Project Update:

Planting date x soybean maturity group regional project – US Midsouth (2012 – 2015)

Larry C. Purcell & Montserrat Salmeron

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

MID-SOUTH Soybean Board

USB
UNITED SOYBEAN BOARD
Making Your Checkoff Pay Off.

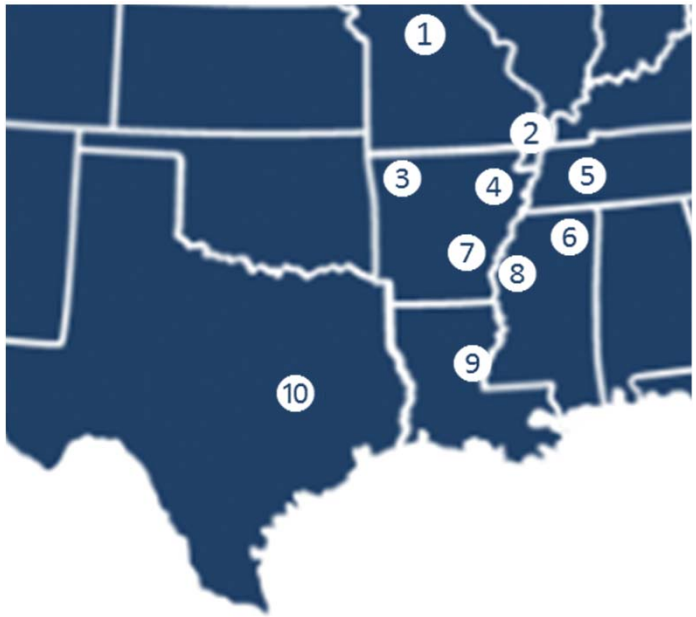
Outline

- Brief project description
- Results 2012 – 2014
  - 1 - Yield response to planting date
  - 2 - Radiation interception study
  - 3 - Yield components
- Decision-support tool
- Economic analysis
- Closing summary

Project description

- 3-year study (2012-14)
- 10 locations
- Irrigated
- **4 planting dates (PD)**
- **MG 3 to 6 soybeans** (16 cultivars)

  (> 6000 plots)



1. **Columbia, MO**
2. **Portageville, MO**
3. **Fayetteville, AR**
4. **Keiser, AR**
5. **Milan, TN**
6. **Verona, MS**
7. **Rohwer, AR**
8. **Stoneville, MS**
9. **St. Joseph, LA**
10. **College Station, TX**

Participants: 1 Felix Fritschi, Bill Wiebold; 2 Earl Vories, Grover Shannon; 3 Larry Purcell, Montse Salmeron, Ed Gbur; 4 Fred Bourland; 5 David Verbree; 6 Normie Buhering; 7 Larry Earnest; 8 Bobby Golden; 9 Josh Lofton; 10 Travis Miller, Clark Nelly, Daniel Hathcoat

1 - Analysis of the yield response to planting date

- ✓ Identify **best MG choice** at any planting date and location.
- ✓ Identify the **optimum planting window** for each MG.

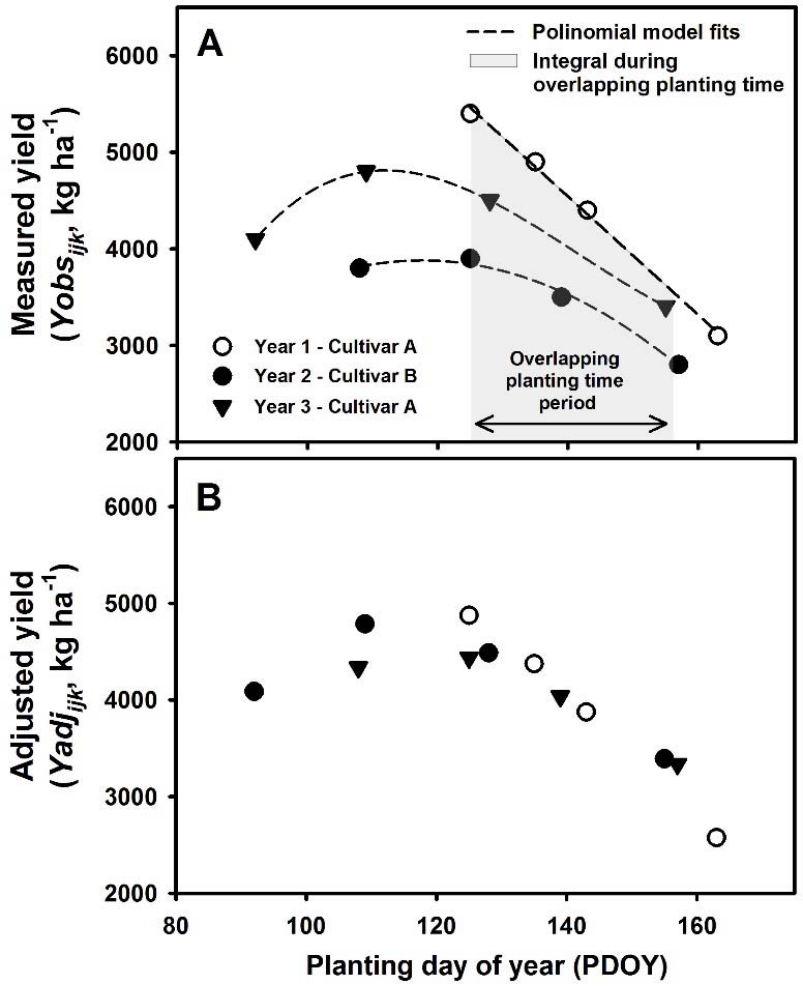
Results 2012 - 2014

- ✓ Data from 2012 – 2014: 3-yr, 8 locations, 4 PD x MG 3 to 6

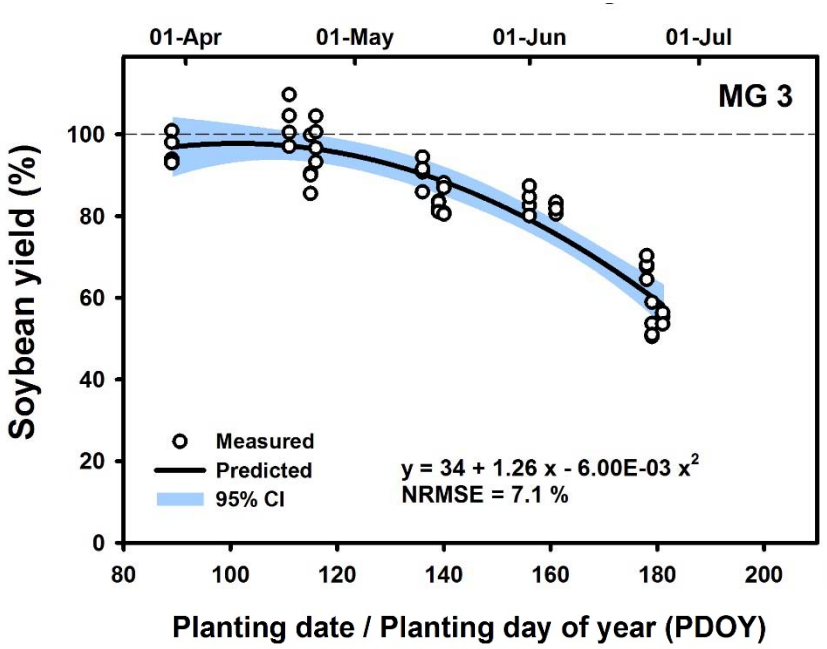
Location	Latitude (°N)	2012	2013	2014
Columbia, MO	38.9	-	4/22 – 6/25	4/23 – 6/27
Portageville, MO	36.4	4/2 – 6/12	4/9 – 6/20	4/22 – 6/17
Milan, TN	35.9	-	4/22 – 6/25	4/24 – 7/3
Keiser, AR	35.7	3/30 – 6/8	6/13 – 7/17	4/23 – 6/5
Verona, MS	34.2	3/21 – 6/7	4/23 – 6/17	4/23 – 6/17
Rohwer, AR	33.8	3/29 – 6/26	4/26 – 6/28	4/21 – 6/30
St. Joseph, LA	32.0	4/6 – 6/1	4/29 – 6/12	4/24 – 6/19
College St, TX	30.6	3/26 – 5/25	4/9 – 5/30	4/9 – 6/2

