



Soybean seed quality response among maturity groups to planting dates in the Midsouth

Larry C. Purcell & Montserrat Salmeron



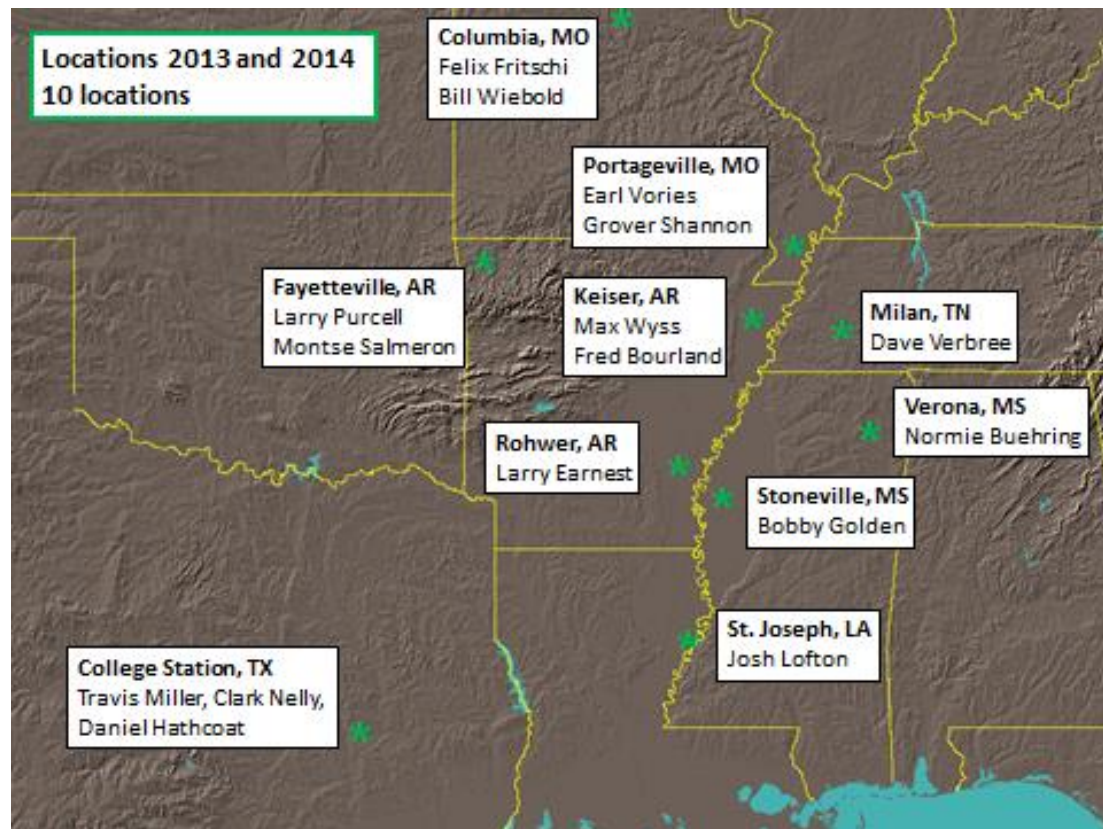
Outline



- ✓ Project description
- ✓ Brief yield results
- ✓ Seed quality:
 - ✓ Oil and protein
 - ✓ Germination and AA
 - ✓ Seed grade
 - ✓ Damaged seeds

Project description

- 8 locations in 2012 and 10 locations in 2013 and 2014
 - 4 Planting dates
 - 4 MG, 16 soybean cultivars
 - Irrigated
- ~4500 plots in 2-year study



Choice of soybean cultivars - Contributions from 9 different companies

Maturity Group	Company	Cultivars 2012	Cultivars 2013	Cultivars 2014
III	Mycogen	5N342R2	5N342R2	5N342R2
	Morsoy	RT 3644	R2 36X82N	R2 36X82N
	Pioneer	P93Y72	P93Y72	P93Y72
	Pioneer	P93Y92	P93Y92	P93Y92
IV	Armor	42-M1	42-M1	42-M1
	Pioneer	P94Y40	P94Y40	P46T212r
	Asgrow	AG4732	AG4732	AG4730
	Terrell Norris	REV49R11	REV48R33	REV48R33
V	Asgrow	AG5332	AG5332	AG5332
	Asgrow	AG5532	AG5532	AG5532
	Pioneer	P95Y50	P95Y50	P55T57r
	Progeny	P5811Y	P5711RY	P5711RY
VI	Stine	6202-4	6202-4	AG6534
	Pion/Asgrow	P96M60	AG6132	AG6132
	Asgrow	AG6732	AG6732	AG6732
	HBK/Pion	HBKR7028	P6710RY	P6710RY

Methodology



Within each MG, we designate it as an early or late, for example: early MG 3, late MG 4

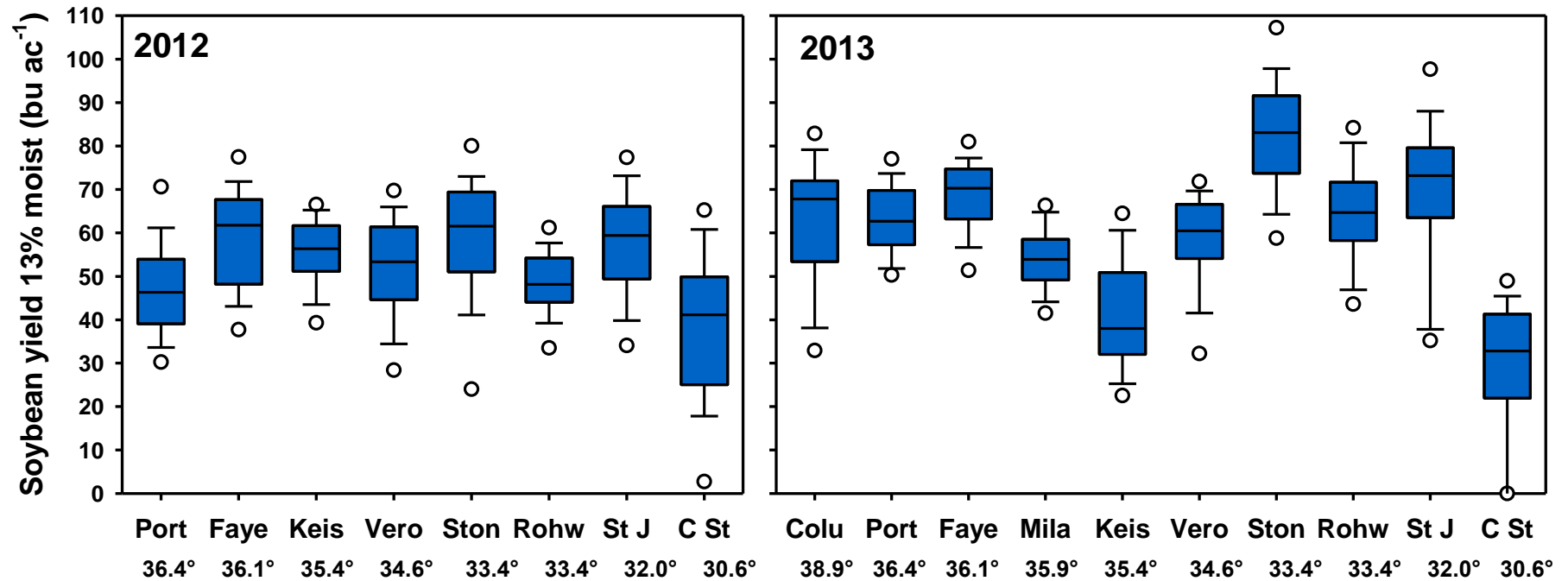
We have designated our first two planting dates at each location as early...

