 responsive site-years
 - Central: 5 out of 18 responsive site-years
 - South: 8 out of 22 responsive site-years
- There did not appear to be a yield level x management interaction

+ = Yield increase with treatments with foliar insecticide

X = Yield of **control** \geq than all other treatments



SOYA 1 Summary

- Seed treatment and early season products show little value in increasing soybean yield
- Benefit from foliar insecticide and fungicide were greatest in the north

Grain Nutrient Removal

	lb/bu	50 bu	75 bu	100 bu
Nitrogen	3.30	165	248	330
P ₂ O ₅	0.73	37	55	73
K ₂ O	1.20	60	90	120
Sulfur	0.18	9	14	18

Are you fertilizing for 50 or 75 bu?

Are soybeans getting the scraps?



Rice Rescue: July 2, 2015



Rice Happy: July 2, 2015

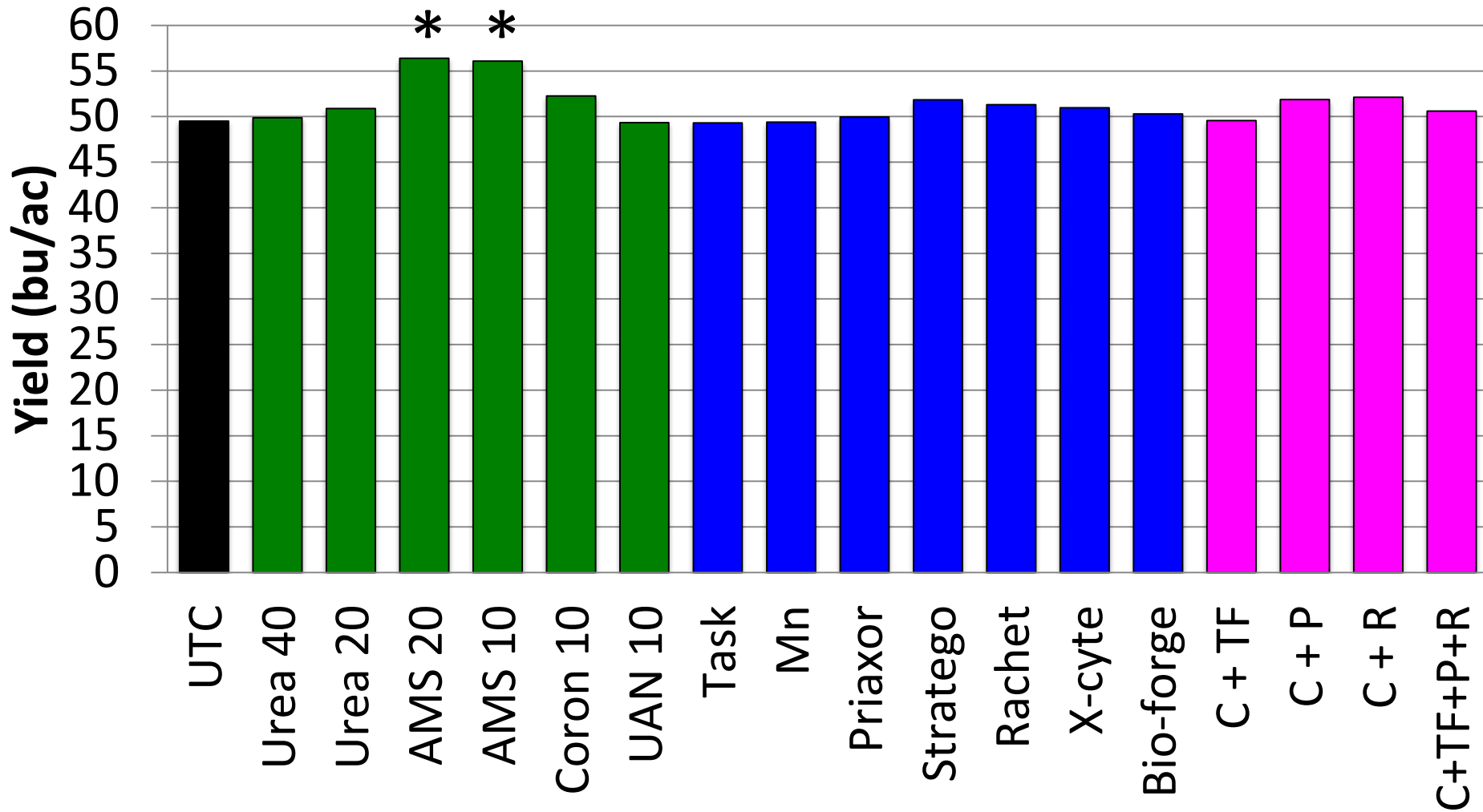
Rice Rescue: Aug 3, 2015



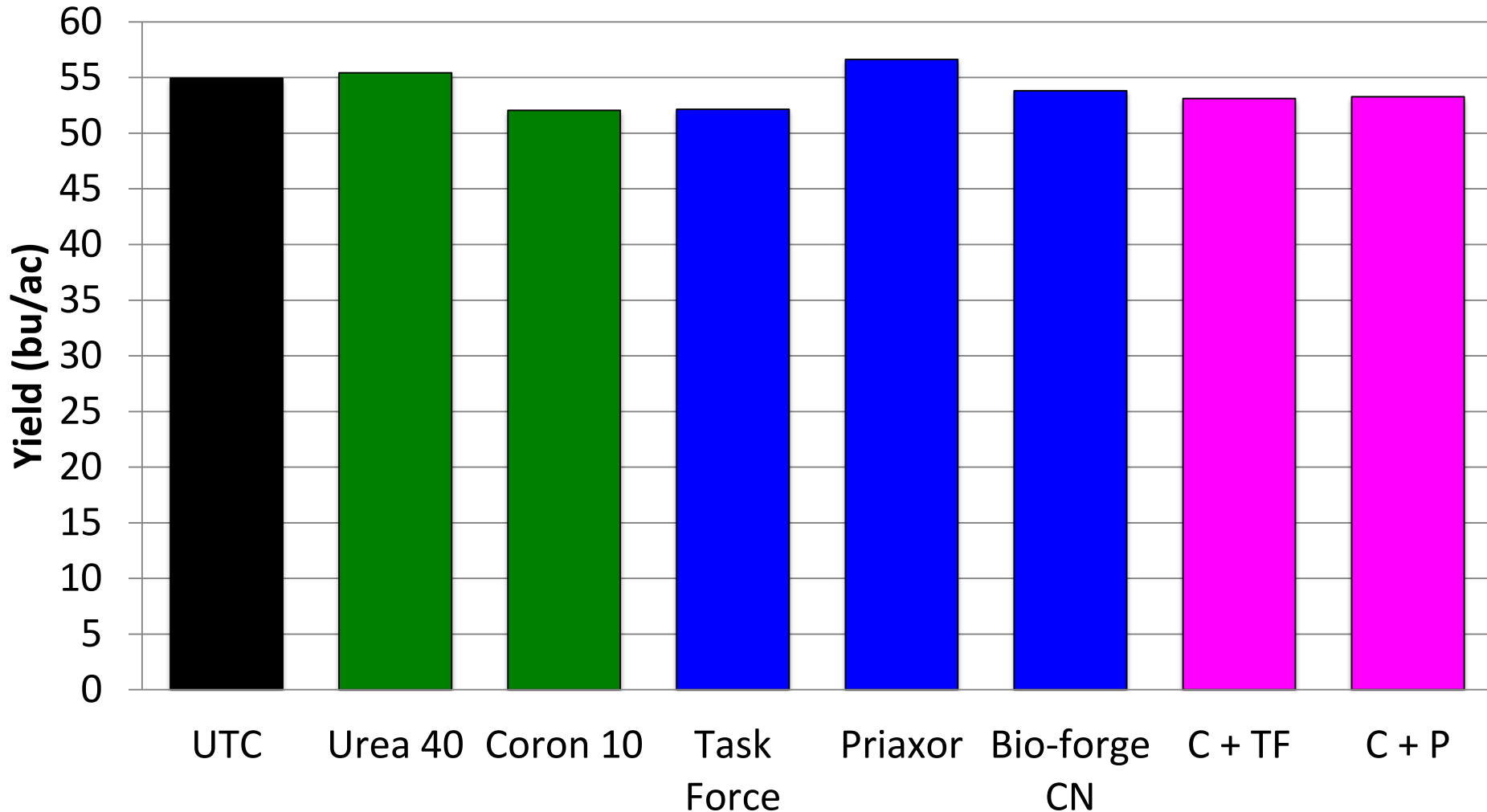
AMS @ 20 lb N/ac

Urea @ 40 lb N/ac

Rice RESCUE Yields



Rice Happy Yields



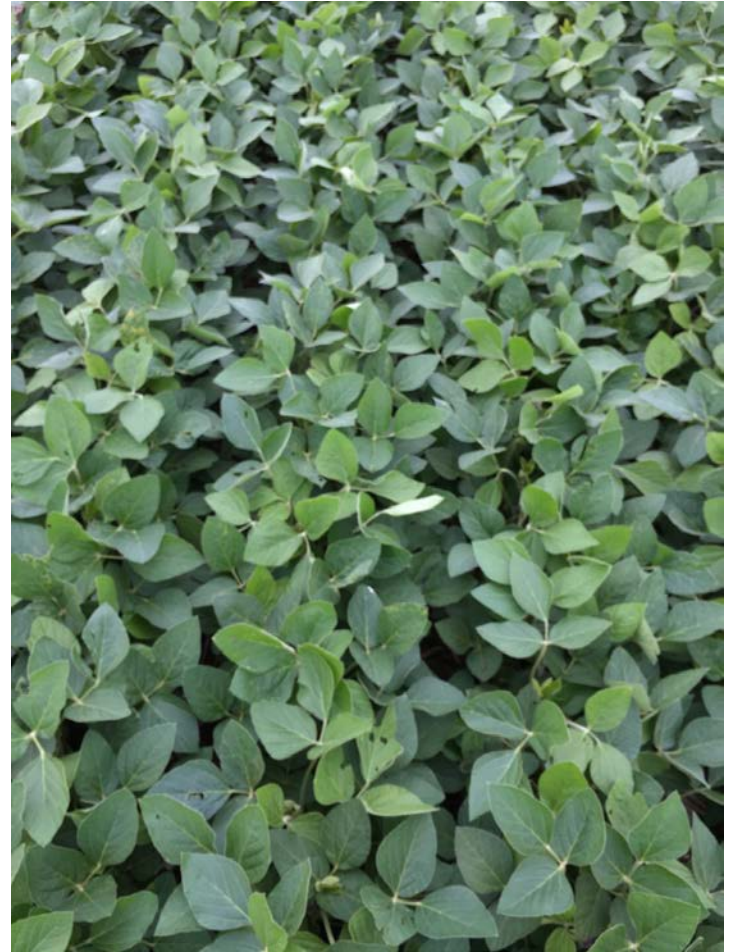
Sulfur Studies at LaCrosse in 2016



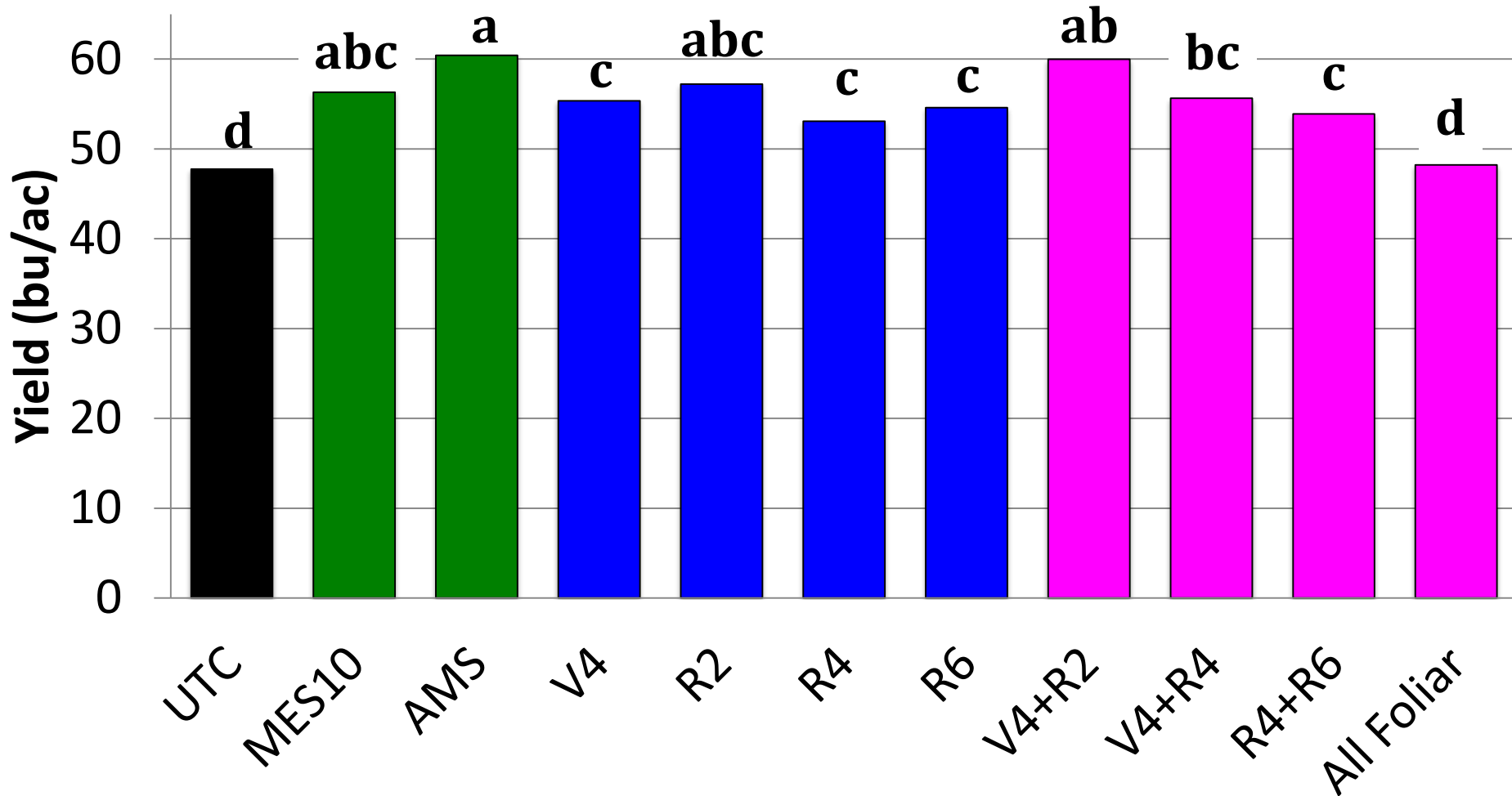
No Sulfur



20 lb S/acre