Results 2012 - 2014

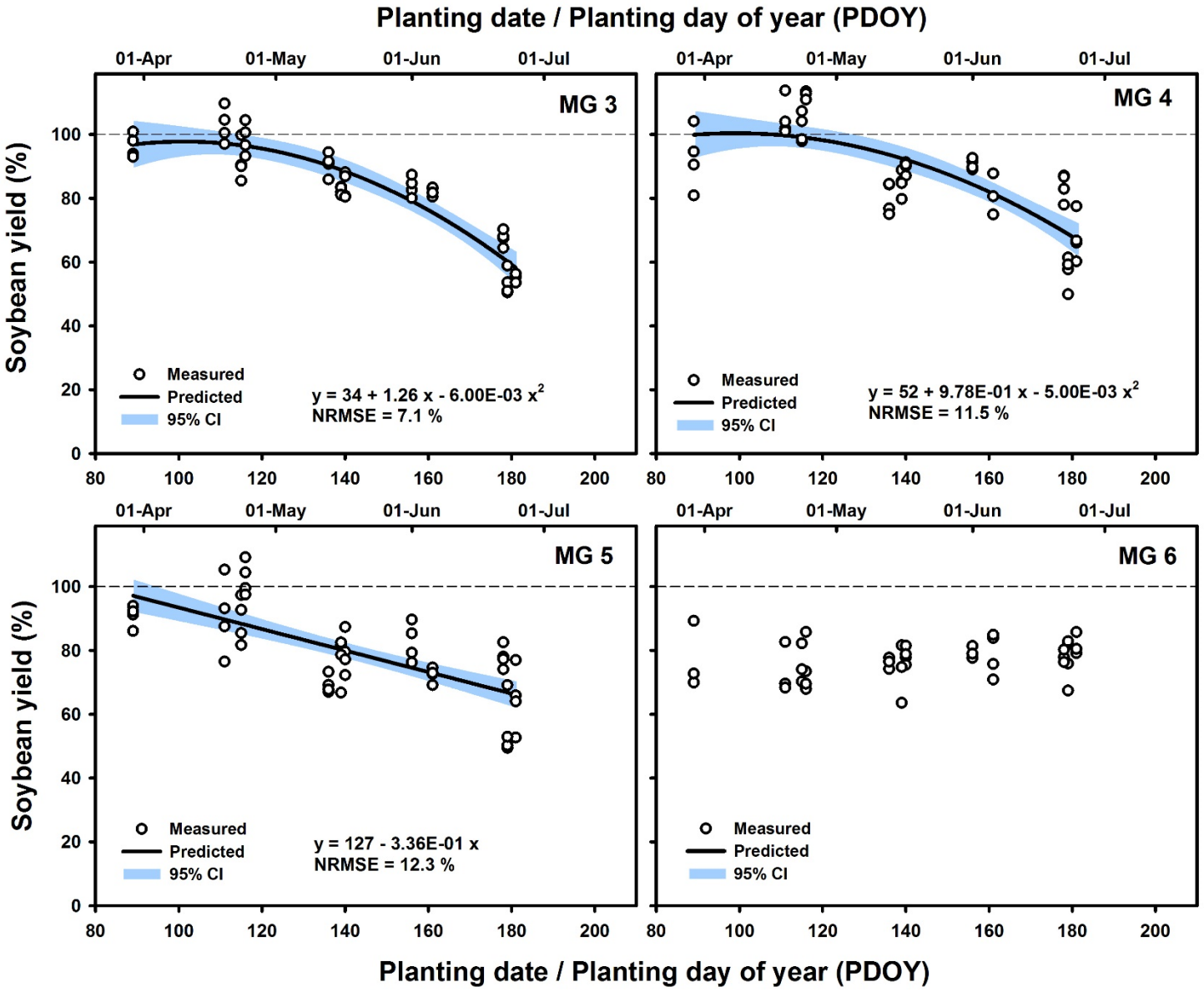
1 - Yield correction for the year and cultivar effect



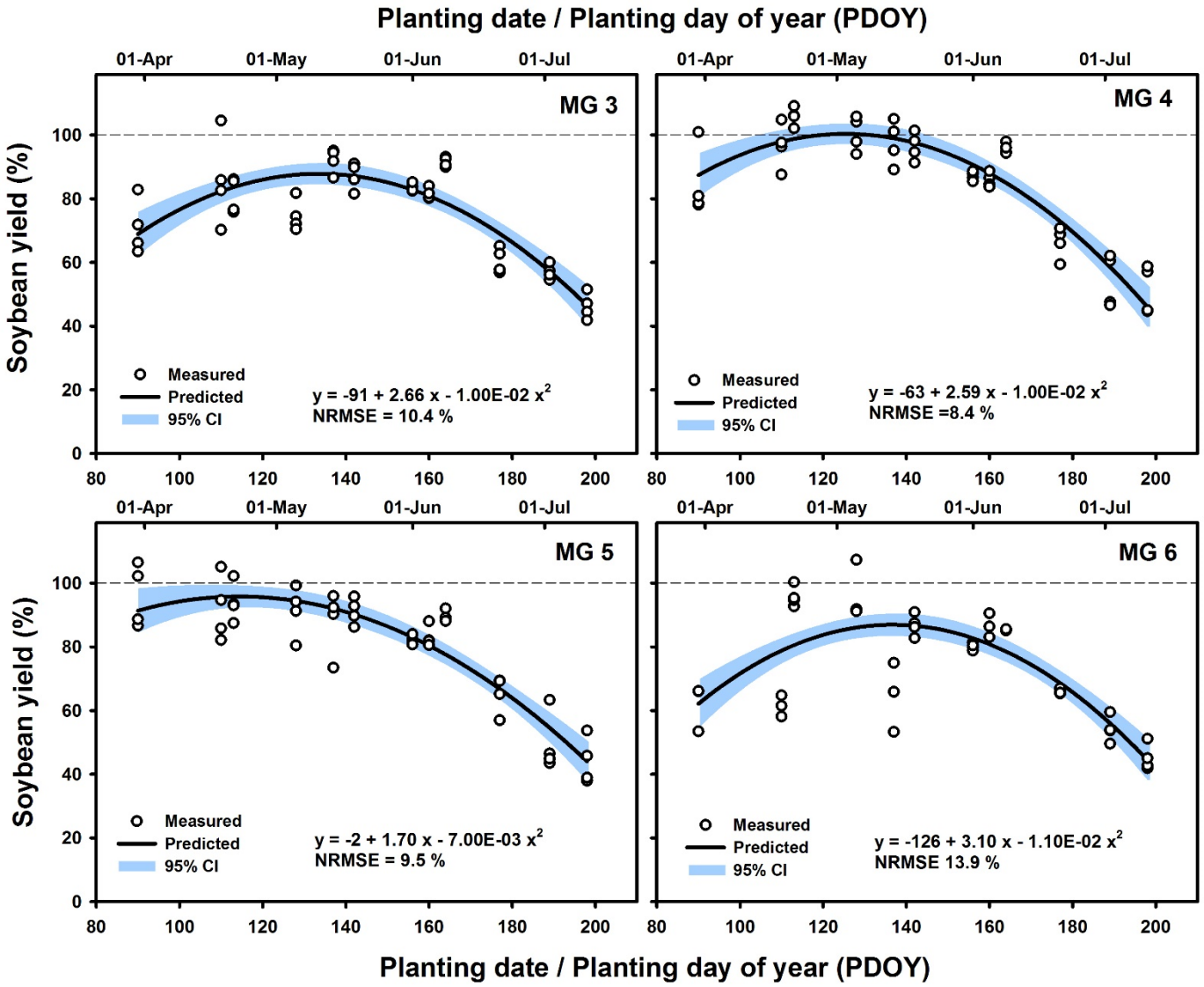
2 - Fit quadratic or linear model for each location and MG combination.



Model fit by MG – Rohwer, AR



Model fit by MG – Keiser, AR



Results 2012 - 2014

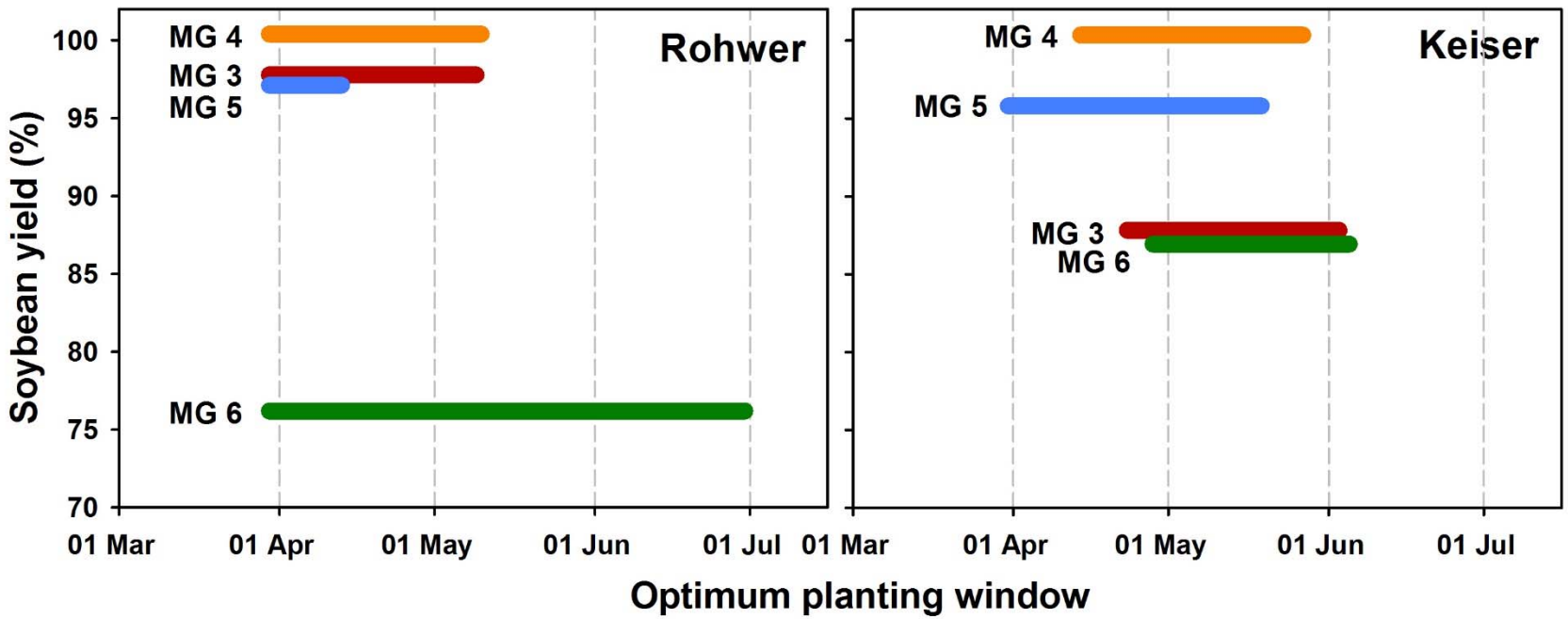
✓ Identify **best MG choice** at any planting date and location.

MG	Max yield (%)	Estimated yield for different PD† (%)					
		Apr 1	Apr 15	May 1	May 15	Jun 1	Jun 15
Rohwer, AR							
3	98	97	98	95	91	82	72
4	100	100	100	98	94	87	78
5	97	96	92	86	82	76	71
6	-	74	75	76	77	77	78
Keiser, AR							
3	88	70	80	86	88	84	77
4	100	88	96	100	99	93	83
5	96	92	95	95	93	85	76
6	87	63	76	84	87	84	77

†Similar yields within a location and planting date are indicated by the orange shaded area.

Results 2012 - 2014

✓ Identify the **optimum planting window**† for each MG.



† Planting dates that allow obtaining 90 % of maximum yield within a MG type.