And our last two planting dates at each location as late.

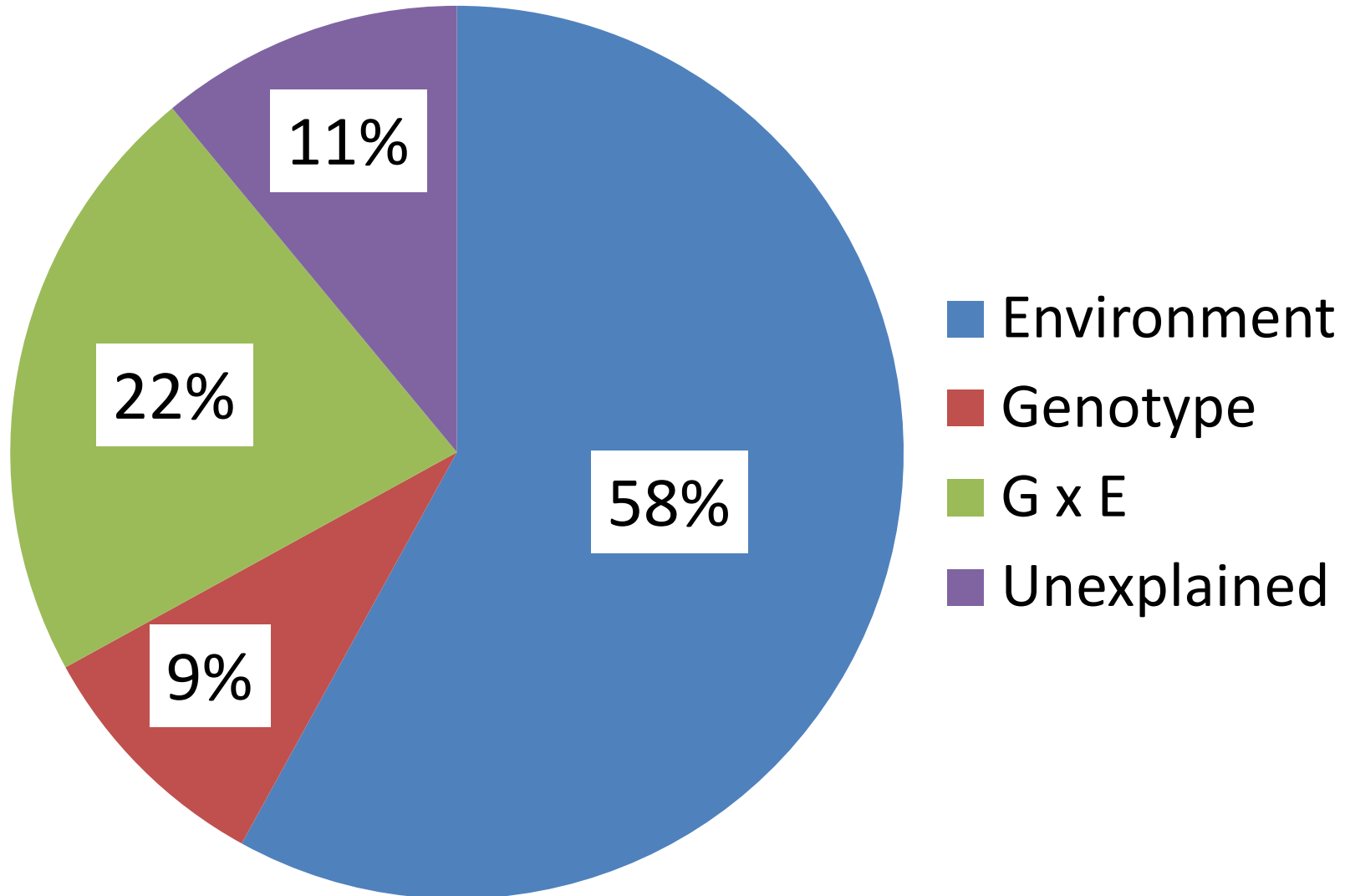
Yield results



Soybean yield by location and year



Yield results



Material and methods



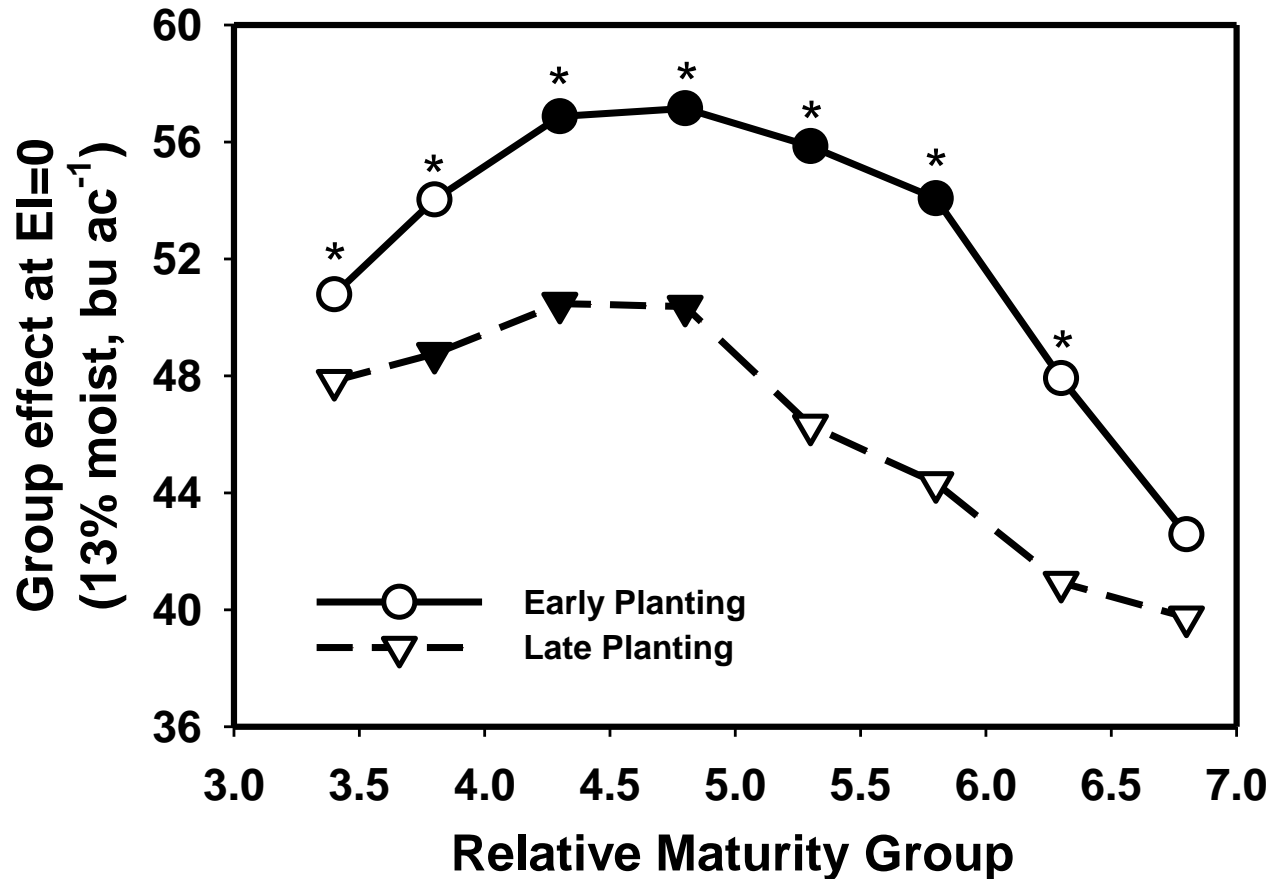
At all locations we are measuring:

- ✓ Yield
- ✓ Seed quality (AA, germ, grade, oil/protein)
- ✓ Dates of key developmental stages
- ✓ Stand counts, plant height, node number
- ✓ Lodging, shattering, green stem

Yield results



Yield results: MG choices for early vs. late planting dates (Agronomy Journal 106, 2014)

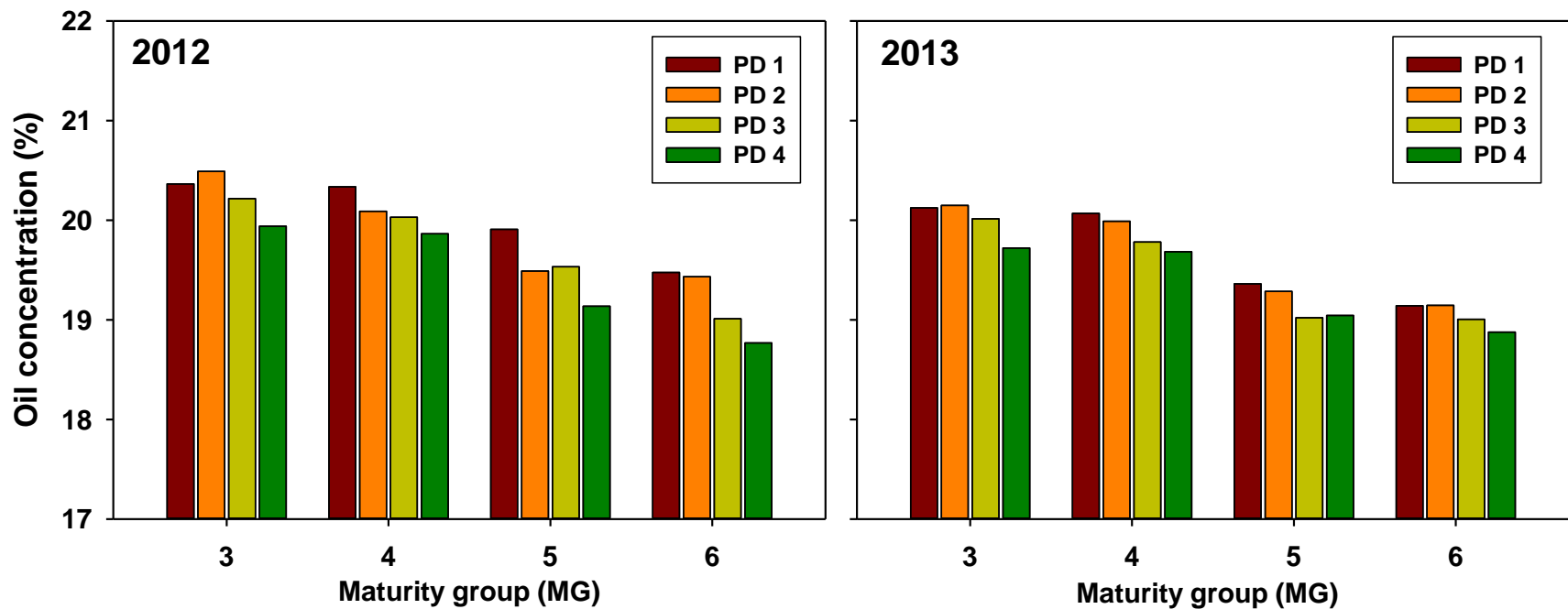


- ✓ MG 4 and MG 5 soybeans were the best choices for early plantings.
- ✓ MG 4 best choices for late plantings, followed by MG 3 soybeans.

Oil



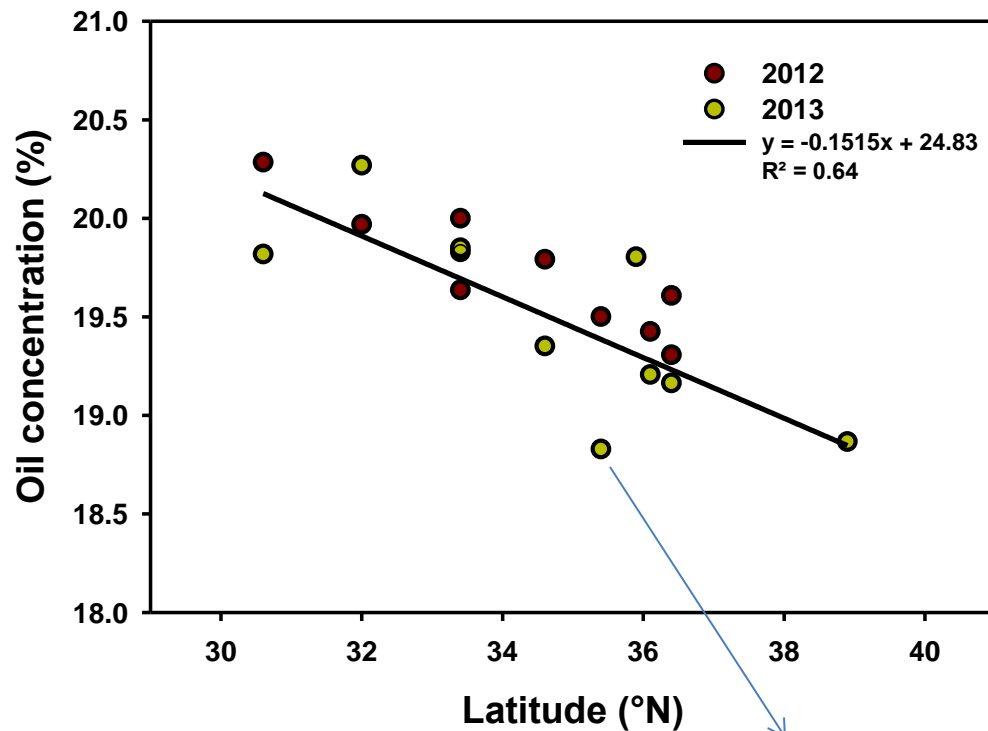
Average oil concentrations (%) by year, planting date and MG



