

# Risk vs. Reward: Can We Resolve Row Spacing and Seeding Rate Questions in Soybean?

**Shawn P. Conley**  
**Soybean and Wheat Specialist**  
**University of Wisconsin, Madison**



## Today's Soybean Production Systems are Dynamic

- **Changes in row spacing**
  - Growers have dropped small grains from their rotation
  - Row units vs drills
    - Accurate seeding rate
    - Uniform planting depth and emergence
- **Changes in seeding rates**
  - RR seed cost - 2007
    - List price – \$30.99 to 33.99 vs. farm gate – \$23.50 to 26.50
- **Changes in planting date and environment**

## What Row Spacing Growers are Using

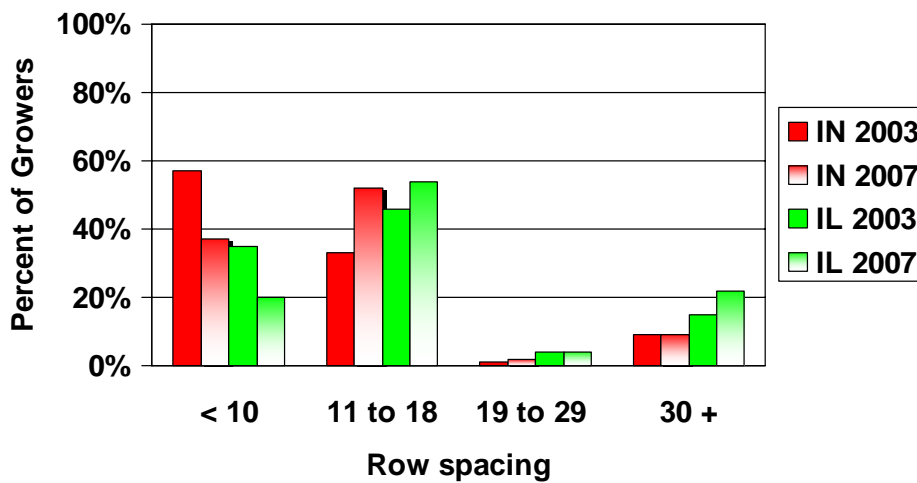
- What row spacing are growers planting?

Row spacing	Seeding rate	Purdue rec's (90*90)	% respondents
≥ 21 in.	155,000	129,000	12%
11 ≥ x ≤ 20	180,000	160,000	31%
≤ 10 in.	198,000	196,000	57%

- 52% of Indiana growers with 1000+ acres are planting their soybeans in 15 inch rows

Conley and Santini, 2007; CM

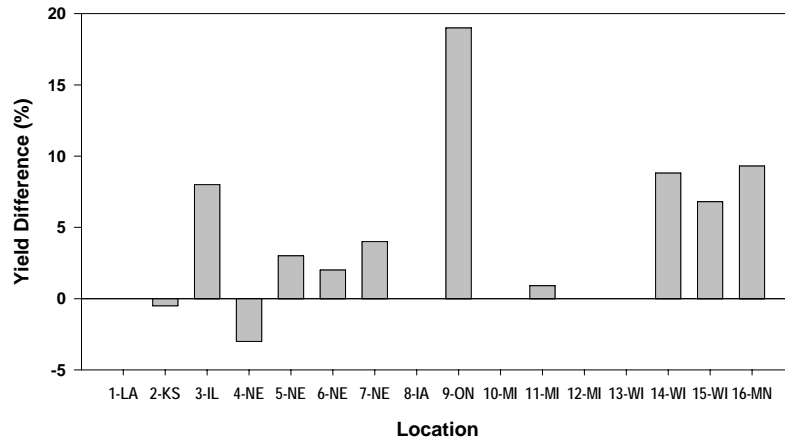
## IN and IL Row Spacing Changes



N = 180

## Row Spacing Affect on Grain Yield

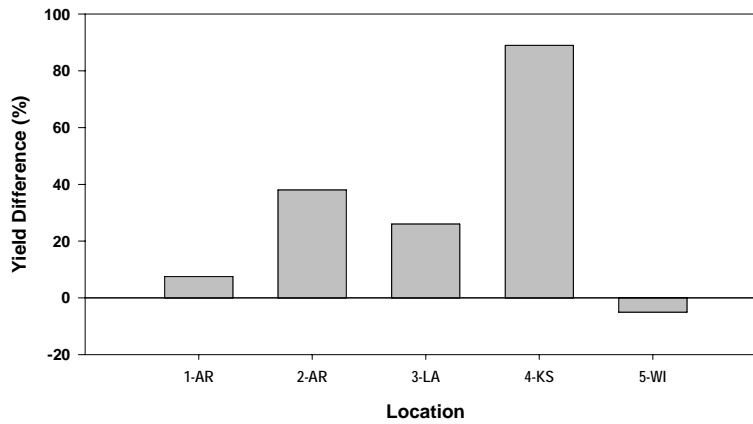
**(A)** Soybean, Narrow vs. Wide Row Widths  
Optimum Seeding Date, Full Season Varieties



Source: C. Lee, CM, 2006. <http://www.plantmanagementnetwork.org/sub/cm/review/2006/wide/>