Results 2012 - 2014

Outputs from the planting date analysis:

1. Research manuscript submitted to Crop Science journal

Yield response to planting date among soybean maturity groups for irrigated production in the US Midsouth

Montserrat Salmeron, Edward E. Gbur, Fred M. Bourland, Normie W. Buehring, Larry Earnest, Felix B. Fritschi, Bobby R. Golden, Daniel Hathcoat, Josh Lofton, Angela McClure Travis D. Miller, Clark Neely, Grover Shannon, Theophilus K. Udeigwe, David A. Verbree, Earl D. Vories, William J. Wiebold, and Larry C. Purcell*

2. **Recommendation guides** for producers and extension specialists:
   - Publication ready for Arkansas
   - Results by location ready for collaborators

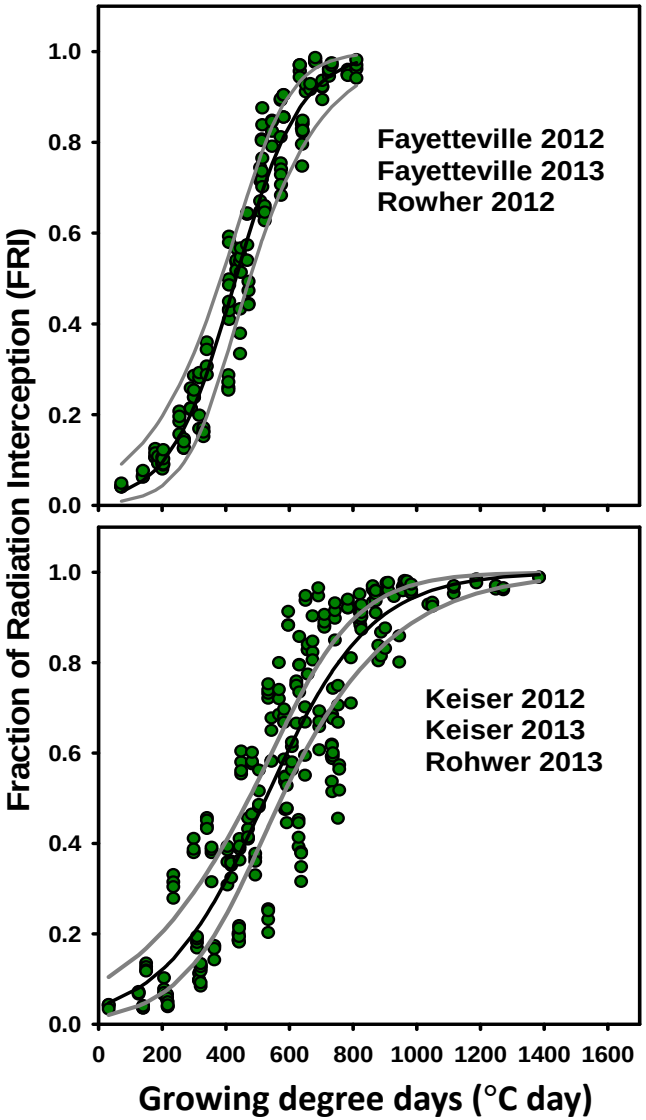
2 - Radiation interception study

- ✓ Can differences in radiation interception explain yield variation?
- ✓ Identify **management options that maximize radiation interception**

Estimation of light interception from digital images of the crop canopy (Purcell, 2000)

Results 2012 - 2014

- 3 locations in AR, 2 years, 4 planting dates, MG 3 to 6

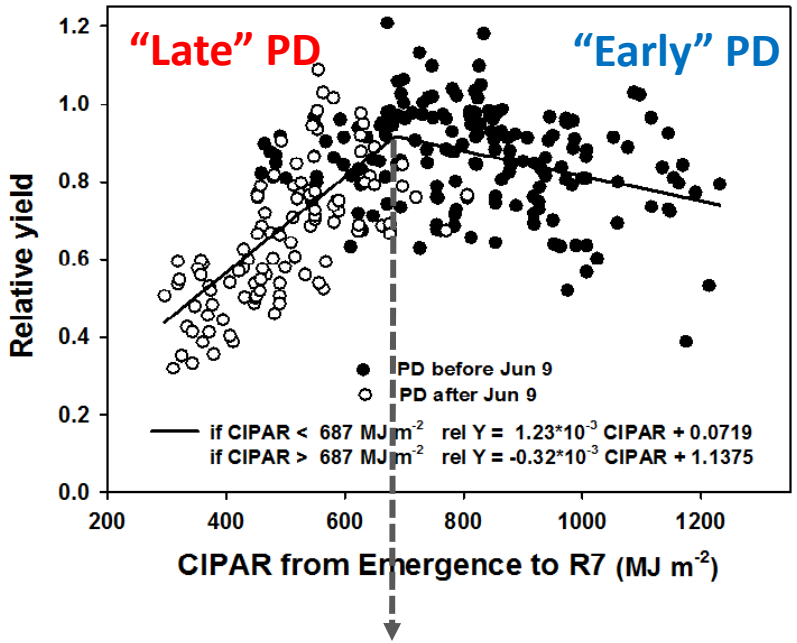


Narrow row
(18 inch)

95% full canopy
at 657 °C days

Twin row
(7.5 inch on 38 inch beds)

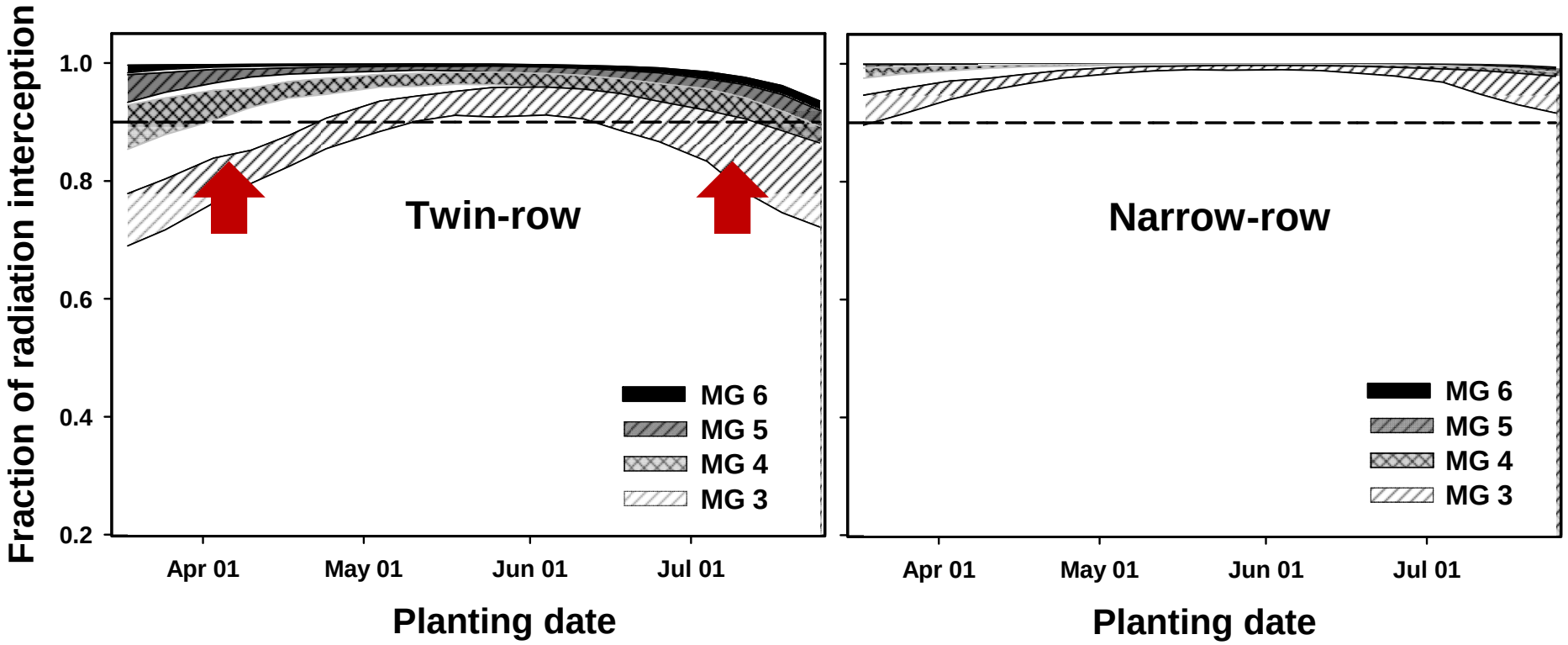
95% full canopy at
890 °C days



650 MJ m^{-2}
for 95 % of max. yield

Results 2012 - 2014

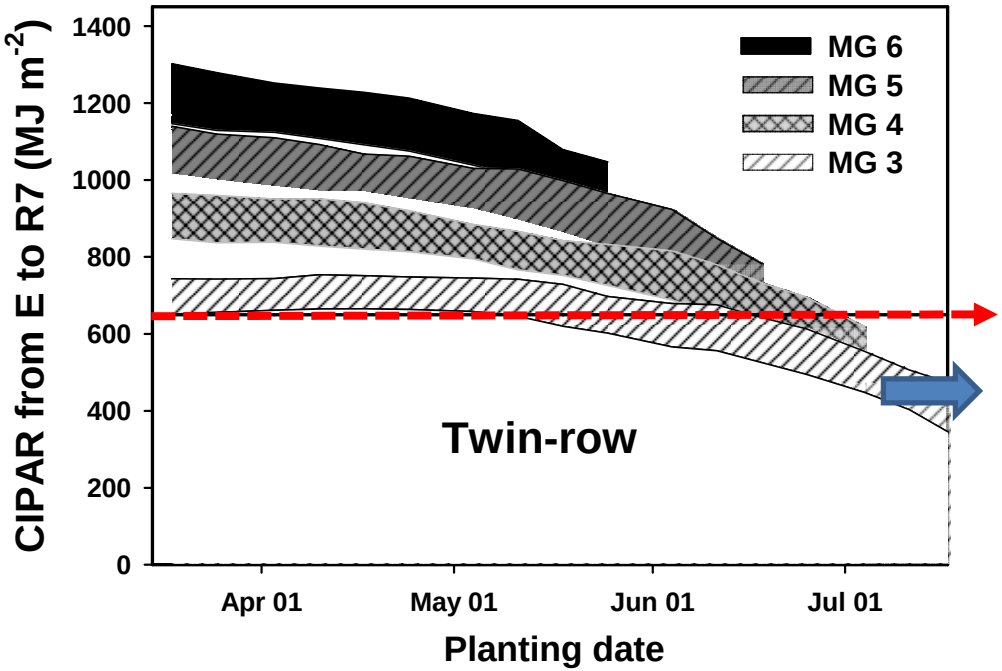
Fraction of radiation interception (FRI) at R5 (Rohwer, AR)