Oil



Average oil concentrations (%) by year and location

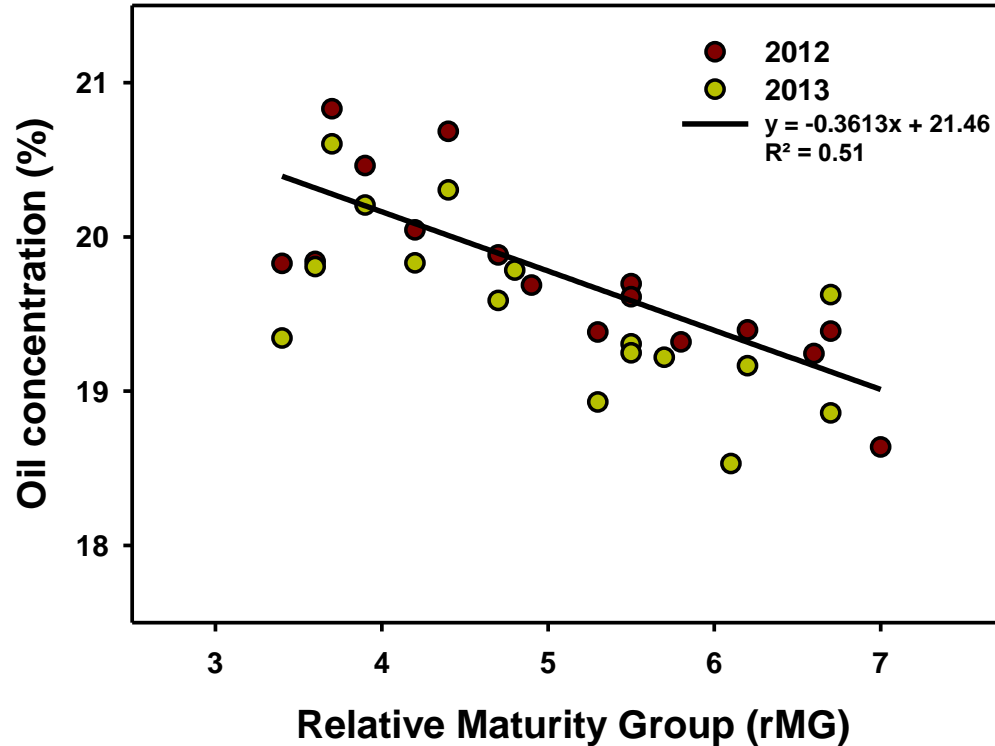


Keiser 2013, late planting dates

Oil



Average oil concentrations (%) by relative maturity group (rMG)



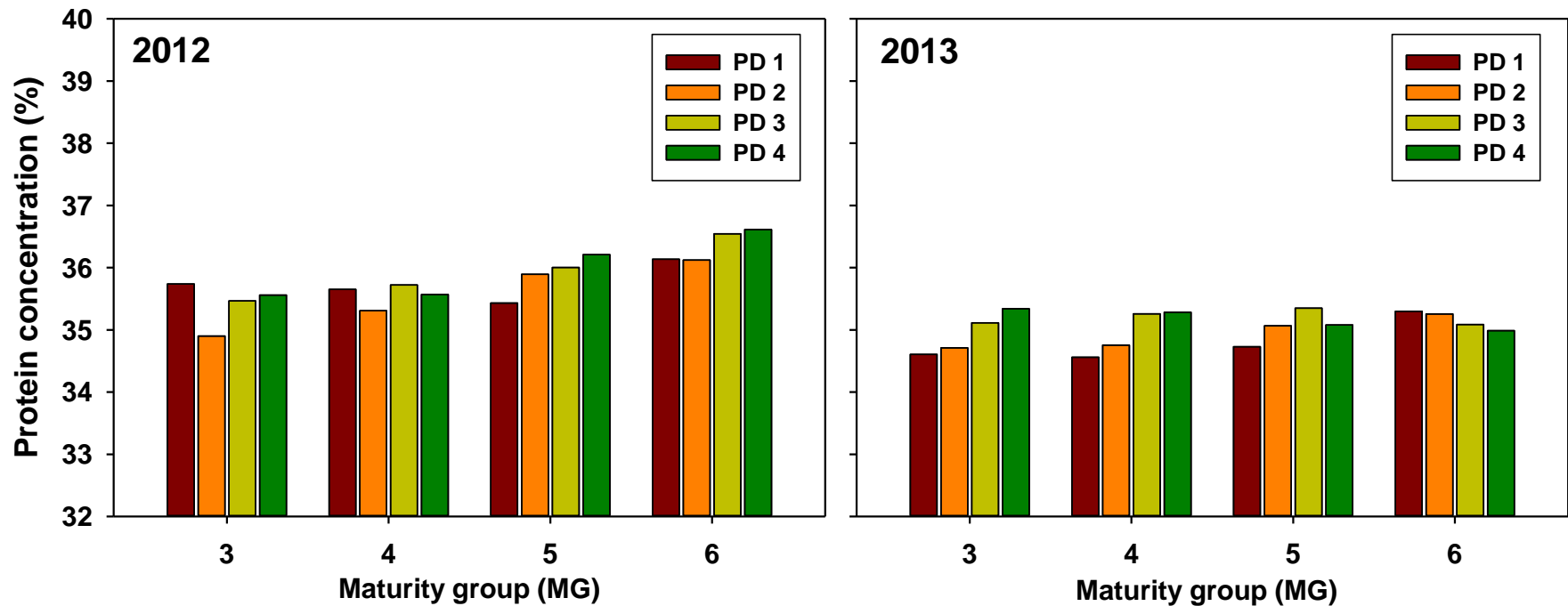
We found increased average oil concentration with:

- Early planting dates
- Southern latitudes
- Early soybean MG

Protein



Average protein concentrations (%) by year, planting date and MG



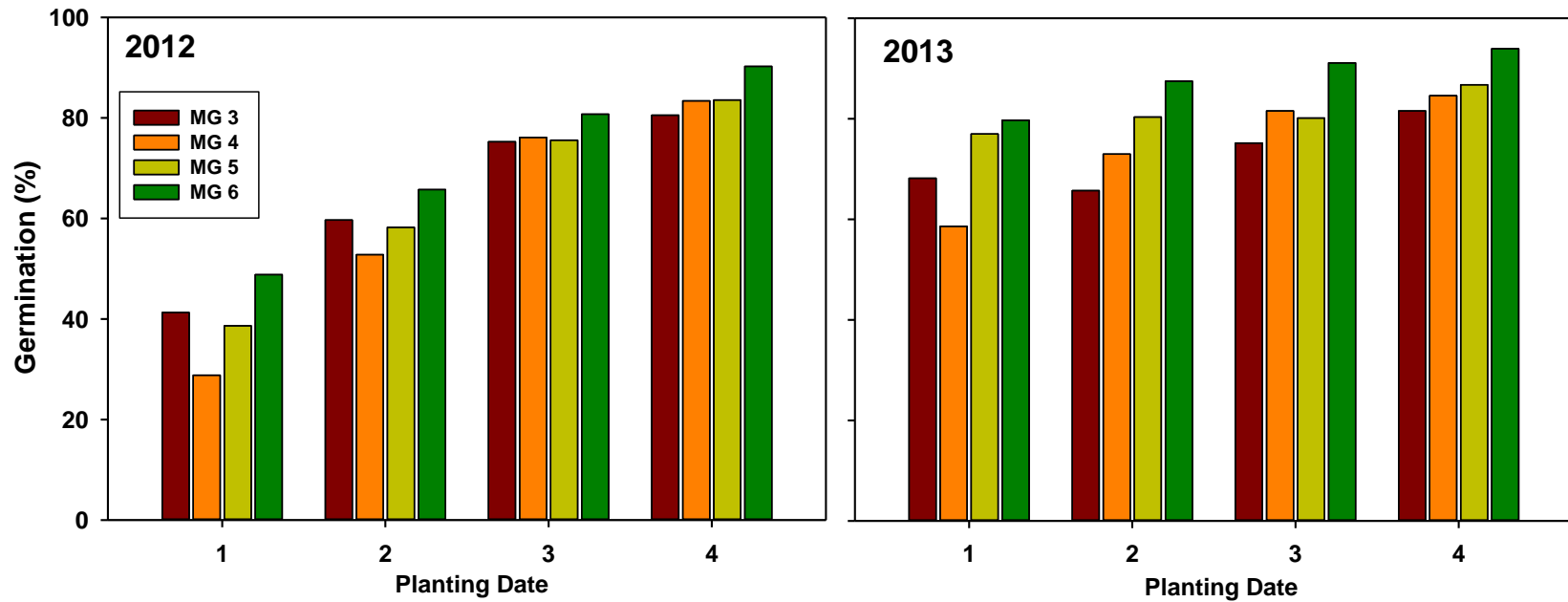
Germination & AA



Germination



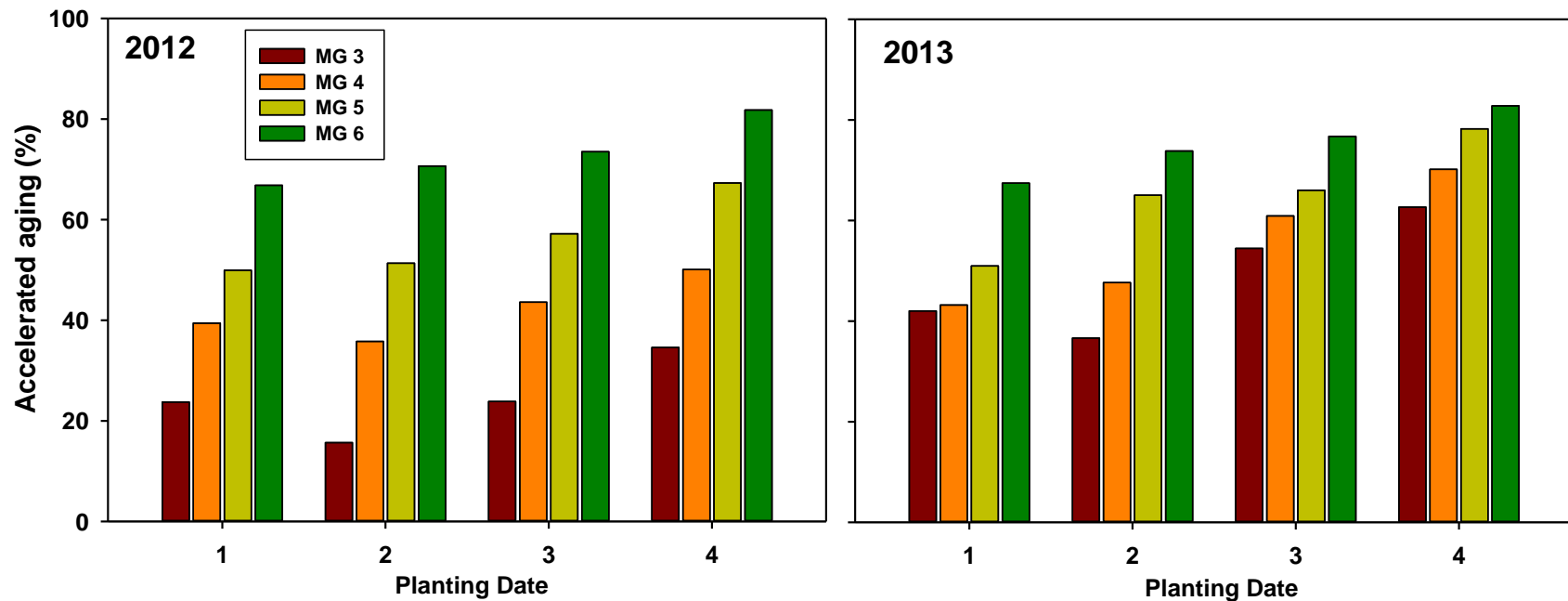
Germination by planting date and soybean MG



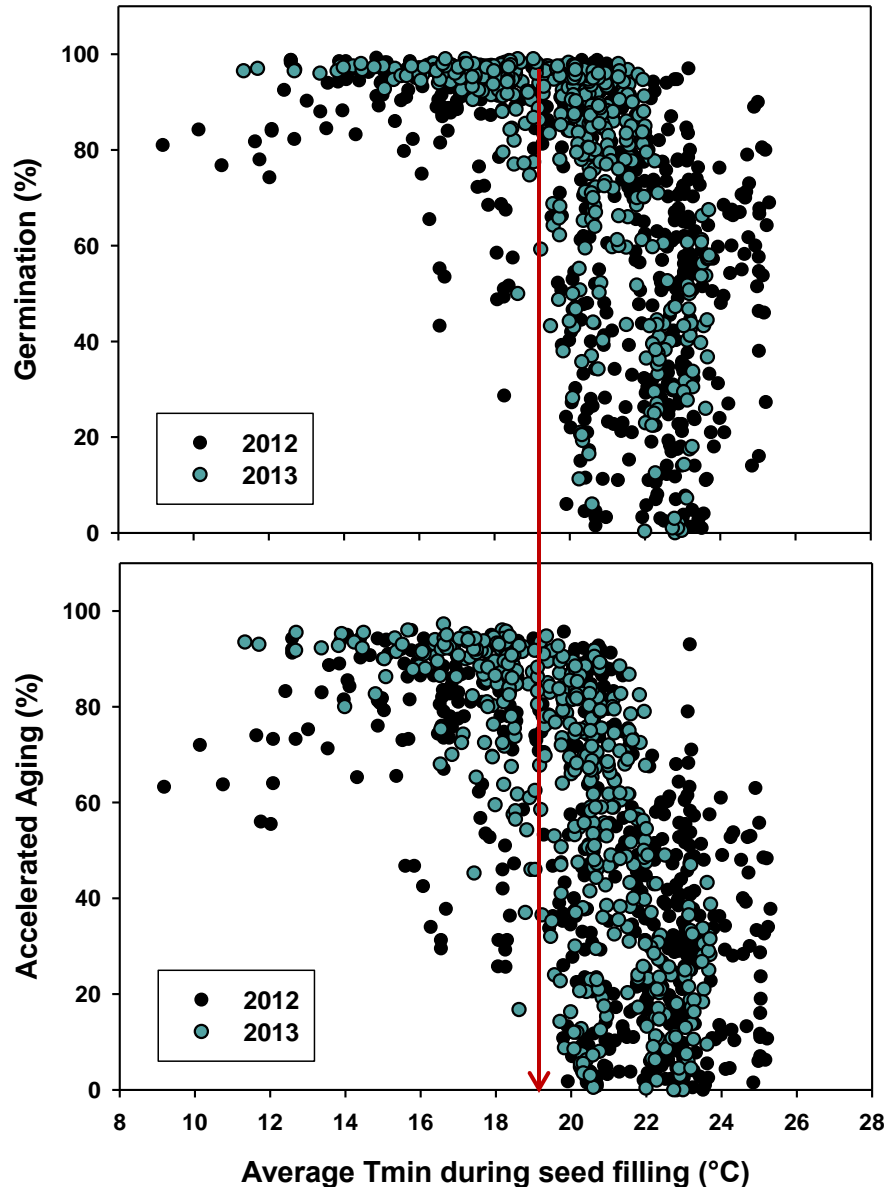
Accelerated Aging (AA)