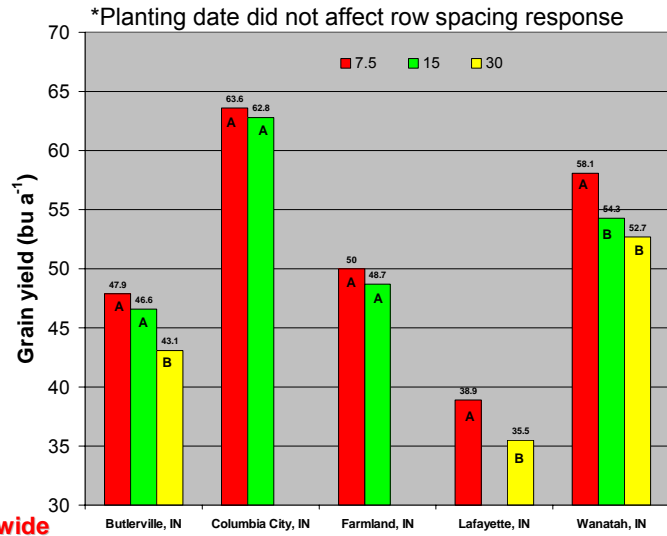
## Row Spacing Affect on Grain Yield

**(B)** Soybean, Narrow vs. Wide Row Widths  
Late Seeding Date, Full and Short Season Varieties



Source: C. Lee, CM, 2006. <http://www.plantmanagementnetwork.org/sub/cm/review/2006/wide/>

## IN Row Spacing Affect on Grain Yield



**Narrow vs. wide  
9.3% difference**

Conley et al. 2007

## IN Row Spacing Affect on Grain Yield

Row spacing	Butler, IN		Farmland, IN		Columbia City, IN	
	2005	2006	2005	2006	2005	2006

-----Grain yield (bu a<sup>-1</sup>)-----

7.5	70.2 a	44.2 a	69.3 a	48.3 a	35.8 a	48.2 a
15	70.5 a	43.8 a	66.3 a	47.4 a	36.9 a	45.6 a
30	65.6 b	36.5 b	56.8 b	41.9 b	36.8 a	48.2 a

Means followed by the same letter within a column are not different ( $p \leq 0.05$ )

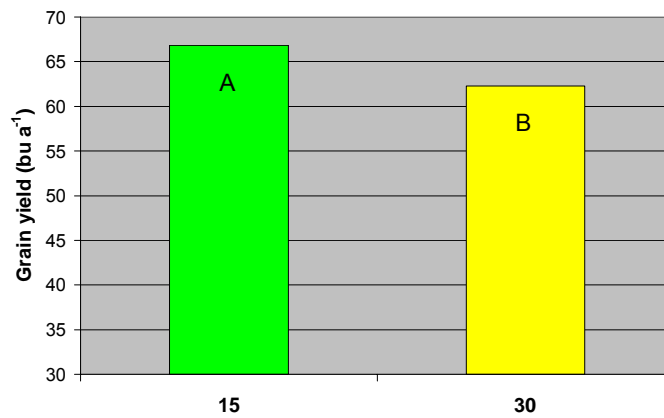
**Narrow vs. wide  
9.2% difference**

Hanna et al. 2007

## Row Spacing Affect on Grain Yield

De Witt, Nevada,  
and Whiting, IA  
2004-06

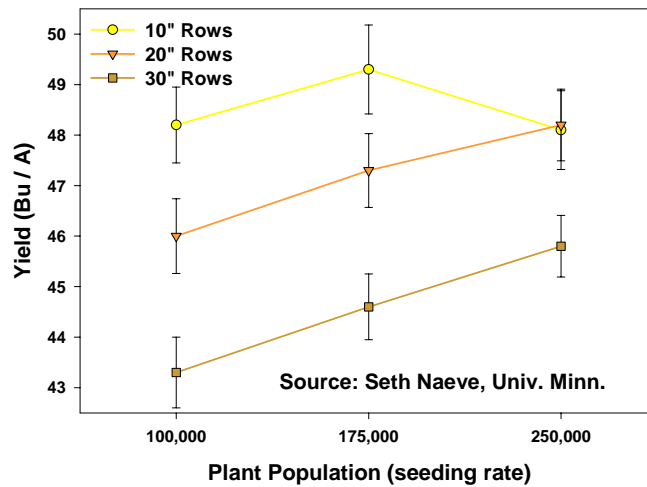
15 vs. 30 inch  
6.7% difference



Source: P. Pedersen, 2007

## Does Row Spacing Impact My Decision to Reduce My Soybean Seeding Rate

Soybean Yield Response  
to Row Spacing and Plant Population  
12 Environments in 1999-2000



Source: Seth Naeve, Univ. Minn.

## Reasons for Differential Row Spacing Yield Response

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- Light interception and canopy development
  - Affected by planting date and population
  - Plant height and photosynthetically-active radiance
  
- Water availability
  - In irrigated systems or when rainfall is sufficient narrow rows generally out-yield wide rows

Source: C. Lee, CM, 2006. <http://www.plantmanagementnetwork.org/sub/cm/review/2006/wide/>

