Current issues in soybean production

Vince M. Davis
University of Illinois
Soybean Extension Specialist
(217) 244-7497 : davisv@illinois.edu

the Bulletin Newsletter: http://ipm.illinois.edu/bulletin
Blog: http://soybean.extension.illinois.edu
Follow me on Twitter: www.twitter.com/vmdavis

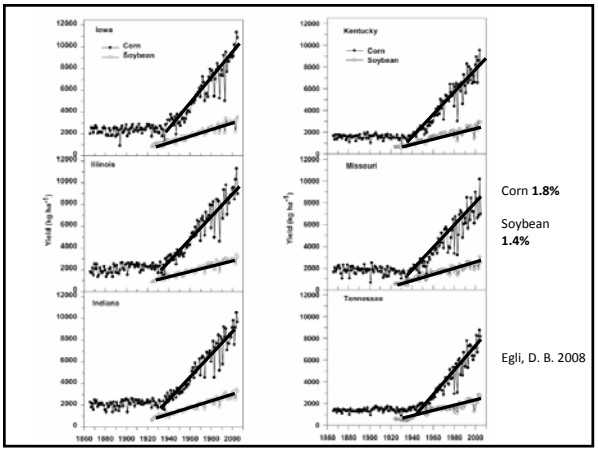
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

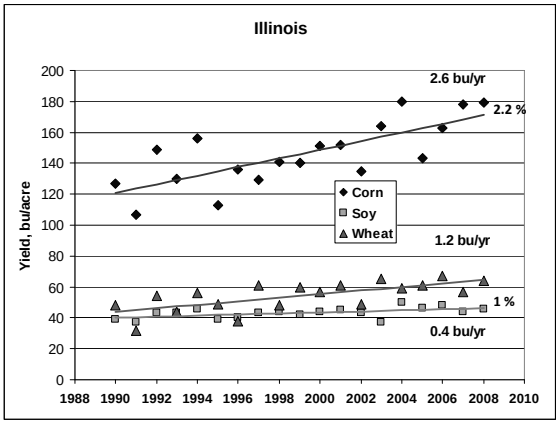
Current issues in soybean production

- Desire to increase soybean yield
  - Soybean yield plateau, perceived or real?
  - Genetic traits for high yield
  - High inputs/management for high yield
- Exponential soybean seed costs increases
  - Reducing soybean seeding rates
    - How much do we really know about management in much lower soybean plant populations? (seed treatments, weed control, row spacing)
  - Increasing genetic trait availability
    - Herbicide-resistant weeds (including volunteer corn!)

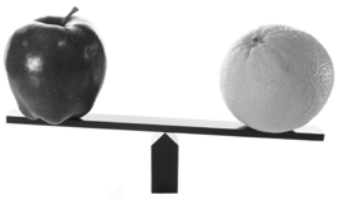
Soybean Yield Plateau perceived or real?

- Specht et al., 1999. Crop Sci.
  - Corn productivity is 2.8 times faster than soybean productivity with unlimited water (irrigated production)
  - Concluded corn and soybean *relative* rate of yield improvement was effectively identical and presented evidence that soybean yields were increasing at an exponential rate
- Egli, 2008. Agron. J.
  - Corn and soybean productivity relatively uniform rates for last 40 years (1.8% corn versus 1.4% soybean)
    - Effectively, no difference in the last 40 years





Soybean Yield Plateau perceived or real?



A bushel of corn is not the same as bushel of soybean

A bushel: Corn vs. Soybean

- 56 lb corn x 84.5% dry matter = 47.3 lb DM
- 60 lb soybean x 87% dry matter = 52.2 lb DM
  - A bushel of soybean has 10% more DM
- Difference in DM composition

	Carbohydrate	Protein	Oil
	~ %		
Corn	85	10	5
Soybean	40	40	20
	"Production Values" (McDermitt and Loomis 1981)		
Energy capture from glucose unit	0.83	0.40	0.33

'Plant cost' per bushel

	Carbo-hydrate	Protein	Oil	Total
	Lbs glucose needed per bushel			
Corn	48	12	7	67
Soybean	25	52	32	109

- Effectively, soybean requires ~63% more energy per bushel than corn due to a difference in grain composition
- In addition, soybean C3 versus corn C4
  - Needs to 'work' over twice as 'hard'

The point,

- The train is not off the track,
  - But, there is no reason to be complacent
- We need to be realistic in our goals for increasing yield and evaluating management changes/inputs
- Be realistic about what inputs will do, there are NO "Magic Pills"

It takes a total management approach for high yields

- Appropriate fertility levels
- Variety selection
  - Including SCN and other appropriate protection traits
- Good planting and agronomic practices
  - Timely
  - Row spacing and seeding rate
- Increasing inputs for high yields??