Accelerated aging (AA) by planting date and soybean MG



Germination and AA



- T min better than T max or average T to explain changes in germination than maximum or average T.
- % of germination decreased with average minimum temperatures during seed filling above 19°C (66°F).

Seed grade

- Conducted at Rohwer, AR
- 2110 samples 2012
- 2368 samples 2013

US. Seed grade N. 1, 2, 3 or 4.

Grade requirements:

- Test weight
- Damaged seeds
- Foreign material
- Splits
- Soybeans of other colors
- Other materials



Seed grade



Seed grade 2012

U.S. Seed grade

1
2
3
4
>4

Portageville, MO

PD	III	IV	V	VI
1	3	>4	3	2
2	4	4	3	1
3	2	1	1	1
4	1	1	1	1

Stoneville, MS

PD	III	IV	V	VI
1	>4	>4	>4	>4
2	4	4	>4	>4
3	4	>4	>4	>4
4	3	4	>4	>4

Fayetteville, AR

PD	III	IV	V	VI
4	3	1	1	1

Keiser, AR

PD	III	IV	V	VI
1	>4	>4	4	1
2	3	>4	3	1
3	2	1	1	1
4	2	1	1	1

Rohwer, AR

PD	III	IV	V	VI
1	3	>4	4	>4
2	>4	4	4	3
3	>4	4	>4	3
4	4	1	1	3

Verona, MS

PD	III	IV	V	VI
1	>4	4	>4	>4
2	3	4	>4	4
3	1	1	1	2
4	1	2	1	2

St. Joseph, LA

PD	III	IV	V	VI
1		>4	>4	>4
2	>4		>4	>4
3	>4	>4	4	>4
4	>4	4	>4	>4

Martin, TN

PD	III	IV	V	VI
1	>4	4	>4	>4
2	3	4	3	4
3	3	>4	>4	3
4	3	3	3	4

College St., TX

PD	III	IV	V	VI
1	>4	>4	>4	>4
2	>4	>4	>4	>4
3	>4	>4	>4	>4
4	>4	>4	>4	>4

Seed grade



Seed grade 2013

U.S. Seed grade

1
2
3
4
>4

Columbia, MO

PD	III	IV	V	VI
1	4	4	4	4
2	4	4	4	4
3	4	4	4	4
4	4	4	3	>4

Verona, MS

PD	III	IV	V	VI
1	4	>4	4	>4
2	3	4	2	3
3	2	3	3	2
4	3	3	2	1

Portageville, MO

PD	III	IV	V	VI
1	>4	>4	>4	4
2	>4	>4	>4	4
3	>4	>4	4	4
4	>4	>4	4	3

Stoneville, MS

PD	III	IV	V	VI
1	4	>4	>4	>4
2	>4	>4	>4	>4
3	>4	>4	>4	>4
4	>4	>4	>4	4

Fayetteville, AR

PD	III	IV	V	VI
4	3	3	3	1

Rohwer, AR

PD	III	IV	V	VI
1	1	2	4	4
2	2	3	3	3
3	3	3	3	3
4	2	2	2	2

Milan, TN

PD	III	IV	V	VI
1	>4	>4	4	4
2	>4	>4	>4	4
3	4	4	4	3
4	3	3	3	2

St. Joseph, LA

PD	III	IV	V	VI
1	2	3	3	4
2	4	4	3	4
3	3	4	4	4
4	4	3	4	4

Keiser, AR

PD	III	IV	V	VI
1	>4	4	2	2
2	>4	3	3	2
3	4	3	3	3
4	4	3	3	3

College St., TX

PD	III	IV	V	VI
1	>4	>4	>4	>4
2	>4	>4	>4	>4
3	>4	>4	>4	1
4	>4	>4	>4	1

Seed grade



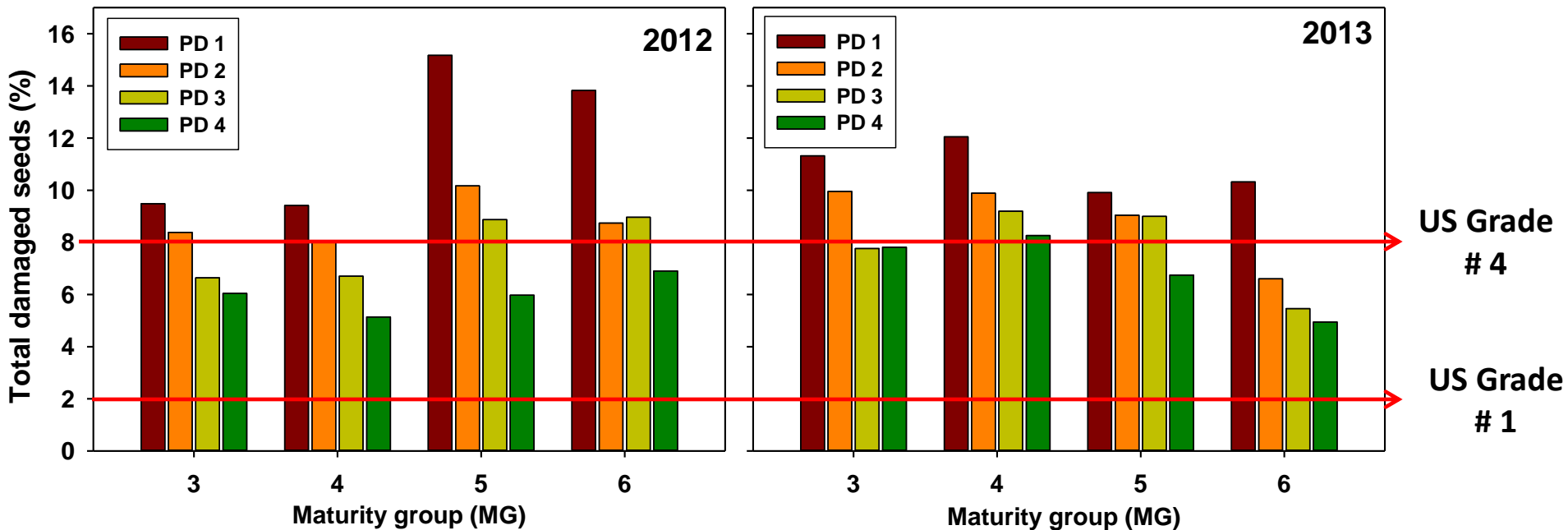
Soybeans

Table No. 1 - Grades and Grade Requirements

	Grades U.S. Nos.			
Grading Factors	1	2	3	4
<i>Minimum Pound Limits of:</i>				
Test Weight lbs/bu	56.0	54.0	52.0	49.0
<i>Maximum Percent Limits of:</i>				
Damaged kernels Heat (part of total) Total	2.0	3.0	5.0	8.0
Foreign material	1.0	2.0	3.0	5.0
Splits	10.0	20.0	30.0	40.0
Soybeans of other colors ¹	1.0	2.0	5.0	10.0