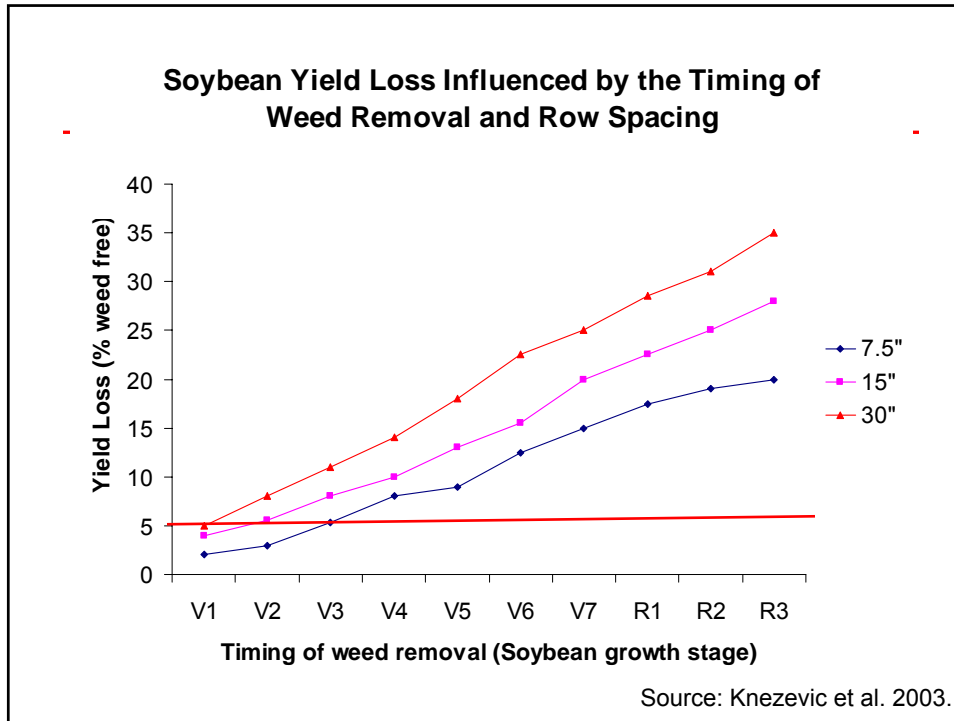
## Weed Management Issues in Wider Rows

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- Weed control implications
  - Weeds are the #1 IN soybean pest (Conley and Santini, 2007 CM)
  - Glyphosate resistance is a reality
  - Delayed canopy closure as row spacing increases

Row Spacing	-----May planting date -----		
	< 5/5	5/6 to 5/15	5/16 to 5/25
7.5	35	30	25
15	50	45	40
30	75	70	65

Source: Purdue Extension publication ID-179, *Corn & Soybean Field Guide*



## Weed Management in GR Soybean

- 26% of respondents indicated that they applied a preemergence herbicide to their soybean crop.
- 23% of growers indicated that they utilized a one pass weed control program.
- The percentage of growers utilizing a one trip weed control programs was 40% (99 or less), 34% (100 to 249), 20% (250 to 499), 13% (500 to 999), and 11% (1000+).
- One pass program produced a 5.8% yield loss compared to those growers with 2+ passes.

Source: Johnson et al. 2007. CM.

## Does Row Spacing Effect Spray Coverage?

- Our studies showed no difference in spray penetration or total coverage between soybean planted in 7.5-, 15-, or 30-inch rows across locations and years
- We recommend that growers base their soybean row spacing decisions on other factors, such as yield potential, equipment availability, or weed control

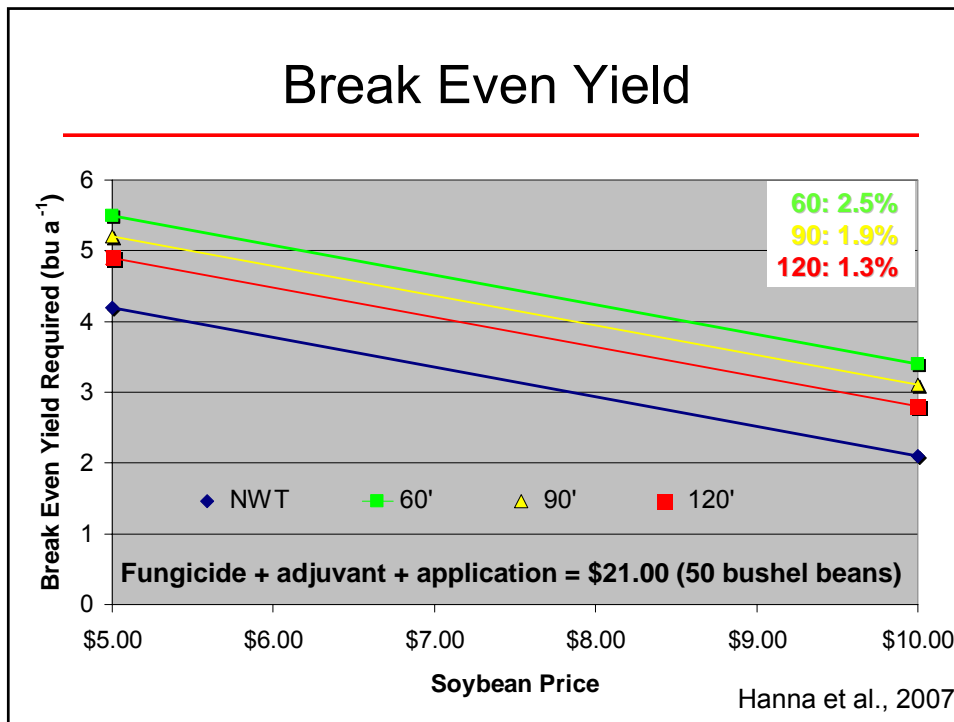
Hanna et al. 2007

## Do Wheel Tracks Affect Yield?

- Sprayer wheel traffic from first flower (growth stage R1) through harvest can damage soybean plants and reduce yield if soybean stands are thin (<100,000 plants per acre) or late planted
- Regardless of stand, plants could not compensate for wheel tracks made at R3 (early pod development) or R5 (early seed)
- Yield loss per acre is based on boom width

Hanna et al. 2007





### Summary – Row Spacing

- Yield response of narrow vs. wide rows in soybean is variable (0-18%)
  - Variability is water and light interception driven
  - (Average yield loss: 7%)
- Increased risk of yield loss due to weed competition
- Row spacing does not affect canopy penetration of foliar fungicides
- Wheel tracks from ground driven sprayers decrease grain yield in 7.5 and 15 inch row spacings when applied at R3 and R5 soybean

## Common Grower Questions Related to Reduced Soybean Seeding Rate Systems

- What is the minimum I can plant and still achieve 100% yield potential?
- Should I select and plant a bush over an erect stem soybean variety?
  - Real or marketing/grower perception?
- What about maturity group response?
  - Should I adjust my seeding rate based on maturity group adaptiveness?