Pest management protects yield potential

- Eliminate bushels lost to weeds
- Eliminate bushels lost to other pests by thresholds – MUST SCOUT!

Iowa State University fact sheet; Managing Soybean for High Yield, Dr. Palle Pedersen

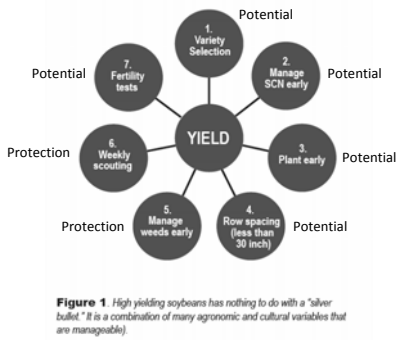


Figure 1. *High yielding soybeans has nothing to do with a "silver bullet." It is a combination of many agronomic and cultural variables that are manageable).*

Nutrient requirements soybean versus corn

	N	P_2O_5	K_2O	Mg	S
Soybean	Lb per bushel				
Grain	3.8	0.84	1.3	0.21	0.18
Stover	1.1	0.24	1.0	0.22	0.17
Total	4.9	1.08	2.3	0.43	0.35
Corn					
Grain	0.9	0.38	0.27	0.09	0.08
Stover	0.45	0.16	1.1	0.14	0.07
Total	1.35	0.54	1.37	0.23	0.15

International Plant Nutrition Institute: http://www.ppi-ppic.org/ppiweb/usanc.nsf/$webindex/E71D7CA9BD24A18D86257060007A8EB3

100 bu soybean vs 300 bu corn

	N	P_2O_5	K_2O	Mg	S
Soybean	Lb per 100 bushel				
Grain	380	84	130	21	18
Stover	110	24	100	22	17
Total	490	108	230	43	35
Corn	Lb per 300 bushel				
Grain	270	114	81	27	24
Stover	135	48	330	42	21
Total	405	162	411	69	45

International Plant Nutrition Institute: http://www.ppi-ppic.org/ppiweb/usanc.nsf/$webindex/E71D7CA9BD24A18D86257060007A8EB3

Fertility challenges

- Many fertilize for corn
  - Corn yields increasing, fertilizer rates constant to decreasing
- Not easy to add nitrogen without losing the benefit of nitrogen fixation
  - The efficiency of soybean to move nutrients during seed fill is poor and not well understood

Variety selection

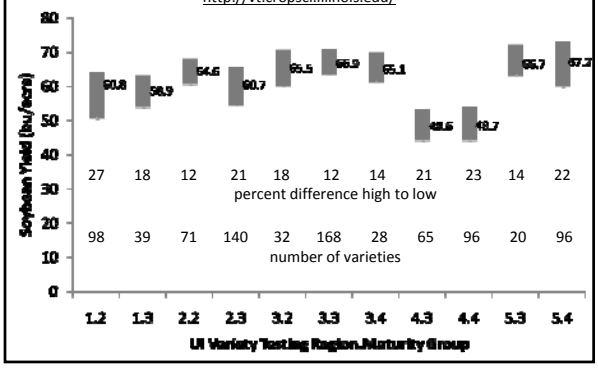
- Most important management decision!
- Improved breeding (molecular tools) for selecting high yielding varieties new on market: higher yield potential, higher cost
- UI Variety Testing Data http://vt.cropsci.illinois.edu/
- Variety Information Program for Soybeans (VIPS) http://www.vipsoybeans.org
- Purdue Crop Performance Program http://www.ag.purdue.edu/agry/PCPP/Pages/default.aspx