<i>Maximum Count Limits of:</i>				
Other material				
Animal filth	9	9	9	9
Castor beans	1	1	1	1
Crotalaria seeds	2	2	2	2
Glass	0	0	9	0
Stones ²	3	3	3	3
Unknown foreign substance	3	3	3	3
Total ³	10	10	10	10

**% of damaged seeds:
main factor limiting seed grade**

Seed damage



- Decreased seed damage with later planting dates compared to early plantings.

Conclusions



✓ **YIELD:**

- ✓ MG 4 and MG 5 soybeans were the best choices for early plantings.
- ✓ MG 4 best choices for late plantings, followed by MG 3 soybeans.

✓ **OIL:**

- ✓ Tendency for increased oil concentrations with: early planting dates, southern latitudes, and early soybean MG.

✓ **PROTEIN:**

- ✓ No clear trends for the effect of latitude, MG choices and planting dates.

✓ **GERMINATION and AA:**

- ✓ Tendency to increase with: late planting dates, northern latitudes and late soybean MG.
- ✓ Decrease with average Tmin during seed-fill greater than $\approx 19^{\circ}\text{C}$.

✓ **SEED GRADE:**

- ✓ Total damaged seeds (TDS) is the main factor limiting seed grade.
- ✓ Increase in TDS in southern latitudes and with early plantings.



Decision-support Tools for Maturity Group Selection for Planting-Date and Latitude Combinations throughout the Mid-South Soybean Production Region

Larry C. Purcell, Montserrat Salmeron,
Michael Popp, Edward Gbur



Decision support tool



GOAL:

To develop a **decision support tool** for aid in determining the best MG choice for a given location in the Midsouth and a given planting date in terms of agronomic and economic performance.

STEPS:

- 1 – Extensive data compiled from previous project (3 yr, 10 locations, 4 PD, 4 MG).
- 2 – Calibration of DSSAT-CROPGRO: phenology and yield.



XBuild

File Environment Management Treatments Simulation Options Refresh Help

Cultivar-C:\DSSAT45\SOYBEAN\UACS1301.SBX(Experimental)

Cultivar

Level	Crop
	Cultivar

XBuild

File Environment Management Treatments Simulation Options Refresh Help

Planting-C:\DSSAT45\SOYBEAN\UACS1301.SBX(Experimental)

Planting

Level	Description

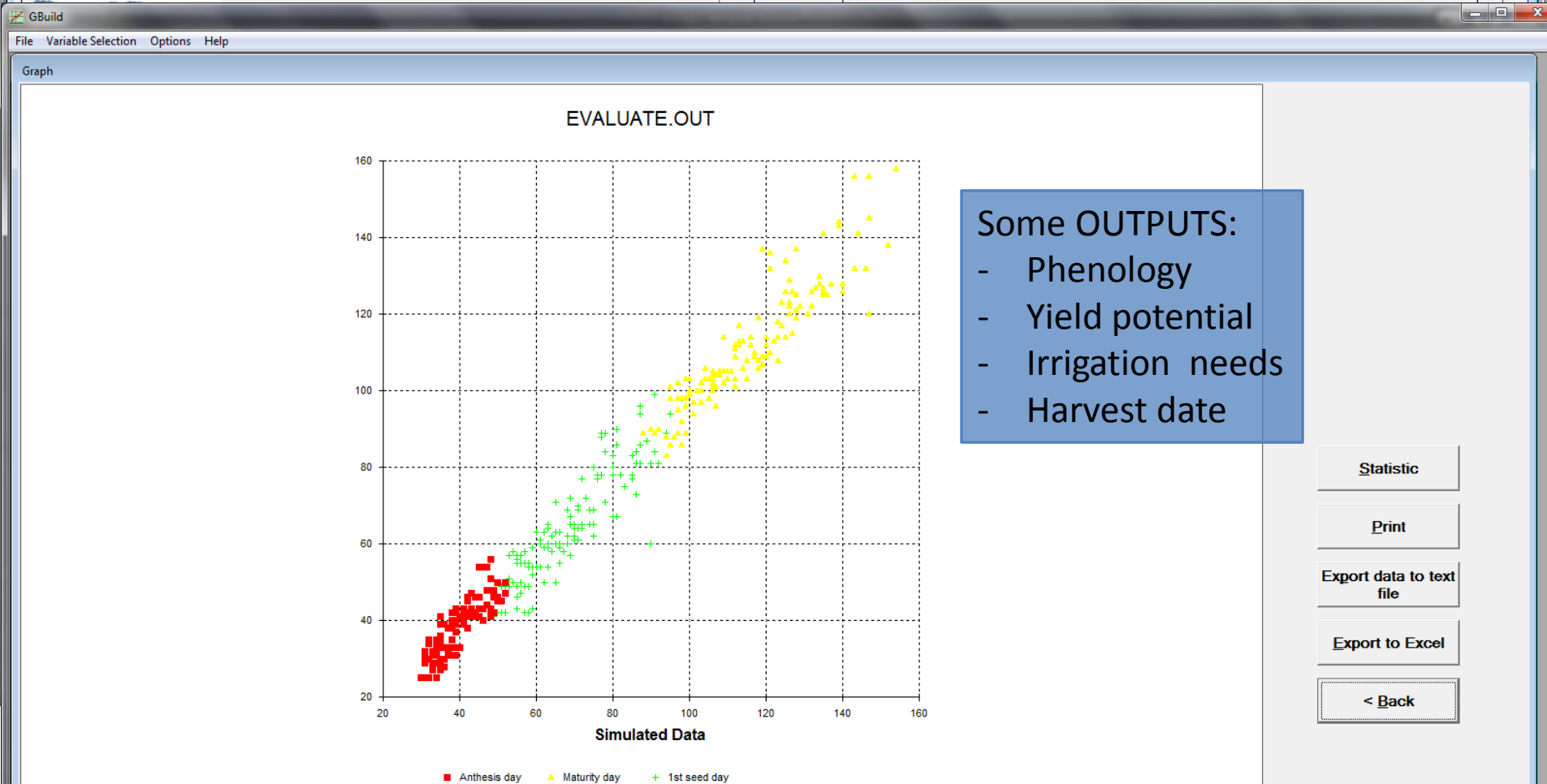
XBuild

File Environment Management Treatments Simulation Options Refresh Help

Fields-C:\DSSAT45\SOYBEAN\UACS1301.SBX(Experimental)

Fields

Level	Description



Decision support tool



GOAL:

To develop a **decision support tool** for aid in determining the best MG choice for a given location in the Midsouth and a given planting date in terms of agronomic and economic performance.