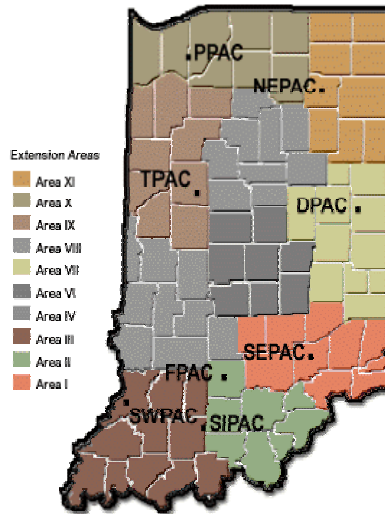
## Current State Soybean Seeding Rec's

State	Germination	-----Recommended Seeding Rates -----		
		30"	15"	7.5"
-----Seeds or plants acre <sup>-1</sup> -----				
Illinois		-	-	-
Iowa-seeds	90%	125 to 140	125 to 140	200*
Kentucky-plants	80%	111 to 139	139 to 167	119 to 179
Michigan-seeds	90%	122 to 157	139 to 174	175 to 280
Missouri-seeds	90%	140,000	175,000	200,000
Ohio-seeds	90*90%	129,000	160,000	196,000
Indiana-seeds	90*90%	129,000	160,000	196,000
Wisconsin		-	-	-

\*Old versus new

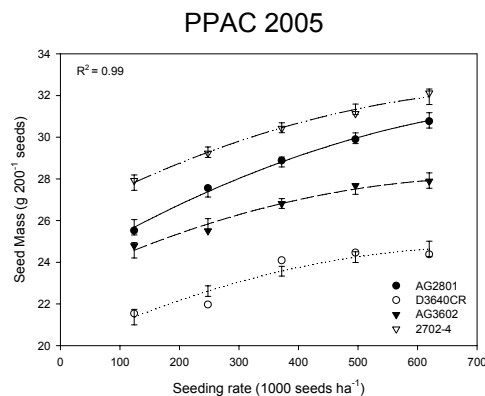
## Maturity Group and Stem Phenotype Response to Decreased Soybean Populations

- Northern:
  - 2.8 and 3.6 M.G
- Southern:
  - 3.6 and 4.2
- Plant populations
  - 50,000 to 250,000
- Erect vs. bushy beans
- 8 site years; 4 varieties
- Drilled soybean (7.5")



## Population Affect on Seed Mass

- Population affected seed mass at all N. locations
- Population did not affect seed mass at S. locations
- Seed mass was greater in early MG soybean varieties than full season

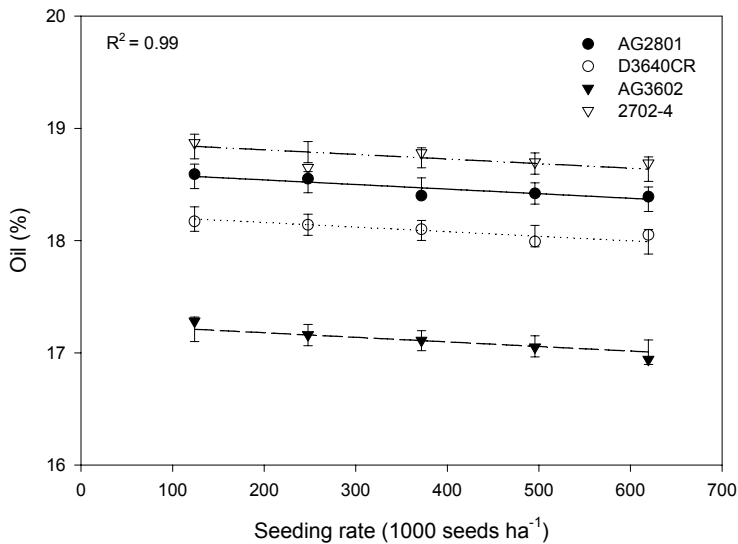


### 2005 -2006 Population Affect on Pod Number Plant<sup>-1</sup>

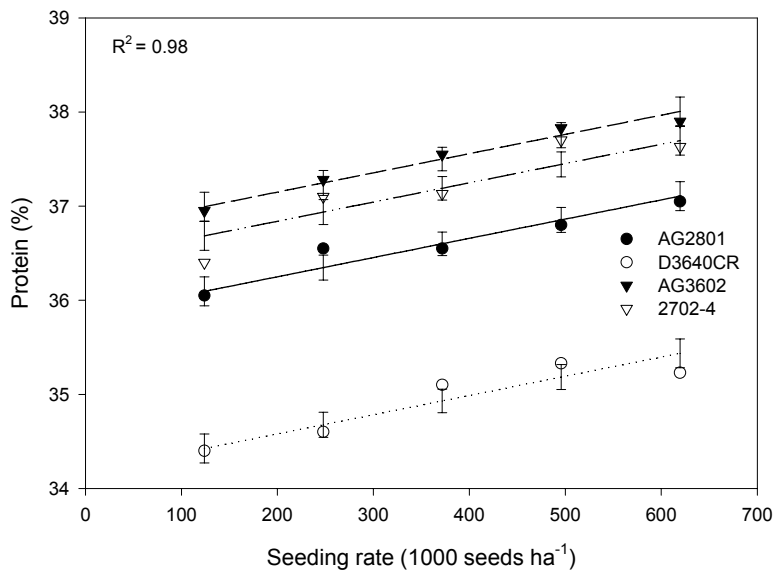
Seeding rate	ACRE	NEPAC	PPAC	SEPAC
50,000	81 a	55 a	109 a	75 a
100,000	45 b	35 b	66 b	55 a,b
150,000	39 b	25 c	43 c	44 b
200,000	37 b	22 c	35 d	43 b
250,000	36 b	21 c	30 d	38 b