- Identifying scenarios of low FRI by R5 can be critical to avoid yield losses

Results 2012 - 2014

Cumulative Intercepted photosynthetically active radiation (CIPAR) during the growing season (Fayetteville, AR)



CIPAR for 95% of max yield

Radiation is limiting

✓ Manuscript published in Agronomy Journal:

Soybean maturity group choices for maximizing radiation interception across planting dates in the US Midsouth

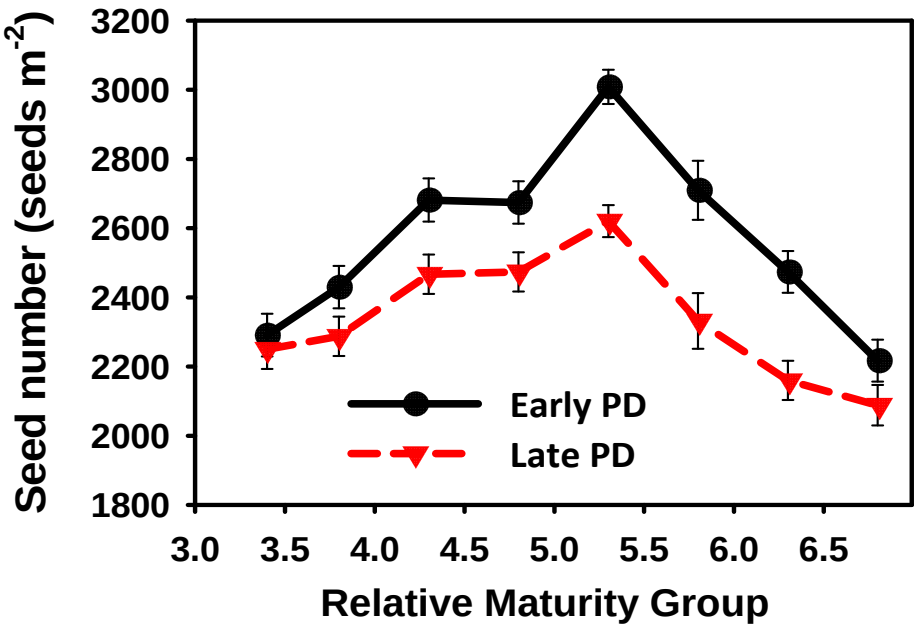
Montserrat Salmeron, Edward E. Gbur, Larry Earnest, Bobby R. Golden, and Larry C. Purcell*

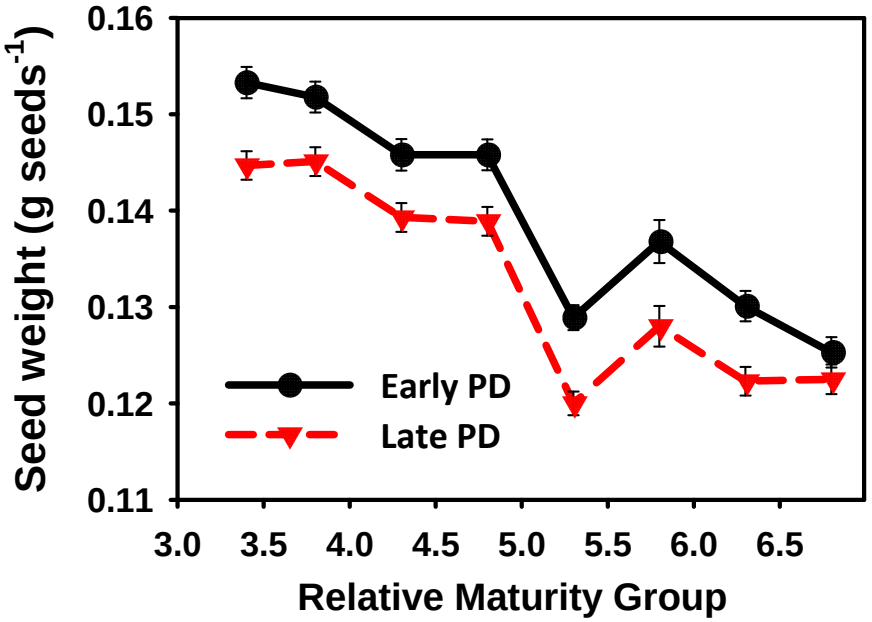
3 - Analysis of yield components across MG, PD and environments.

- ✓ Stability analysis of phenology and environmental variables.
- ✓ Effect of genotype and environmental variables on yield component determination.

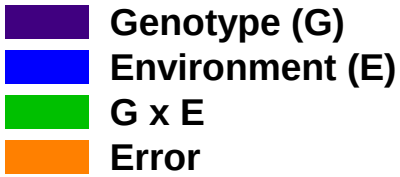
Results 2012 - 2014

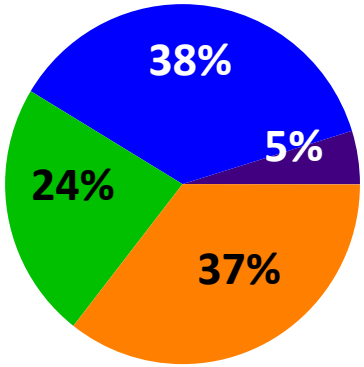
YIELD = SEED NUMBER x SEED WEIGHT
($g\ m^{-2}$) ($seeds\ m^{-2}$) ($g\ seed^{-1}$)

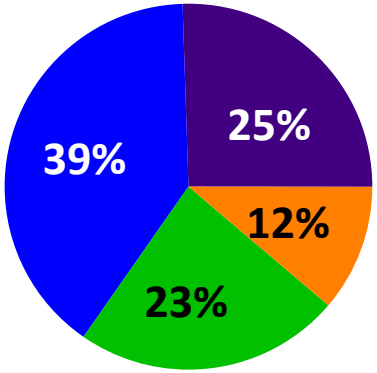




Source of yield variability



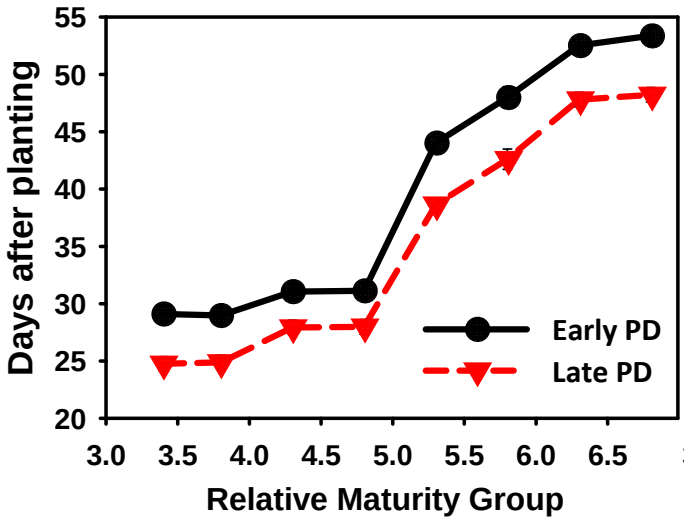




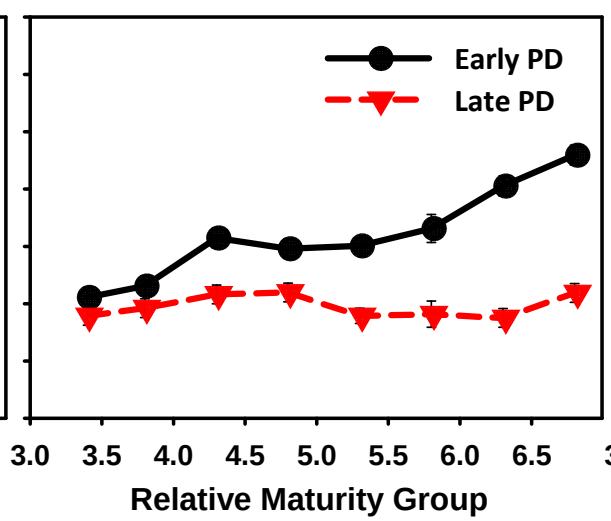
Results 2012 - 2014

✓ **Length of soybean developmental stages:**

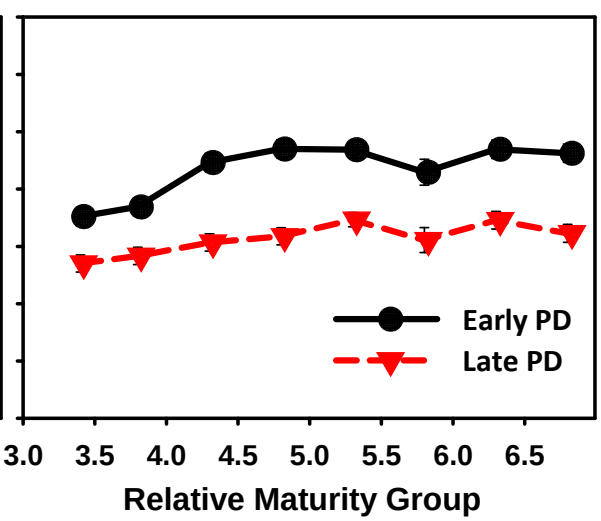
Vegetative phase (E to R1)



Flowering phase (R1 to R5)