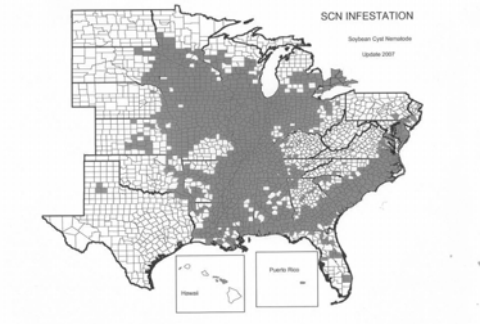
UI Variety Testing Regions

http://vt.cropsci.illinois.edu/

2009 UI Variety Testing Data

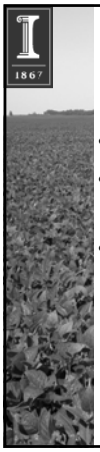
http://vt.cropsci.illinois.edu/





- Test your fields for SCN
- Use VIPS (Variety Information Program for Soybeans) http://www.vipsoybeans.org

(Riggs, 2007)



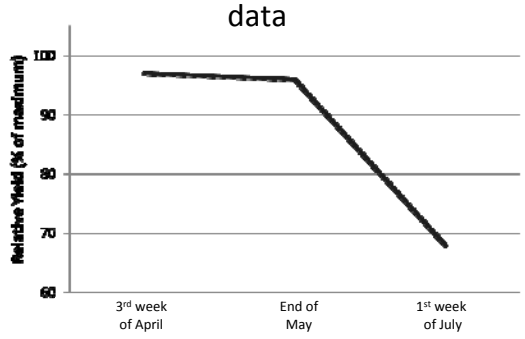
You must have 'good' planting practices

- Plant timely (*not necessarily early*)
- Row spacing less than 30 inch for high yields
- Seeding rate likely does NOT need to increase

Plant timely, not necessarily early

- Historical perspective
  - Egli D.B. and P.L. Cornelius. 2009. A Regional Analysis of the Response of Soybean Yield to Planting Date. Agron. J. 101:330-335.
  - They used data from 9 previous manuscripts (Midwest)
    - 1960, '79, '81, '81, '87, '88, '90, '90, 2005
  - In the Midwest rapid decline in soybean yield began on May 30th
    - 0.7% per day
      - (40 bu/acre = 0.3 bu; 50bu=0.35bu; 60bu=0.4bu)

Soybean yield loss due to planting date in the Midwest from historical data



Graphic data adapted from (Egli and Cornelius, 2009)

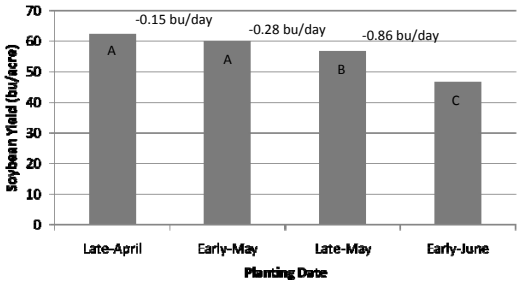
Plant timely, not necessarily early

- Robinson, A.P., S.P. Conley, J.J. Volenec, and J.B. Santini. 2009. Analysis of high yielding, early-planted soybean in Indiana. Agron. J. 101:131-139.
  - 6 planting dates (late-March to Mid-June), 3 varieties, 2006 and 2007
  - Yields were lower in Late-March and Mid-April versus late-April through Mid-May for 2 varieties, and yield were not increased for other 4
  - Last week of April through ~10th of May produced the highest yields
  - Yields decreased 0.5 bu/day after May 15th

Plant timely, not necessarily early

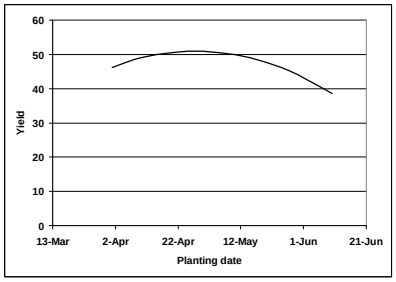
- De Bruin, J.L. and P. Pedersen. 2008. Soybean seed yield response to planting date and seeding rate in the Upper Midwest. Agron. J. 100:696-703.
  - 4 planting dates (late-April, Early-May, Late-May, Early-June), 6 locations, 2003 through 2006 (24 site-years)
  - Highest yields Late-April and Early-May

Soybean yield response for 24 site-years from 6 locations during 2003-2006 in Iowa