Means within the same column and followed by the same letter are not considered different  $p < 0.05$

### Population Affect on Oil Content (ACRE 05-06)



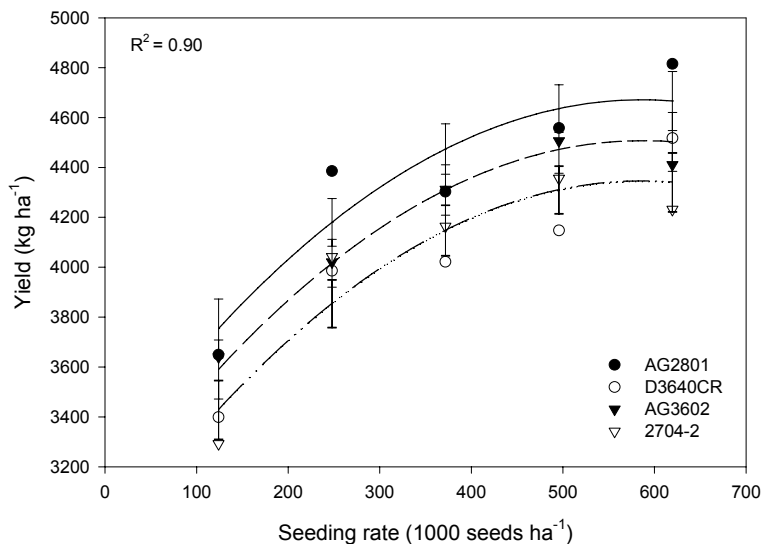
## Population Affect on Seed Protein (ACRE 06)



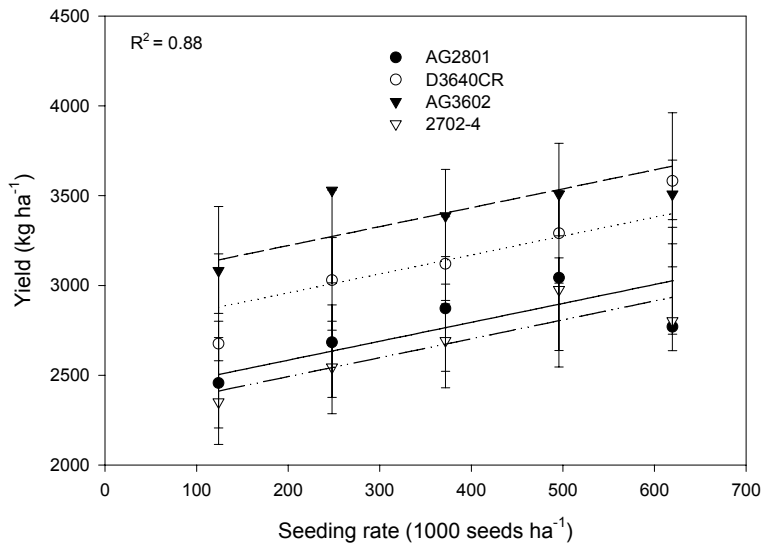
## Summary Oil and Protein Content

- Oil content as not affected by population
- Oil content was affected by variety at ACRE
- Protein content varied among years, varieties, and locations
- In general protein content increased as population increased

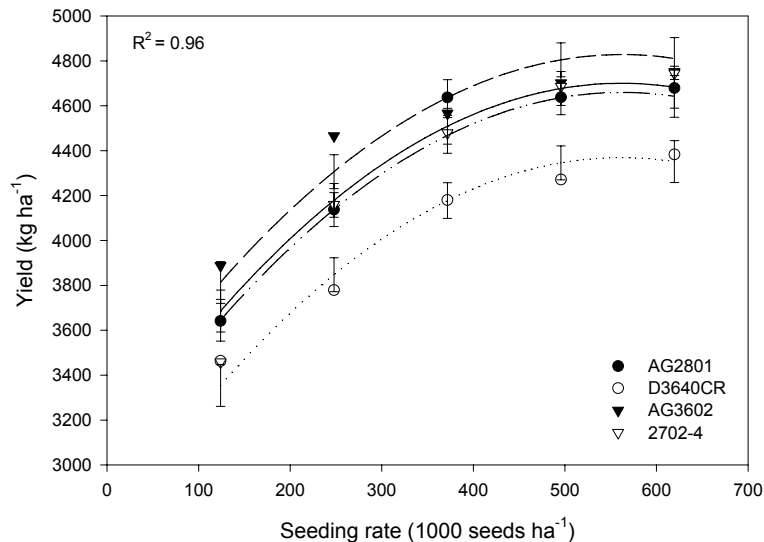
### Population Affect on Grain Yield (ACRE 05-06)



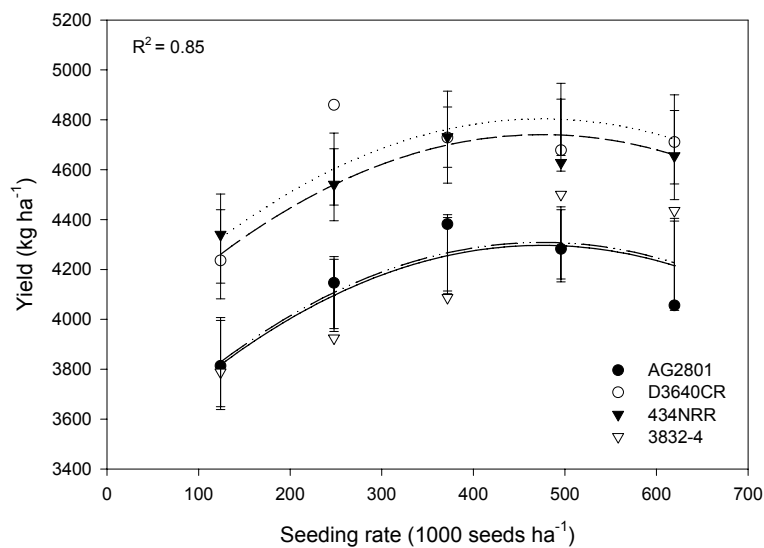
### Population Affect on Grain Yield (NEPAC 05-06)