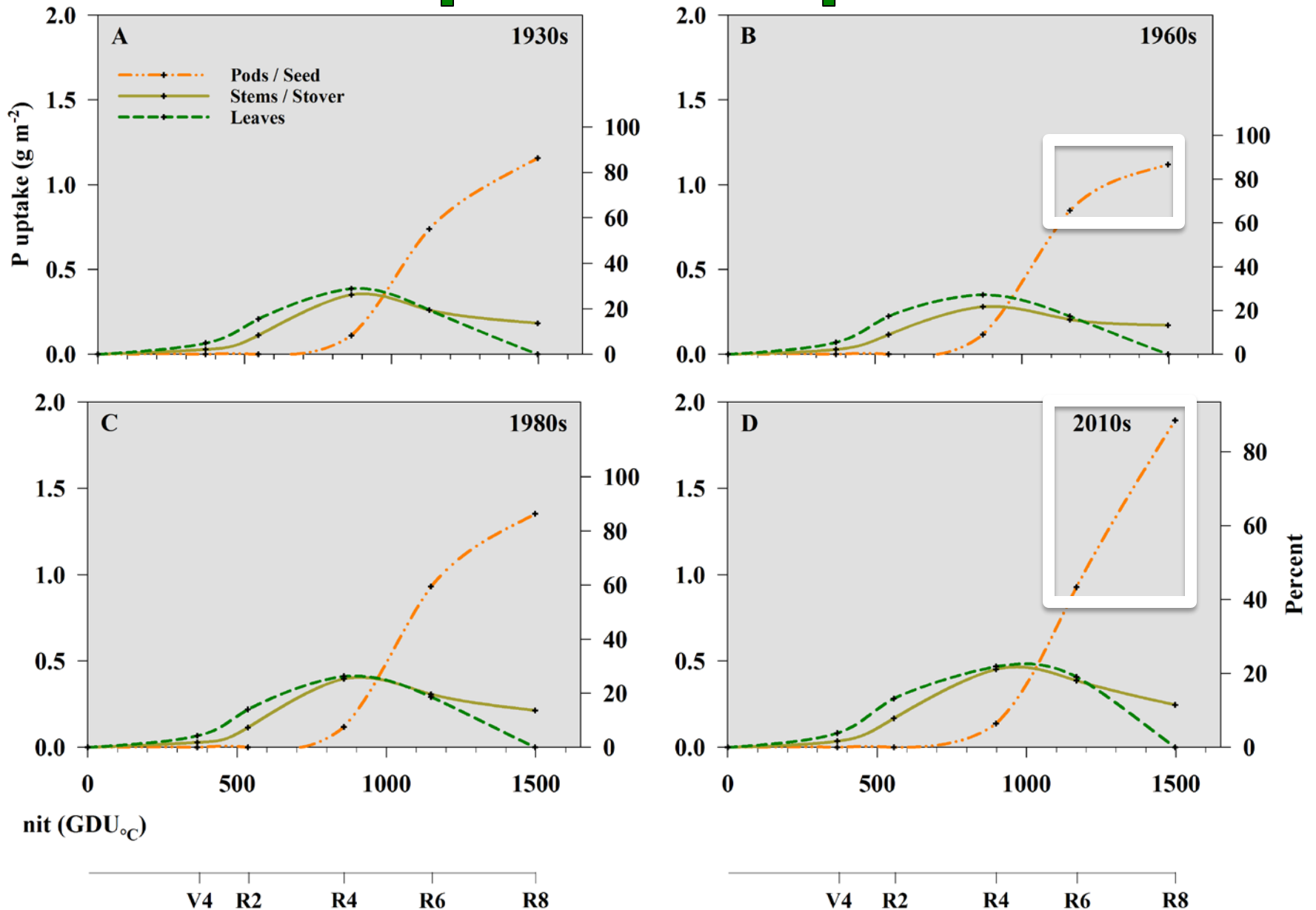


2016 Sulfur Season @ LaCrosse

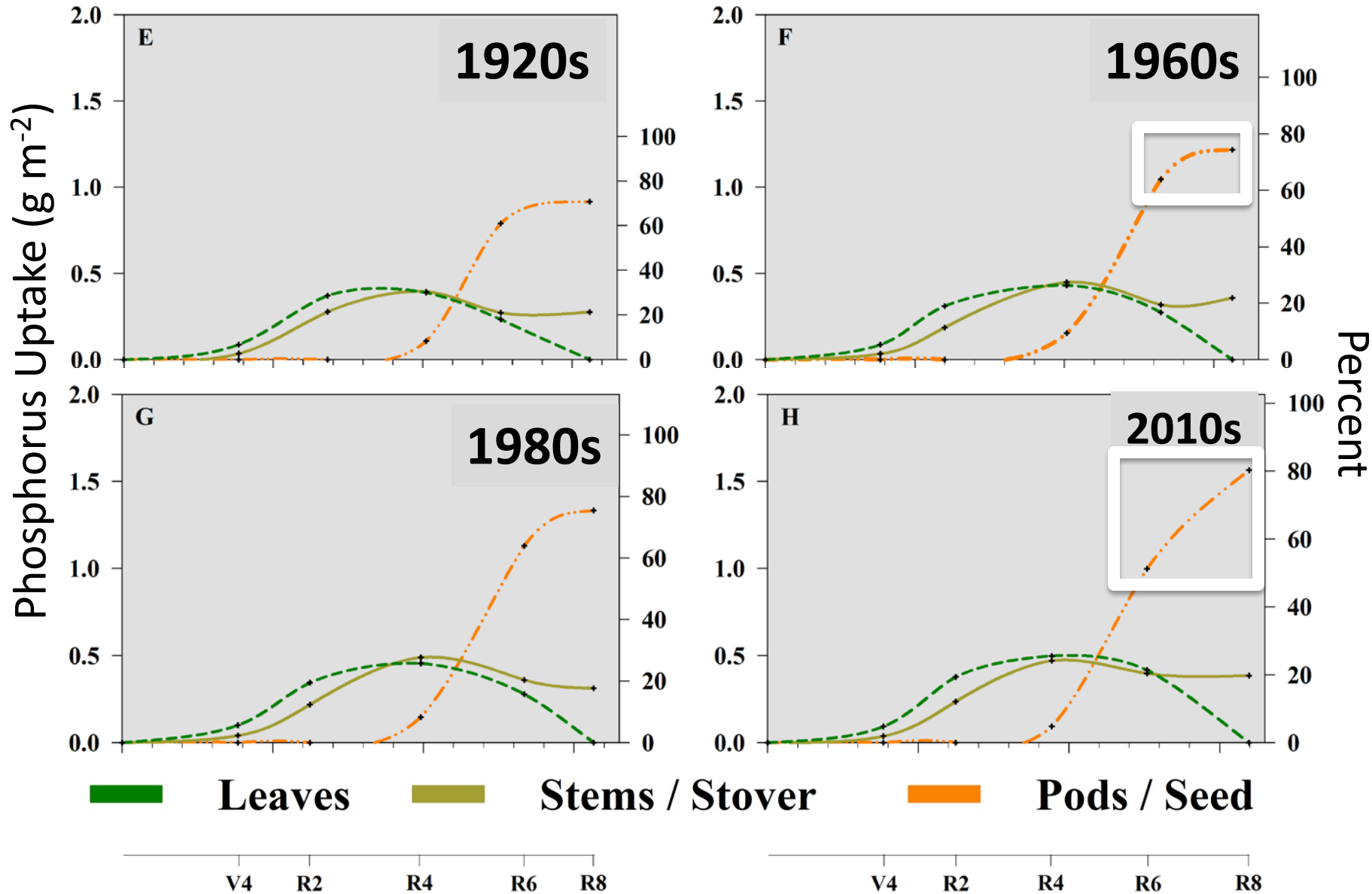




MG2 Phosphorus Uptake Rates



MG3 Phosphorus Uptake Rates



Cultivar Response x Fertility + Foliar

- **6 Cultivars x 6 Fertility + Foliar Combos**
→ 36 treatments per Maturity Group (MG)
- **Six MG2 Cultivars**
 - 2 from 1970s, 2 from 1990s, 2 from 2010s
- **Six MG3 Cultivars**
 - 2 from 1970s, 2 from 1990s, 2 from 2010s

Fertility + Foliar Treatments

Fertility (lb/acre)	N	P ₂ O ₅	S
Untreated (UTC)	-	-	-
MAP	17	80	-
MES10	24	80	20
TSP + AMS	17.5	80	20
UTC + Foliar	-	-	-
TSP+AMS+Foliar	17.5	80	20

- **Foliar** at R4 (Full Pod): Priaxor @ 4 oz / acre
Warrior II @ 2.6 oz/acre

Maturity Group 2 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968						
1972						
1988						
1994						
2013						
2014						

Maturity Group 2 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968	65.3	64.3	62.0	60.1	68.5	68.7
1972	56.4	53.0	55.3	52.4	50.7	58.5
1988	63.9	61.2	58.2	60.2	53.7	62.3
1994	65.9	64.4	64.2	70.3	64.0	75.4
2013	93.3	83.0	88.2	84.8	84.6	93.6
2014	78.6	75.4	74.0	77.8	70.6	80.8