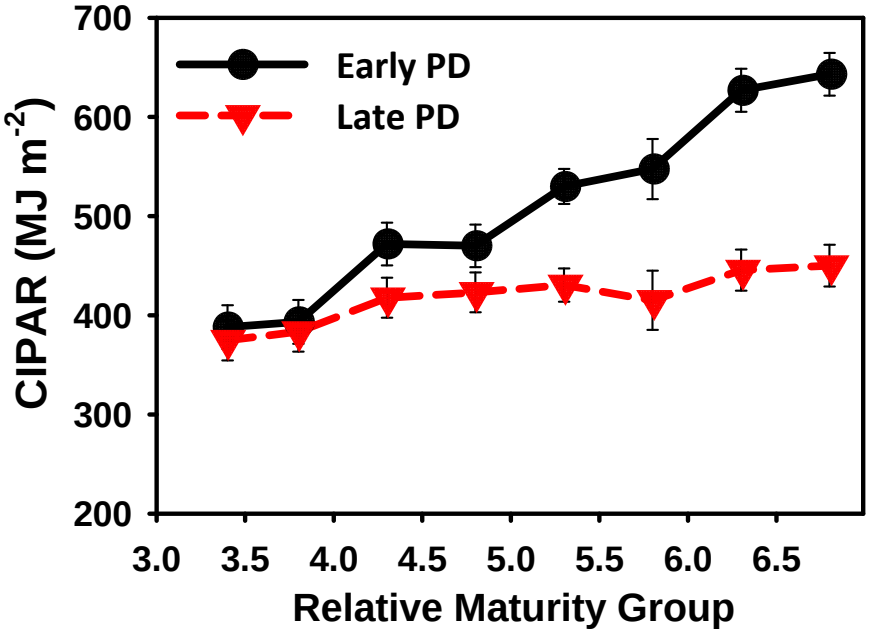


Seed-fill phase (R5 to R7)

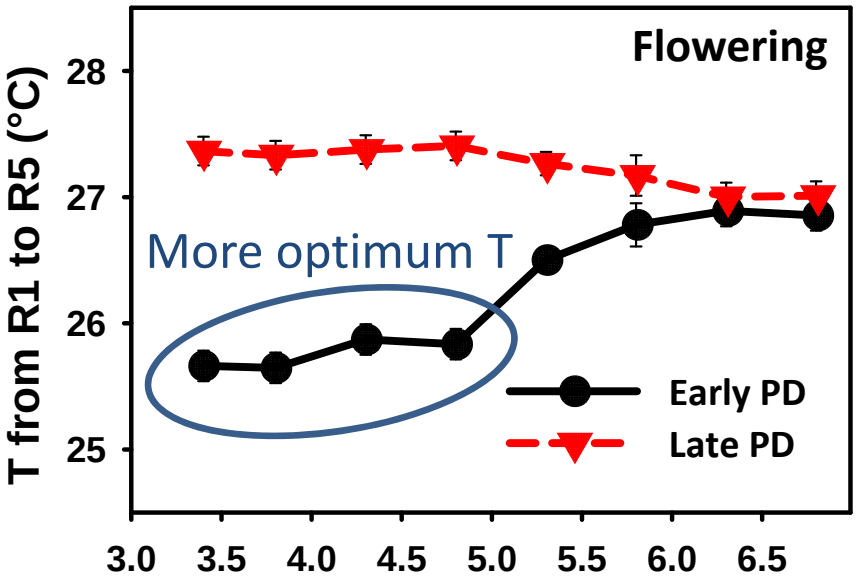


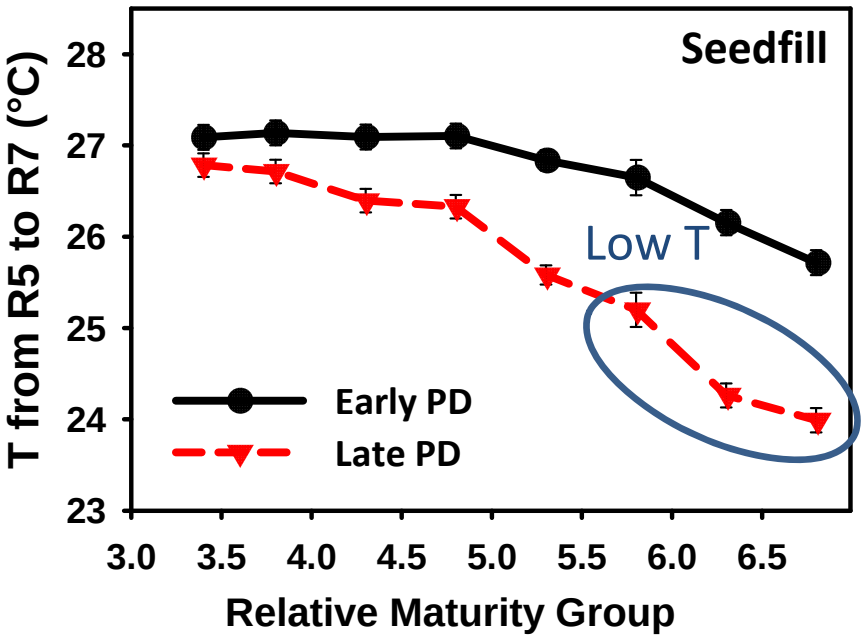
➢ **Longer growing season in MG 5 and 6 due to extended vegetative phase**

✓ **Cumulative intercepted PAR (CIPAR) during flowering**



✓ **Temperature**





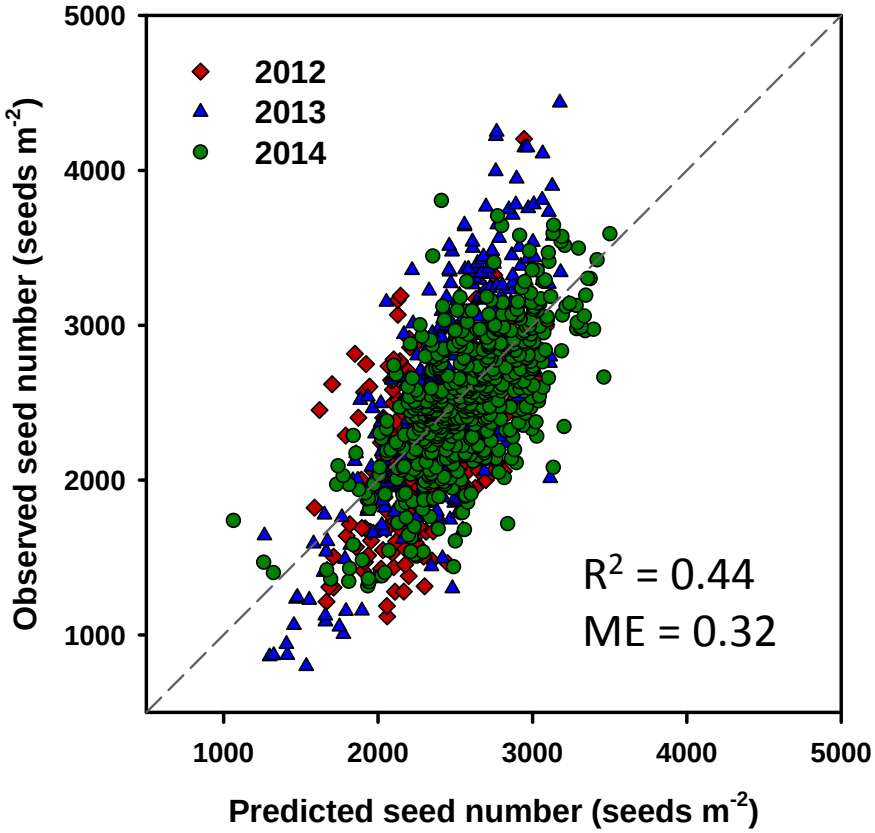
Results 2012 - 2014

✓ **Prediction of yield components** as a function of **genotype** and **environmental variables** averaged across key developmental stages

SEED NUMBER

Factors in the model
• Maturity group (MG) • Variety
• Seed weight
• Length flowering • Temperature flowering • Average solar radiation • Photoperiod

Model explains 38.5% of total sum of squares.



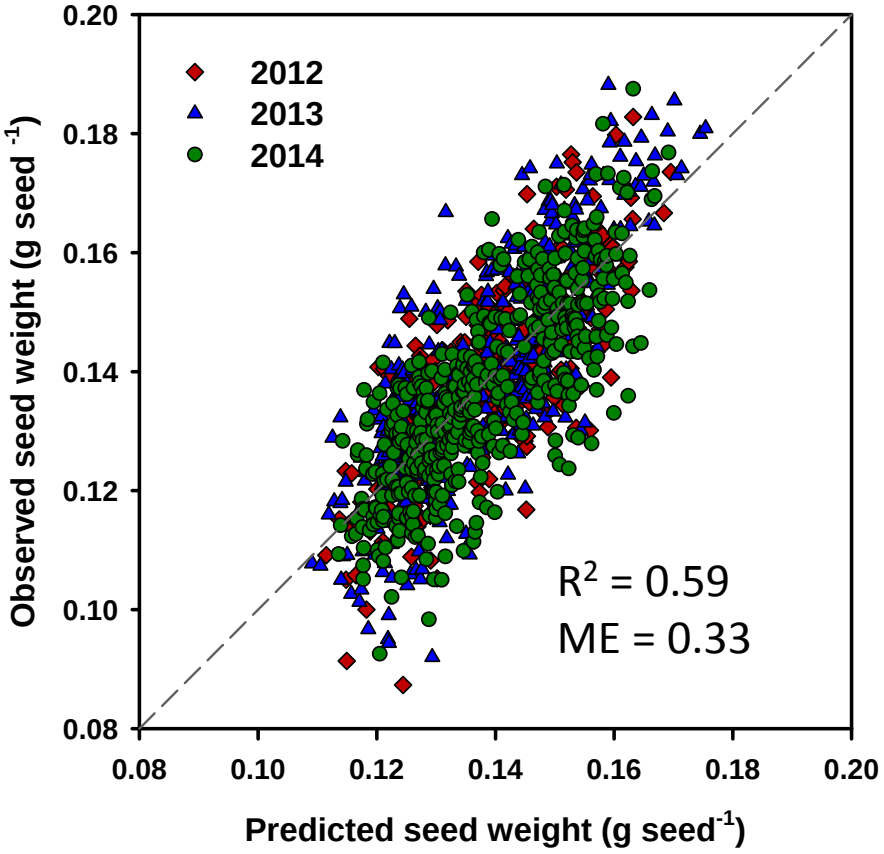
Results 2012 - 2014

✓ **Prediction of yield components** as a function of **genotype** and **environmental variables** averaged across key developmental stages

SEED WEIGHT

Factors in the model
• Maturity group (MG) • Variety
• Seed number
• Length seedfill • Temperature flowering • Temperature seedfill • Cumulative solar radiation

Model explains 35.4 % of total sum sq.