### Population Affect on Grain Yield (PPAC 05-06)



### Population Affect on Grain Yield (SEPAC 05-06)



## Summary Plant Populations

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- Stem architecture (bushy vs. erect) did not affect soybean grain yield
- Soybean oil content was relatively stable among locations, varieties, and years
- Soybean protein content was variable
- Optimal seeding range was 100,000 to 150,000 plants  $a^{-1}$





## Planting Date Shift Over the Last Decade

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- How has your average soybean planting date changed from 10 years ago? (1253 respondents)

Planting date shift	Percent of growers
One week earlier	28%
Two weeks earlier	32%
Three weeks earlier	7%
Later by one week	3%
Other	3%
No change	27%

Conley and Santini, 2007; CM

## What is Driving this Shift?

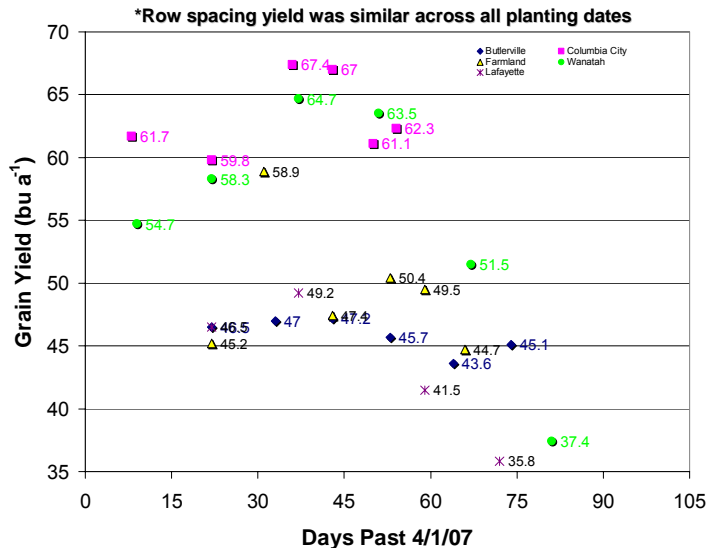
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- Rank the importance of the following factors for that have influenced your planting date? (1 to 5)

Reason for shift	Importance
Yield increase	1.9
Weather changes	2.0
Improved soybean varieties	2.1
Seed applied technology advances	2.5
Spread out work load	2.8
Industry re-plant programs	3.5

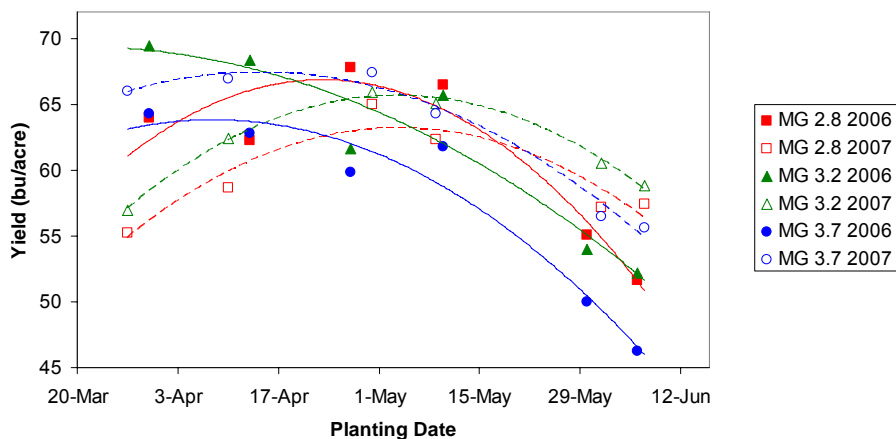
Conley and Santini, 2007; CM

### Location by Planting Date Affect on Soybean Yield



### Variety by Planting Date Affect on Soybean Yield

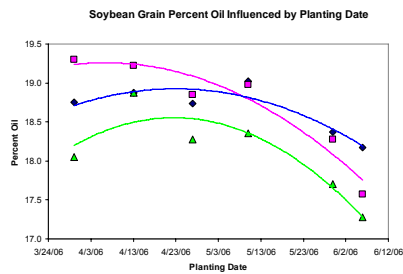
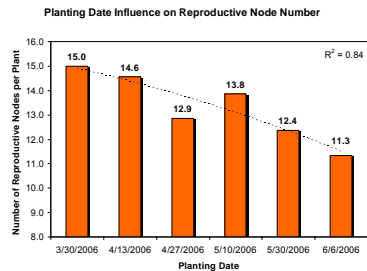
Planting Date Impact on Yield - Field Trial 2006, 2007, West Lafayette, IN



Robinson et al. 2007

## Changes in Soybean Flowering Characteristics, Node Number, and Grain Composition

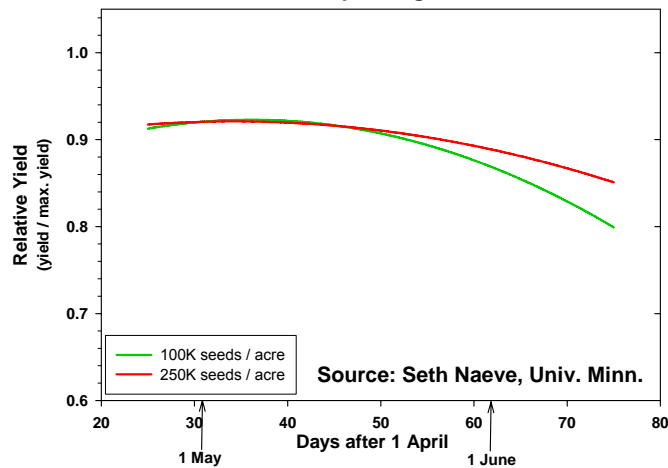
- Early planted, early maturity group soybean cultivars are producing flowers in May
- Increased node number
- Modified grain composition
- Decreased seed size