STEPS:

- 1 – Extensive data compiled from previous project (3 yr, 10 locations, 4 PD, 4 MG).
- 2 – Calibration of DSSAT-CROPGRO: phenology and yield.
- 3 – Simulation study: long term (30 yr) weather data simulation with:
 - MG 3, 4, 5 and 6.
 - PD from late March to late June.
 - latitudes from 29 to 39°N.
 - two soil types.
- 4 – Create a dataset with average agronomic and economic performance, probabilities and risks for each treatment combination.
- 5 – Tool development.

Decision support tool - INPUTS



INPUT INFORMATION: Location and producer choices

Location:

Please select the growing area closest to your location

Stoneville, MS – 33.4°N



Soil water holding capacity:

Please select a type of soil
and irrigation management

Clay soil

Irrigated with 2 inches allowable water deficit



Planting date:

Please select your week of planting

4th week of March



Soybean Maturity groups:

Please select two soybean maturity groups
to compare

MG 4



MG 6



Decision support tool - OUTPUT



OUTPUT INFORMATION:

1 – Risk of freezing:

Risk of freezing for your selected latitude and week of planting. Data based on 30 year weather data.



45 % risk

2 – Yield prediction:

Predictions for your selected latitude, week of planting, and MG choices based on calibrated crop simulations for 30 years.

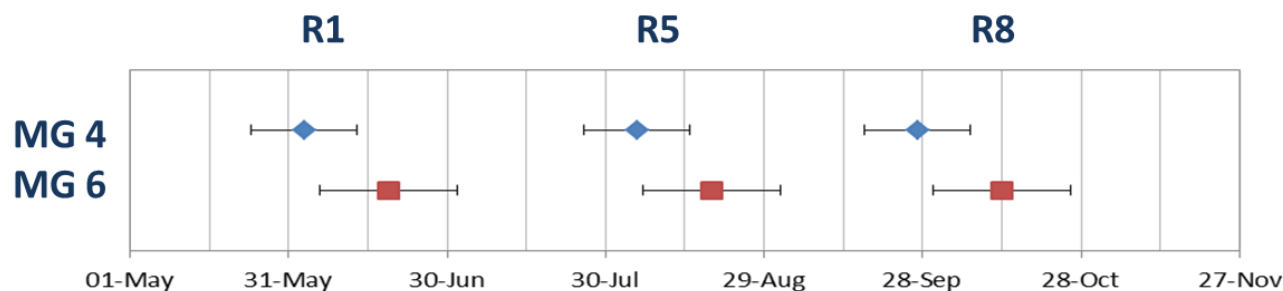
Yield prediction analysis	MG 4	MG 6
Risk of yields below 30 bu ac ⁻¹	15%	55%
Yield potential 50% of the years	55 bu ac ⁻¹	4 bu ac ⁻¹
Probability of yields > 60 bu ac ⁻¹	30%	5%

Decision support tool - OUTPUTS



3 – Phenology prediction:

Average expected dates with 90 % confidence intervals (error bars) for flowering (R1), beginning seed fill (R5) and harvest maturity (R8). Calculated for your selected latitude, week of planting, and MG choices based on calibrated crop simulations for 30 years.



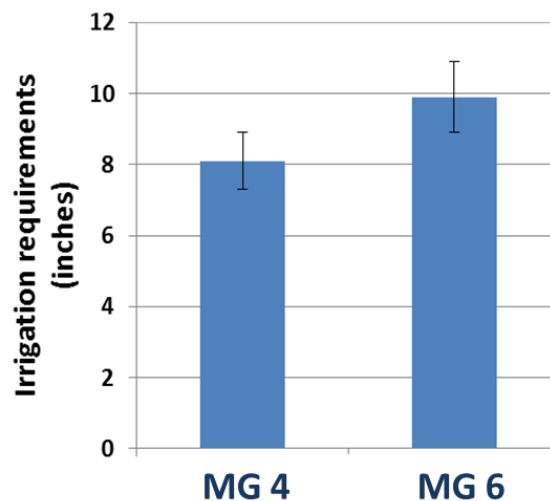
Phenology prediction analysis	MG 4	MG 6
Day of flowering (R1)	2 Apr (± 10)	18 Jun (± 12)
Beginning seed fill (R5)	7 Aug (± 9)	19 Aug (±10)
Harvest maturity (R8)	27 Sep (± 9)	15 Oct (± 10)

Decision support tool - OUTPUTS



4 – Irrigation requirements:

Average expected irrigation needs with 90 % confidence intervals (error bars). Calculated for your selected latitude, week of planting, and MG choices based on calibrated crop simulations for 30 years.



Irrigation requirements	MG 4	MG 6
Average irrigation requirements and 90% confidence intervals (inches)	8.1 (± 1.8)	9.8 (± 2.1)

Decision support tool - OUTPUTS



5 – Economic analysis/ net returns

Producer Choices	MG 4	MG 6
<p>Please choose an irrigation cost that most closely represents your cash costs per acre-inch applied</p> <p>(i.e. fuel and labor needed to apply water. Usually one furrow irrigation is about 2 to 3 acre-inches of water)</p>	<div>\$5.00 ▼</div>	
<p>Please choose from four different markets that most closely reflect your seasonal market conditions</p> <p>(you have a choice of four states (TX, AR/TN, LA, MO))</p>	<div>Memphis ▼</div>	
<p>Expected Soybean Price (\$/bu)</p> <p>(please provide a price for your harvested soybean as appropriate for the expected harvest date range)</p>	<div>\$12.35</div>	<div>\$12.15</div>
<p>Expected Price Range (\$/bu)</p> <p>(given your chosen market region and harvest date expectation, your cash soybean price is expected to fluctuate by the indicated amount in 2 out of 3 years)</p>	<div>± \$0.55</div>	<div>± \$0.45</div>
<p>Expected Partial Return (\$/acre)</p> <p>(this is your expected yield times the expected price less cash irrigation costs. With these returns you still need to cover harvest cost, chemicals, seed, cash rent, labor and equipment costs to earn a profit. The MG choice with higher partial returns is highlighted.)</p>	<div>\$512.93</div>	<div>\$314.66</div>

Decision support tool - OUTPUTS



5 cont'd – Economic analysis (What if and risk analysis)

Sensitivity Analysis	MG 4	MG 6
How much can soybean price drop for the optimal MG choice compared to the alternative MG at it's current expected sale price?	As low as \$8.75	... compared to \$12.15
How much can irrigation cost increase not to affect optimal MG choice?	Optimal choice uses less water	... currently at \$5.00

Other activities in the project



- ✓ Analyze data on seed grade, oil and protein, germination and accelerated aging from 2014 that will be available during spring 2015.
- ✓ Compile and analyze statistically data on yield, phenology and seed quality from the three growing seasons.
- ✓ Write manuscripts as appropriate on the effect of latitude, planting date, MG choices and environmental factors affecting the variables studied.
- ✓ Develop fact sheets on MG-risk portfolios directed to producers and extension services.