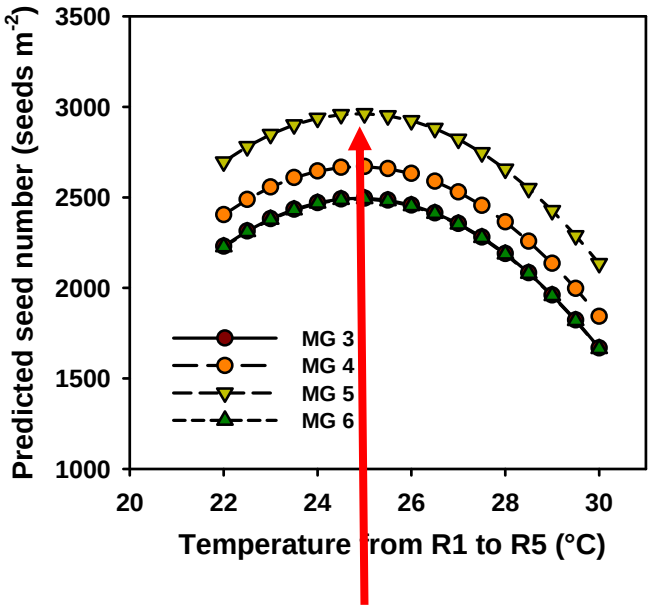


➢ **Identify main env. variables affecting yield components in our experiments**

Results 2012 - 2014

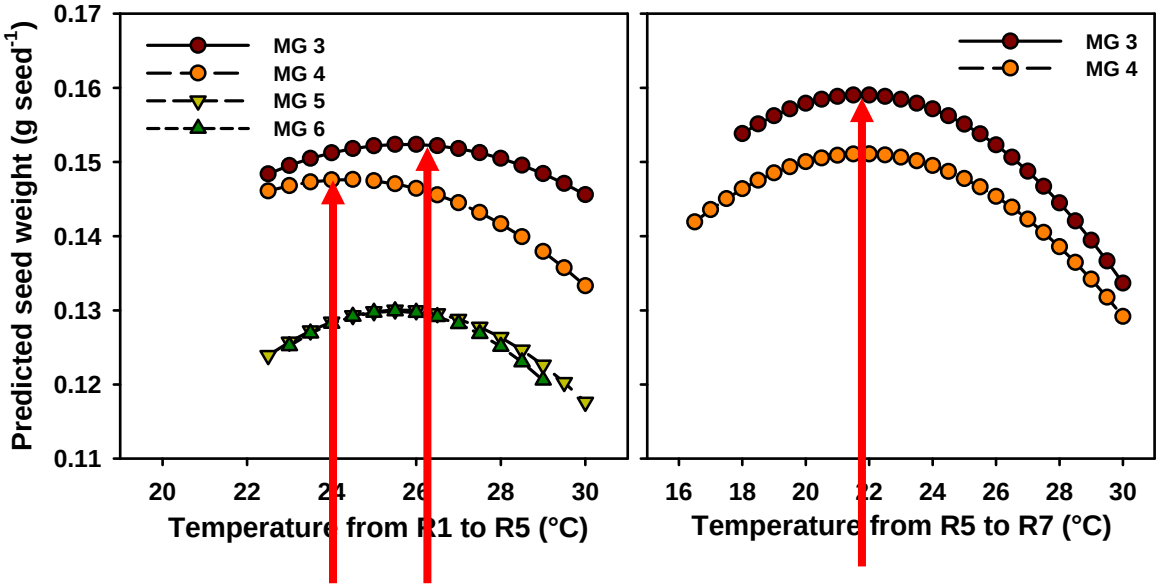
✓ Effect of temperature on yield component prediction.

SEED NUMBER



77°F

SEED WEIGHT



75.5 to 79°F

70.7°F in MG 3 and 4

➢ **Temperatures that maximize yield components in our experiments**

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- **Decision-support tool**
- Economic analysis
- Closing summary

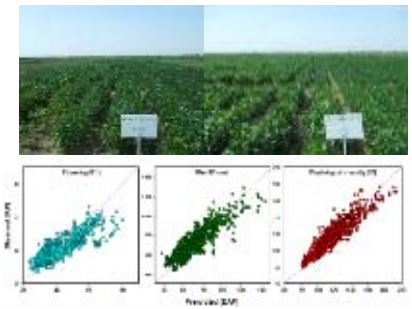
MIDSOUTH SOYBEAN GENOTYPE SELECTION DECISION TOOL

MSSB – USB Project 2015

Larry C. Purcell (PI); Michael Popp; M. Salmeron

GOALS:

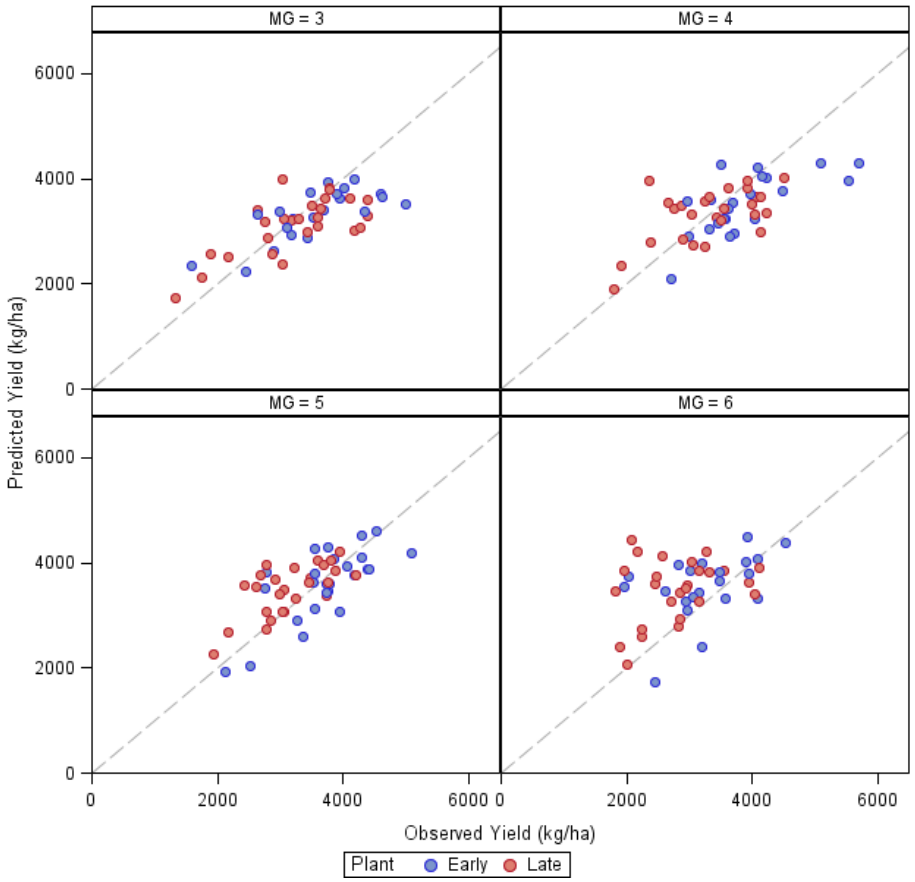
- Determine best MG choices in terms of agronomic and economic performance
- Make information easily available to growers



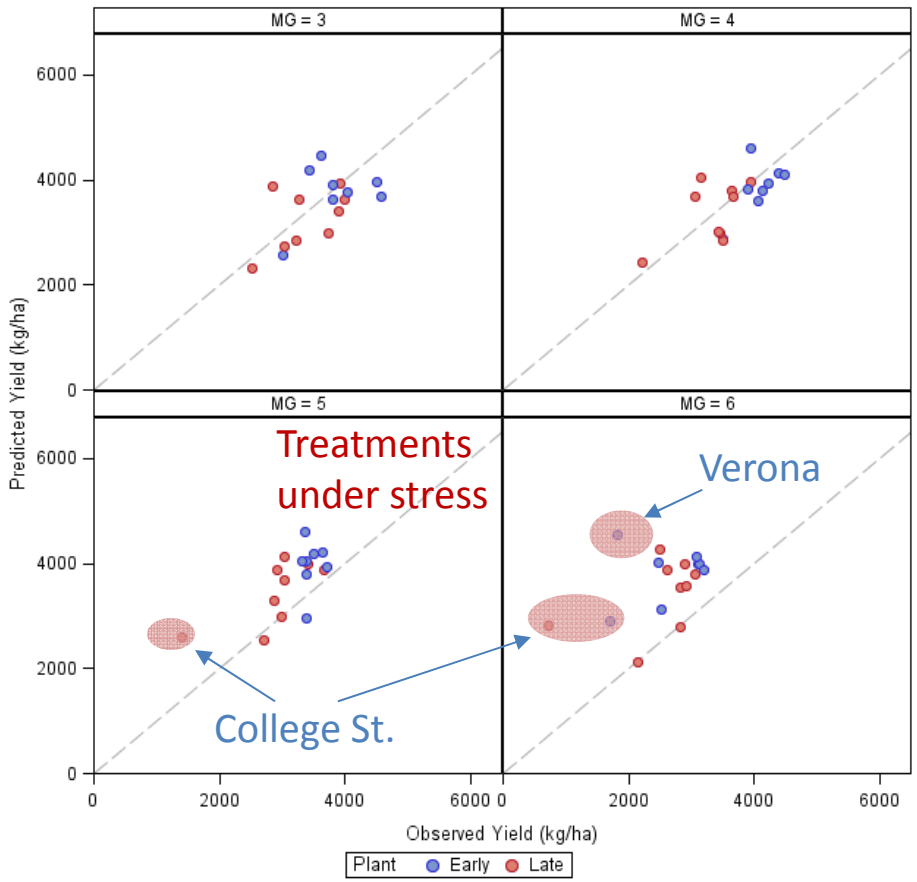
- DSSAT-CROPGRO simulations for a total of 2688 scenarios in a 10° range of latitude and for 30-yr of weather data
  - MG 3, 4, 5, and 6
  - PD from late March to late June
  - Latitudes from 29 to 39°N

Decision support tool

1 - Model calibration, data 2012 – 2013



2 - Model evaluation with data from 2014



- **The model will simulate potential yields based on management inputs.**

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Economic analysis

MG x PD interactions for risk-return tradeoffs in the Midsouth US.