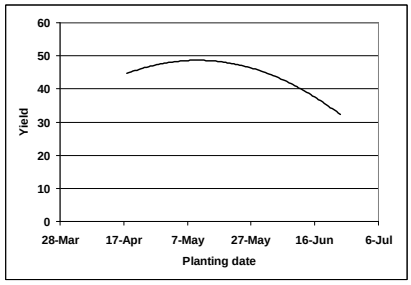
Graphic data adapted from (De Bruin and Pedersen, 2008)

Response to planting date in Illinois



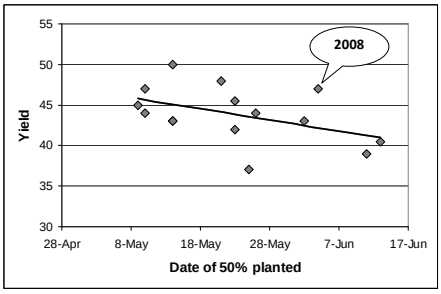
- 8 site-years in the 1990s at Monmouth and DeKalb
  - Planting date for the highest yield was April 27, and the yield loss was **0.10, 0.23, 0.36, and 0.54** bushels per day of delay for the **May 1-10, May 11-20, May 21-30, and June 1-10 periods**, respectively.

Response to planting date in Illinois



- 5 site-years at Brownstown and Dixon Springs, 2006-08
  - Planting date for the highest yield was May 9, and the yield loss was **0.10, 0.26, 0.42, and 0.59** bushels per day of delay for the **May 10-20, May 20-30, June 1-10, and June 10-20 periods**, respectively.

Response to planting date in Illinois



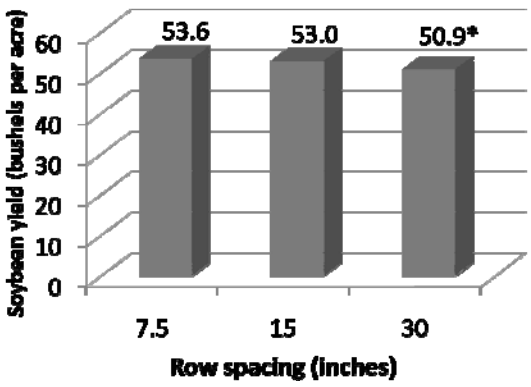
- Correlation between date of 50% completed soybean planting in Illinois and statewide yield (bu/acre), 1994-2008
- The date of 50% completed planting in 2009 was June 5th

Reducing soybean seeding rates: Is it risky?

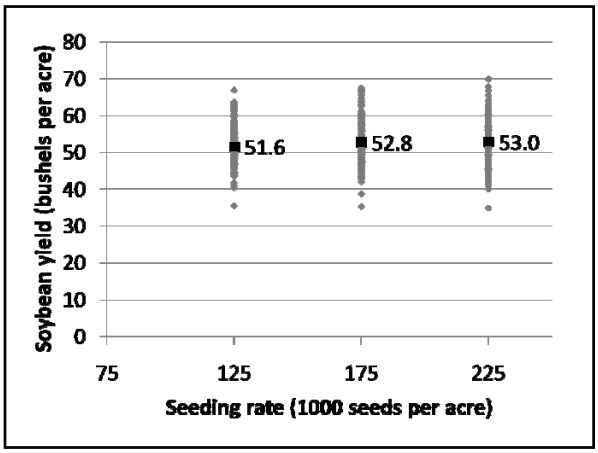
- May 8th 2009; issue 7 of *the Bulletin* and can be accessed at: http://ipm.illinois.edu/bulletin/article.php?id=1115
- What are the drawbacks to reduced seeding rates?
  - Established plant stand too low
  - Slower to canopy reducing weed suppression
  - Just does not 'look right'