Robinson et al. 2006

## Does Planting Date Impact My Decision to Reduce My Soybean Seeding Rate

Population effects on soybean yield across planting dates



## Defining Planting Date Responses in N. Illinois\* 2001-2003 University of Illinois

Source: E. Nafziger University of Illinois

Seed rate†	Planting date			
	Early April	Late April	Early May	Late May
000/acre				
	----- bushel/acre -----			
75	38.7	45.8	46.6	43.5
125	41.9	48.3	47.6	46.5
175	43.8	48.7	48.3	46.5
225	45.3	48.9	48.9	46.6

\*Soybean yield averaged over nine environments in Northern Illinois.

†Seeding rates are expressed as **viable** seeds per acre.

## Defining Planting Date Responses in S. Illinois\* 2001-2003 University of Illinois

Source: E. Nafziger University of Illinois

Seed rate†	Planting date			
	Mid-April	Early May	Late May	Early June
000/acre				
	----- bushel/acre -----			
75	30.4	33.7	35.9	30.6
125	29.3	33.7	35.3	32.8
175	32.3	34.6	36.3	32.4
225	32.9	35.4	34.6	33.7

\*Soybean yield averaged over four environments in Southern Illinois.

†Seeding rates are expressed as **viable** seeds per acre.

## Defining Planting Date Responses in Illinois

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“In Northern Illinois....Planting in early April reduced yield by about 10 percent, and planting in late May reduced yield by about 5 percent; these results suggest that planting “too early” tends to reduce yield more than planting late.”

“It pays to wait to plant, but if planting is earlier than ideal, it pays to add extra seed.”

Source: E. Nafziger  
University of Illinois

## Defining Planting Date Responses in Illinois 2001-2003 University of Illinois CMRA Project

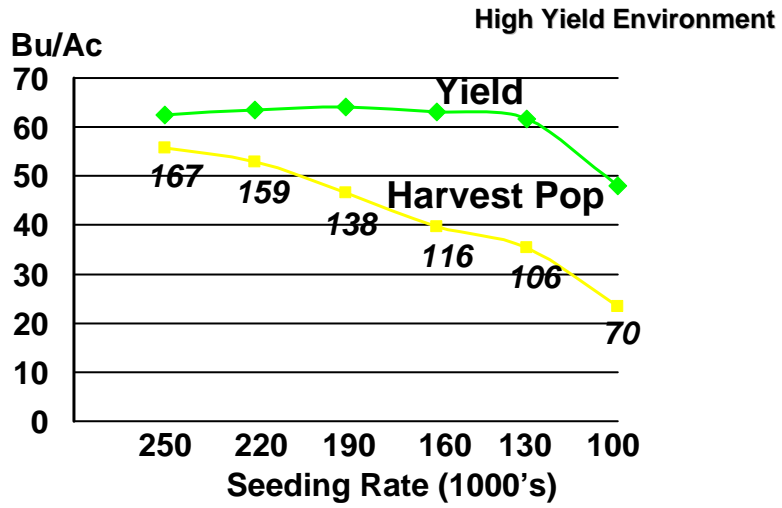
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“In Northern Illinois....Optimum planting rates for planting in the optimum window were about 150,000 to 160,000 viable seeds per acre, but this rose to above 200,000 per acre if planting was earlier than the optimum time.”

“Still it appears that planting rate should be between 150,000 to 175,000 viable seeds per acre in Southern Illinois.”

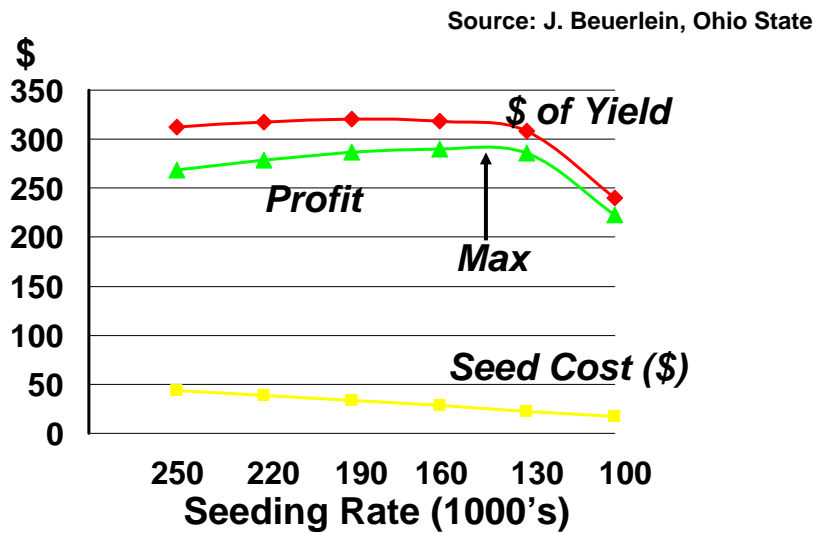
Source: E. Nafziger  
University of Illinois