Wes Weeks, Michael P. Popp, Montserrat Salmeron, Larry C. Purcell et col.

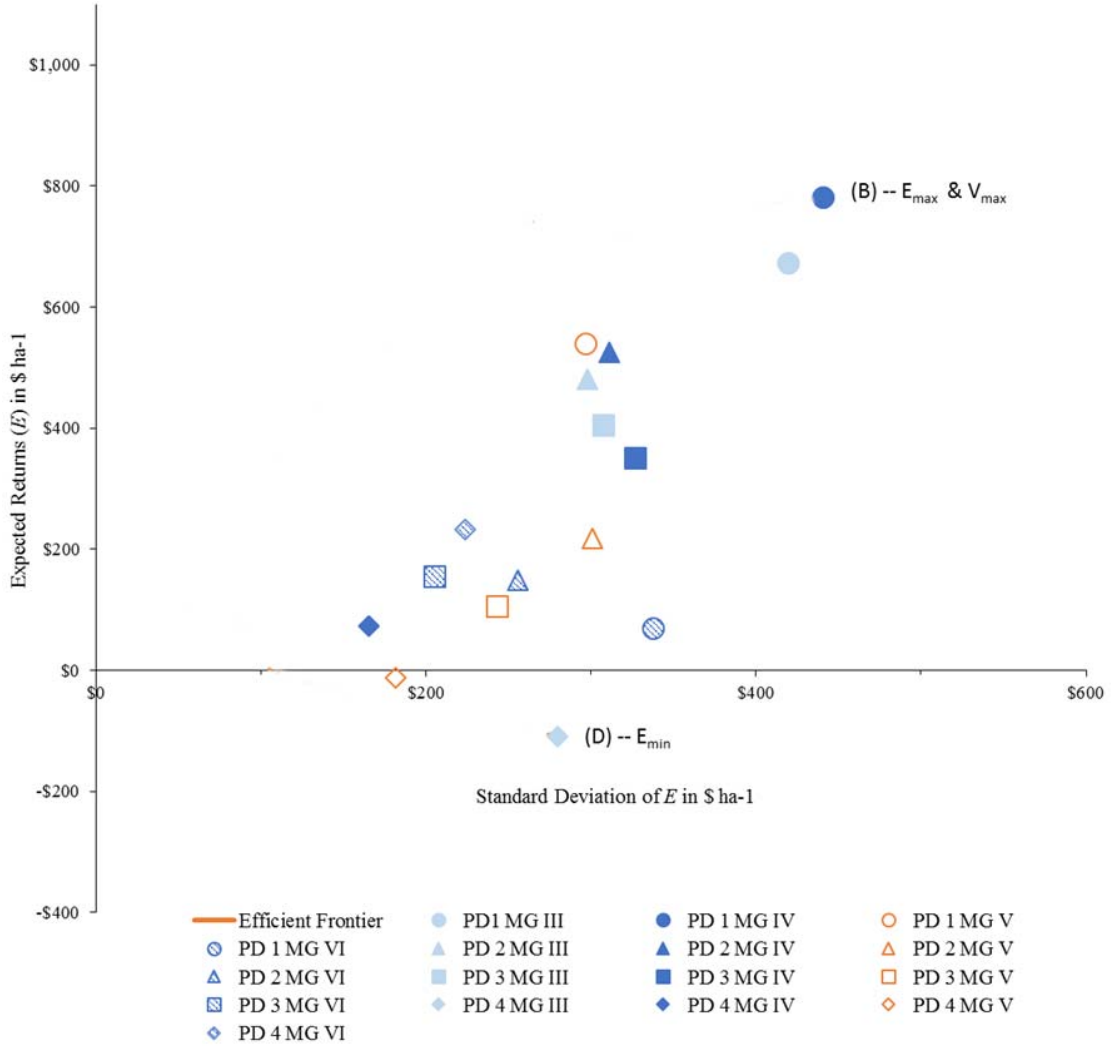
Goal:

- ✓ Identify a several PD x MG combinations that reduce production risks, as opposed to planting only the profit-maximizing PD x MG selection.

Revenue expectations taken into account:	**Expenses:**
▪ Harvested yield ▪ Seasonal changes in seed price ▪ Oil and meal premium or discounts	▪ Differential irrigation needs by PD x MG ▪ Constant: seed, fuel, fertilizer, equipment and chemical costs

Economic analysis

✓ Expected returns vs. return risk at **Rohwer, AR**.



Economic analysis

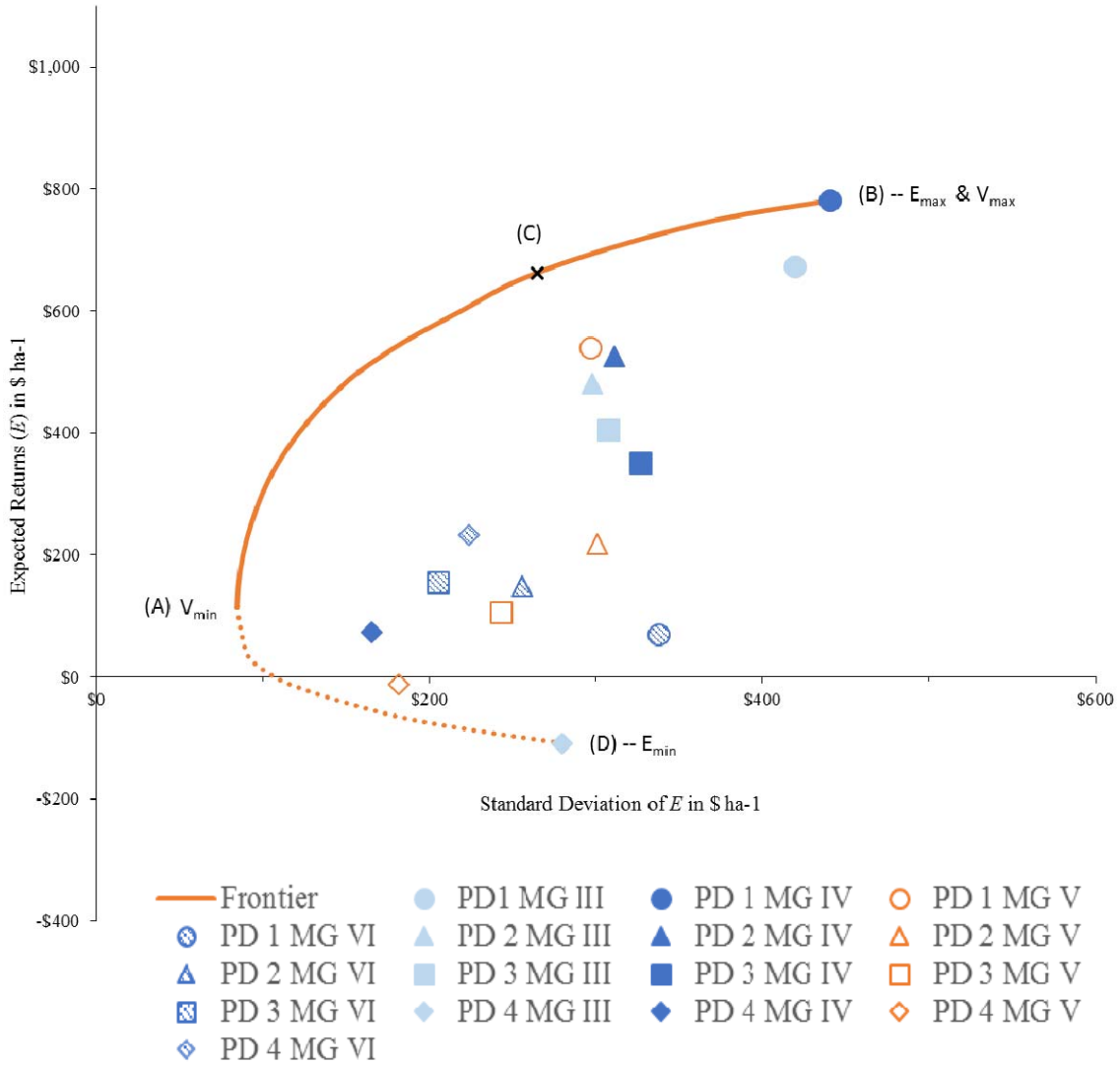
✓ **Location-Specific average profit, risk, MG × PD combination with maximum profit, and with minimum risk**

Location	Average		MG × PD with max. Profit				MG × PD with min. Risk			
	Profit ($)	Risk‡ ($)	MG	PD	Max. Profit ($)	Risk‡ ($)	MG	PD	Profit ($)	Min. Risk‡ ($)
Columbia, MO	232	402	III	2	710	129	III	2	710	129
Portageville, MO	89	342	IV	1	504	246	V	4	-60	177
Milan, TN	247	279	IV	1	606	237	IV	4	169	77
Keiser, AR	149	329	IV	1	447	259	V	1	341	166
Verona, MS	199	266	IV	1	453	241	VI	1	-271	73
Stoneville, MS	488	434	V	1	697	520	III	3	618	198
Rohwer, AR	290	287	IV	1	781	441	IV	4	74	166
St. Joseph, LA	519	407	IV	2	878	268	VI	4	2	166
College St, TX	-134	444	III	2	328	328	VI	4	853	98