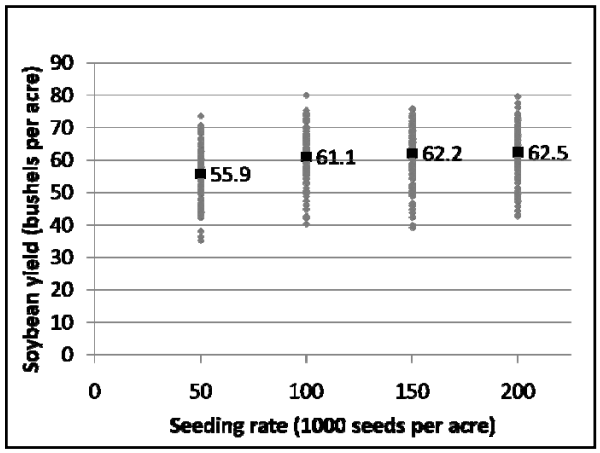
Two studies in Illinois

- 1) Eric Adee data from 1998 at Monmouth + 1999 and 2000 at Monmouth, DeKalb, and Urbana (7 site years)
  - 3 row widths 7.5", 15", and 30"
  - 3 seeding rates 125, 175, and 225 (X 1,000)
- 2) Emerson Nafziger (UI Variety Testing) 2005 -2008 (33 site years)
  - 4 seeding rates 50, 100, 150, and 200 (x 1,000)
  - 30" rows



*significant at alpha 0.05



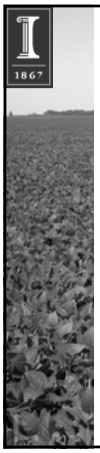


Economic Optimum Soybean Seeding Rates based on 33 site years of data generated from 2005 through 2008 at locations throughout Illinois

Price of soybean seed	Soybean value in dollars bushel^{-1}									
	7	8	9	10	11	12	13	14	15	16
$ 1000^{-1} seeds	Optimum seeding rate (1000 seeds acre^{-1})									
0.05	134	135	135	136	136	136	136	137	137	137
0.15	126	127	129	130	130	131	132	132	133	133
0.25	117	120	122	123	125	126	127	128	129	129
0.35	108	112	115	117	119	121	122	123	124	125
0.45	100	104	108	111	114	116	118	119	120	122
0.55	91	97	102	105	108	111	113	115	116	118
0.65	82	89	95	99	103	106	108	110	112	114

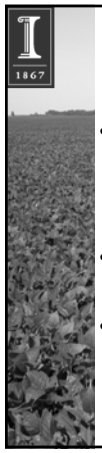
Economic optimum seeding rates based on price of soybean seed and product value

Price of soybean seed	Soybean value in dollars bushel^{-1}									
	7	8	9	10	11	12	13	14	15	16
$ 1000^{-1} seeds	Optimum seeding rate (1000 seeds ha^{-1})									
0.05	134	3,000 seeds per acre								137
0.15	126									133
0.25	117	The increasing importance in difference of Economic Optimum								129
0.35	108									125
0.45	100									122
0.55	91									118
0.65	82	32,000 seeds per acre								114



High input, or intensive management

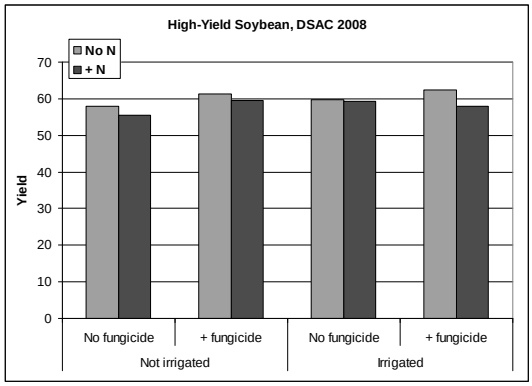
- I've done all that, what else?



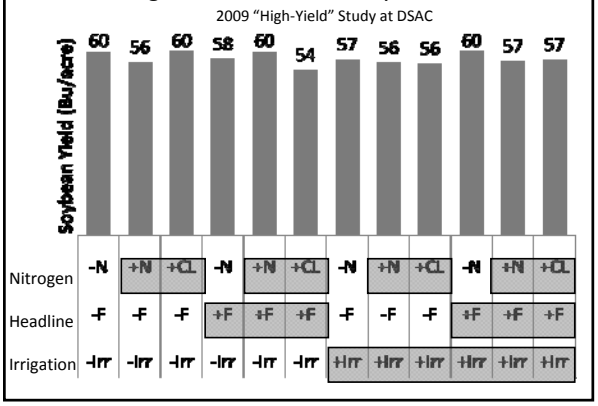
U of I "High-Yield" Soybean Management

- Funded by the IL Soybean Assoc. in 2008 at DSAC (Ebelhar) and at Urbana (Nafziger)
- Includes +/- sprinkler irrigation
- Fungicide and N (and sometimes other stuff) in combination within irrigation treatments