### Should Yield Environment Affect Seeding Rate

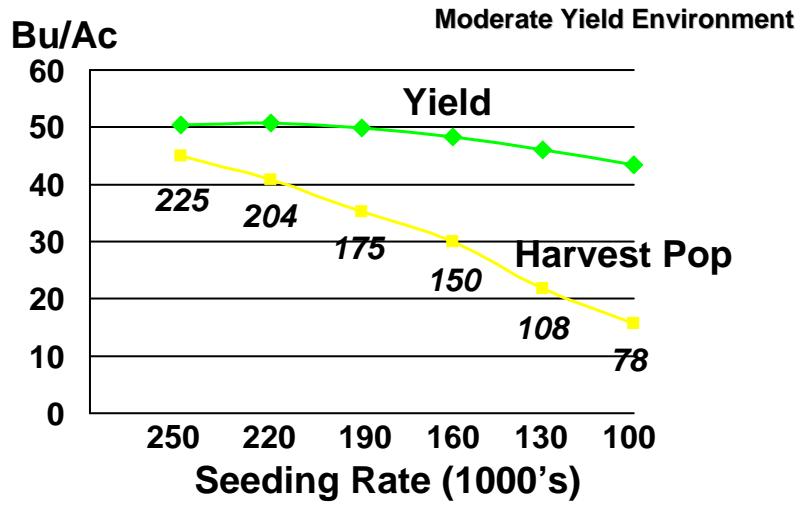


Source: J. Beuerlein, Ohio State

### Economic Analysis for a High Yield Field



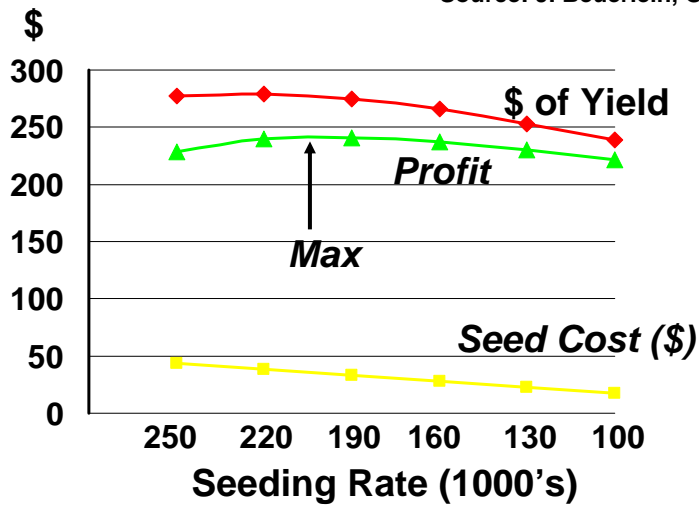
### Should Yield Environment Affect Seeding Rate



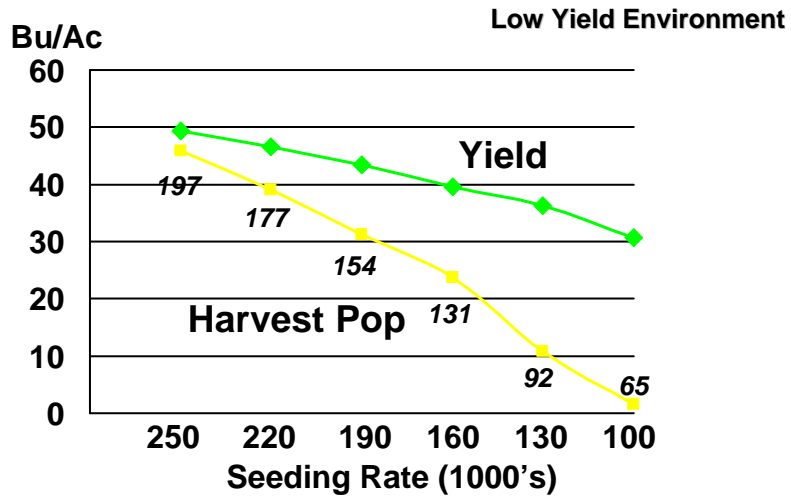
Source: J. Beuerlein, Ohio State

### Economic Analysis for a Medium Yield Field

Source: J. Beuerlein, Ohio State

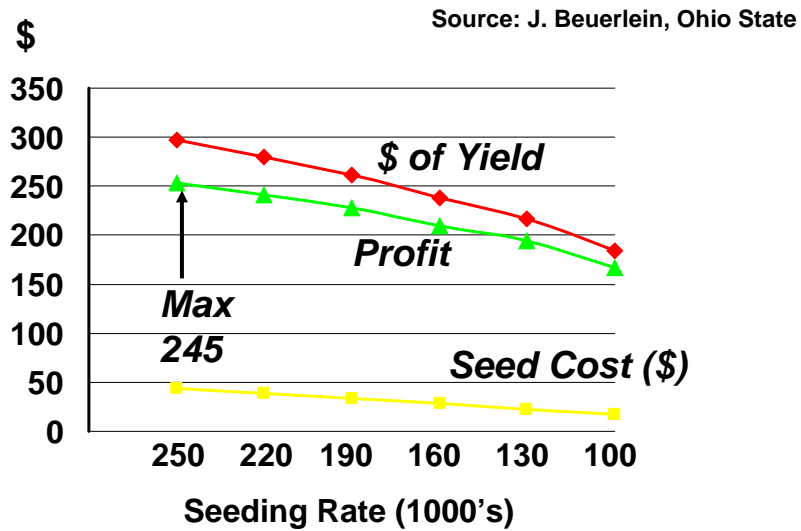


### Should Yield Environment Affect Seeding Rate



Source: J. Beuerlein, Ohio State

### Economic Analysis for a Low Yield Field





## Conclusions

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- 7.5 and 15 inch rows still out-yield 30 inch rows under optimal conditions
- Early planting pays if you seed the correct maturity group soybean
- All you need is 100,000 plants a<sup>-1</sup> in moderate to high yield fields