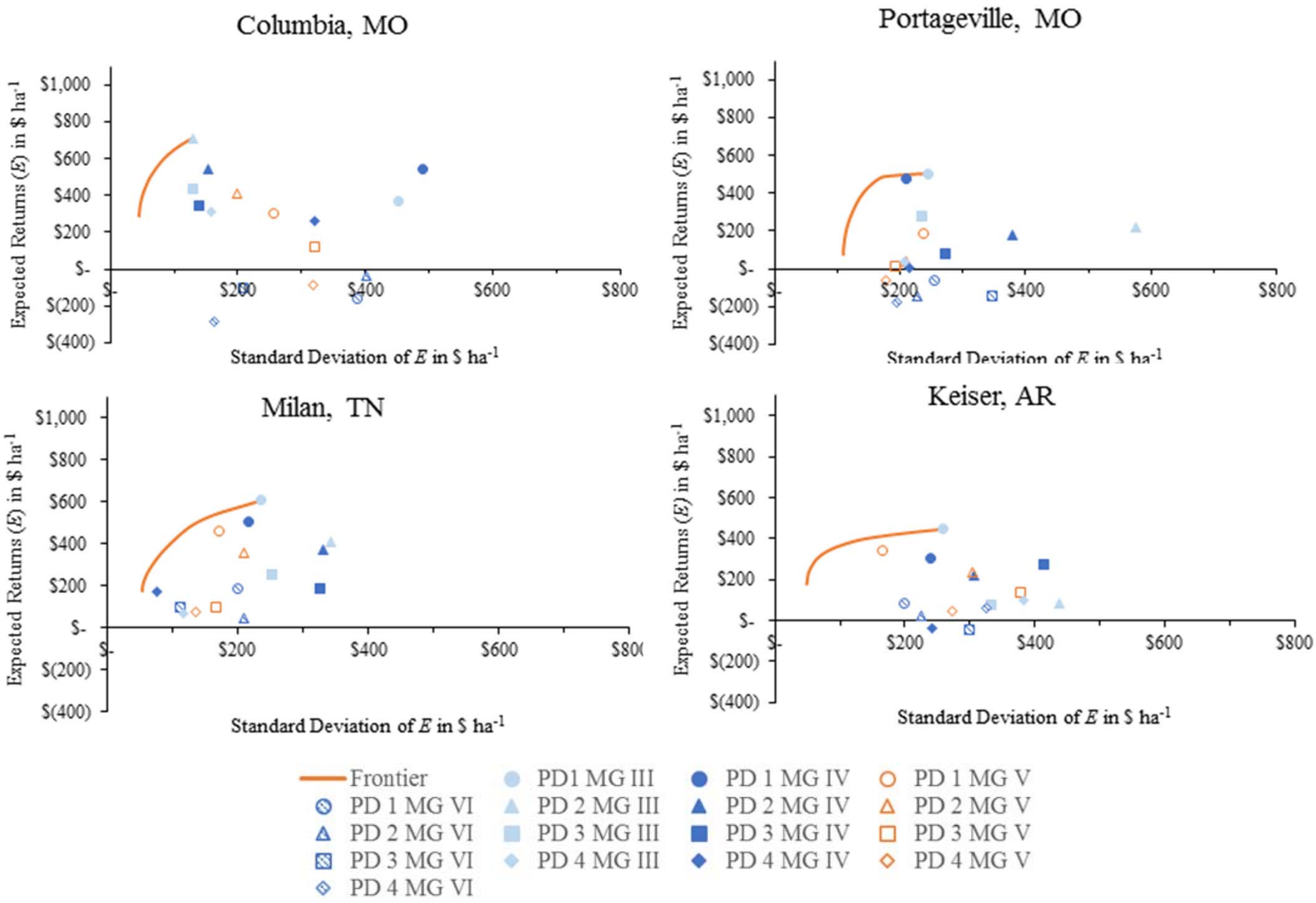
‡Standard deviation, $\sqrt{V_a}$

Economic analysis

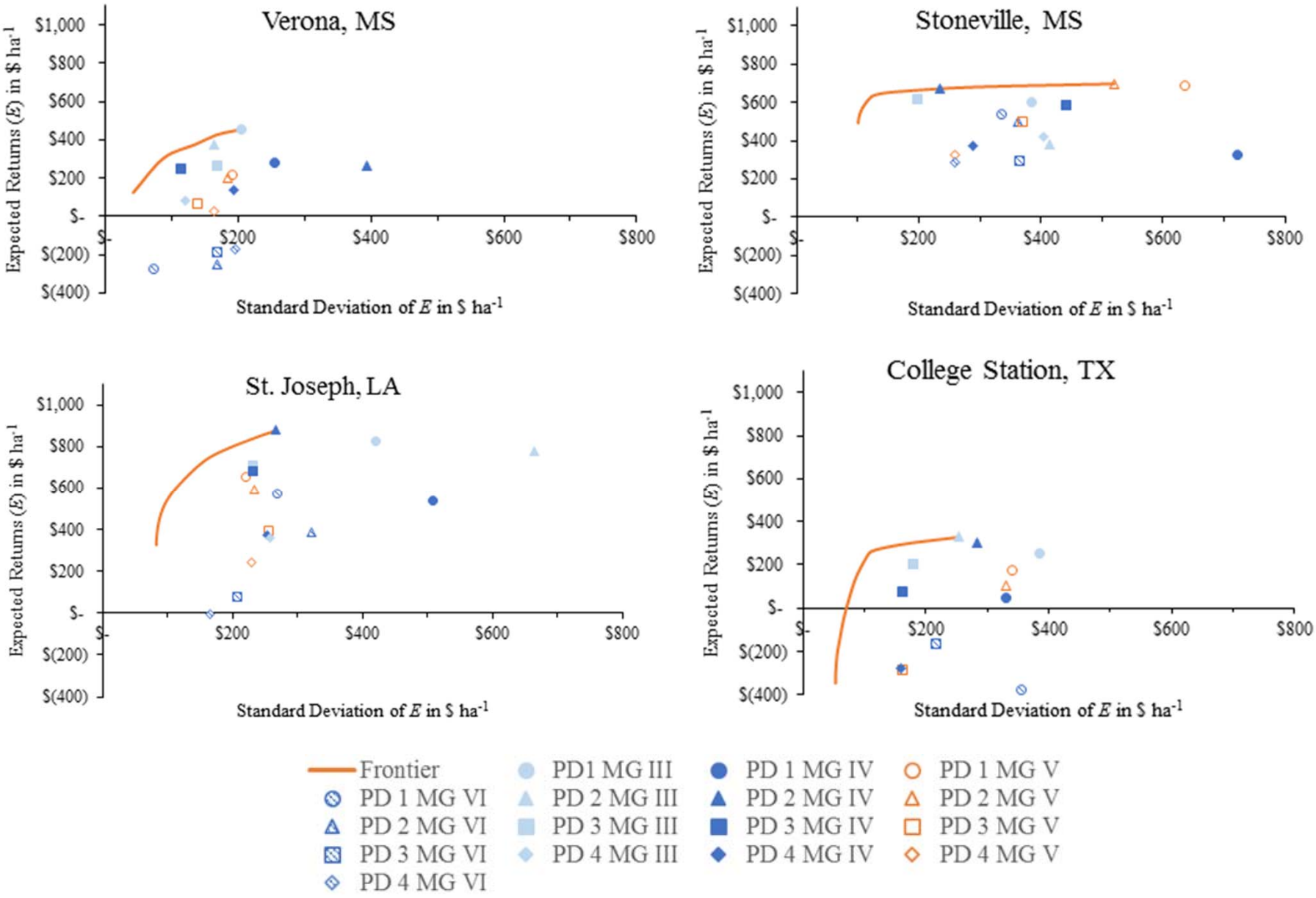
✓ Expected returns vs. return risk and E-V frontier at **Rohwer, AR**.



✓ Expected returns vs. return risk and E-V frontier by location.



✓ Expected returns vs. return risk and E-V frontier by location.



Economic analysis

✓ MG x PD combinations that reduce risk to the mid point (Vmid).

MG	III	IV	V	VI	III	IV	V	VI	III	IV	Profit ($)	% Change in Profit	Risk ($)	% Change in Risk
PD	1	1	1	1	2	2	2	2	3	3				
Location	% of land allocated to a MG × PD choice													
Columbia, MO	3	2	0	0	68	16	0	0	11	0	640	-9.8	87	-32.5
Portageville, MO	33	67	0	0	0	0	0	0	0	0	494	-2.0	178	-27.7
Milan, TN	24	56	20	0	0	0	0	0	0	0	554	-9.7	145	-38.6
Keiser, Ar	10	60	30	0	0	0	0	0	0	0	400	-10.5	313	-40.6
Verona, MS	0	72	0	0	20	0	0	0	9	0	421	-7.0	124	-39.6
Stoneville, MS	0	0	20	0	0	24	56	0	0	0	688	-1.3	310	-40.3
Rohwer, AR	29	54	2	0	0	14	0	0	0	0	707	-9.4	263	-40.4
St. Joseph, LA	0	0	9	0	0	65	12	0	13	0	804	-8.4	175	-34.4
College St, TX	0	0	0	0	61	26	0	0	13	0	305	-7.1	151	-39.6

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Update summary

- ✓ **Seed quality analysis** for 2014 completed
  - ✓ Oil and protein concentration in seed
  - ✓ Germination and accelerated aging
  - ✓ Seed grade (% damaged seeds)
- ✓ Preparation of a **producer guide for AR** and results ready by location.
- ✓ **Research manuscripts submitted/accepted**:
  - Soybean maturity group choices for maximizing radiation interception across planting dates in the US Midsouth.
  - Yield response to planting date among soybean maturity groups for irrigated production in the US Midsouth.
  - Maturity group and planting date interactions for risk-return tradeoffs in the Mid-Southern United States.
- ✓ **Decision support tool:** development of an excel based interface.

Future activities

- ✓ **Seed quality**: analyze data on seed grade, oil and protein, germination and accelerated aging from 2012 – 2014.
- ✓ **Decision support tool**: generation of a simulation dataset to be incorporated to the tool.
- ✓ Diffusion of project results:
  - Coordinate preparation of **production guides** for farmers for all locations.
  - Preparation of **research manuscripts.**