Maturity Group 2 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968	65.3	64.3	62.0	60.1	68.5	68.7
1972	56.4	53.0	55.3	52.4	50.7	58.5
1988	63.9	61.2	58.2	60.2	53.7	62.3
1994	65.9	64.4	64.2	70.3	64.0	75.4
2013	93.3	83.0	88.2	84.8	84.6	93.6
2014	78.6	75.4	74.0	77.8	70.6	80.8

Release	Change from UTC	Change from TSP
1968	2%	0%
1972	6%	15%
1988	4%	16%
1994	2%	18%
2013	12%	11%
2014	4%	14%

Maturity Group 3 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968						
1971						
1989						
1992						
2013						
2014						

Maturity Group 3 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968	50.2	47.2	44.1	46.3	47.7	55.5
1971	50.7	50.3	52.2	51.7	49.8	57.7
1989	61.9	61.6	59.4	64.1	56.7	72.1
1992	57.9	60.0	58.6	59.0	60.1	60.1
2013	79.5	77.2	74.7	77.6	76.2	75.8
2014	84.0	80.9	81.2	77.9	80.5	87.3

Maturity Group 3 Effects: 2016

Release	UTC+Foliar	UTC	MAP	MES10	TSP + AMS	TSP+Foliar
1968	50.2	47.2	44.1	46.3	47.7	55.5
1971	50.7	50.3	52.2	51.7	49.8	57.7
1989	61.9	61.6	59.4	64.1	56.7	72.1
1992	57.9	60.0	58.6	59.0	60.1	60.1
2013	79.5	77.2	74.7	77.6	76.2	75.8
2014	84.0	80.9	81.2	77.9	80.5	87.3

Release	Change from UTC	Change from TSP
1968	6%	16%
1971	1%	16%
1989	1%	27%
1992	-4%	0%
2013	3%	0%
2014	4%	8%

2016 Fertility + Foliar Synergies?

MG 2	Change from UTC
1968	2%
1972	6%
1988	4%
1994	2%
2013	12%
2014	4%

Change from TSP
0%
15%
16%
18%
11%
14%

MG 3	Change from UTC
1968	6%
1971	1%
1989	1%
1992	-4%
2013	3%
2014	4%

Change from TSP
16%
16%
27%
0%
0%
8%

Variety

Selection

Intentional Soybean Management

Manage
Weeds Early

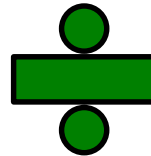
CASTEEL
FOR
SHERIFF

PAID FOR BY CASTEEL FOR SHERIFF COMMITTEE

Economic Efficiencies

- Yield per 10,000 plants per acre
- What does it take to get 10,000 plants
- Breakpoint? It is not a linear increase.
- Market price per bushel
- Seed costs
- Economic Optimal Plant Population (or seeding rate)

Harvest Index



Harvest Index Relations

- Yield range
- Planting Date
- Fertility supply
- Foliar Protection
- Water Supply

2017 Purdue Avg Budget: 52 bu/ac

Seed Rate	Plant Pop.	\$40/ unit	\$50/ unit	\$60/ unit	\$70/ unit
1000s/ac		-----\$/bu -----			
100	90	0.56	0.65	0.79	0.94
125	113	0.67	0.83	1.00	1.17
150	135	0.81	1.00	1.21	1.40
175	158	0.94	1.17	1.40	1.63
200	180	1.08	1.33	1.60	1.87
225	203	1.21	1.50	1.81	2.10
Reduce 50K, Save ~		\$0.27	\$0.35	\$0.40	\$0.46

Assume 2800 seeds/lb and 90% germination

Seed Savings per Bushel: \$60/unit x Yield Level

Seed Reduction	42 bu	52 bu	62 bu	72 bu
	-----\$/bu-----			
10,000	0.10	0.08	0.06	0.06
20,000	0.19	0.15	0.13	0.11
30,000	0.29	0.23	0.19	0.17
40,000	0.38	0.31	0.26	0.22
50,000	0.48	0.38	0.32	0.28

Assume 2800 seeds/lb and 90% germination