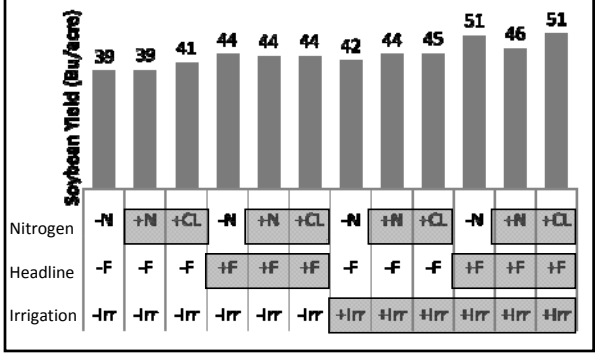
No Significant Effects of Any Treatments

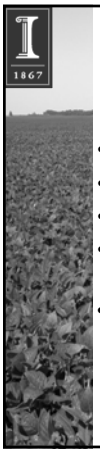


No Significant Effects of Any Treatments



2009 "High-Yield" Study at Brownstown, IL





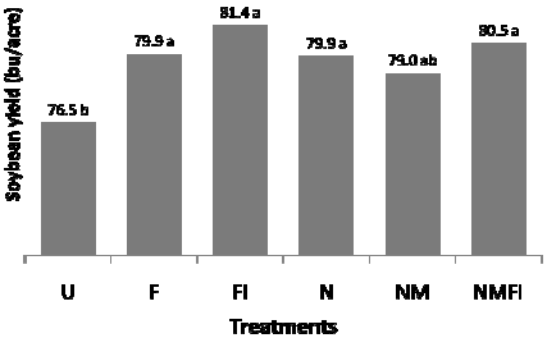
"High-Yield" Soybean at Urbana

- Nitrogen (urea at 100 lb/ac) at R2 and R5
- Fungicide (Headline) at R3 and R6
- Insecticide (Warrior) with fungicide at R3 and R6
- Micronutrient mix (Mn, Fe, Zn, S, B) + cytokinin at R2 and R5
- Stance (mepiquat chloride) stem shortener at R2, R3, and R5 (with N, F, and M)

Urbana "High-Yield" Soybean Study, 2008

Treatment	Irrigated	Not irrigated
	bushels per acre	
Untreated	63	59
Nitrogen	71	59
Fungicide	68	59
Micronutrients	62	58
Nitrogen+fungicide	68	60
Nitrogen+fungicide +micronutrients	67	61
Average	66	59

Urbana "High-Yield" Soybean Study, 2009

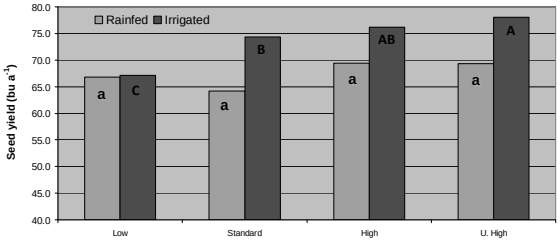


"High-Yield" Experiment in Wisconsin from Shawn Conley

- RCB split-plot design with 5 reps
  - Experimental unit: 20' by 50'

	Treatments									
		LOW INPUT		STANDARD		KITCHEN SINK		ULTRA KITCHEN SINK		
Irrigation	1	Irrigated	2	Irrigated	3	Irrigated	4	Irrigated		
Seeding Rate		175,000		175,000		260,000		260,000		
Fertigation		28%		28%		28%		28%		
Inoculant				Optimize		Optimize		Optimize		
Seed treatment				CruiserMaxx		CruiserMaxx		CruiserMaxx		
Foliar Insecticide				Warrior		Warrior		Warrior		
Foliar Fungicide				Headline (1x)		Headline (2x)		Headline (2x)		
						Quilt (1x)		Quilt (1x)		
Soil applied biocide						Contans		Contans		
Foliar nutrients						Micros (3x)		Micros (3x)		
Nitrogen						Chicken litter		Chicken litter		
P and K						40P + 80K		40P + 80K		
Ethephon								Yes		

Grain Yield by Management System



- No response to management in a rain-fed environment
- Significant ($p \leq 0.10$) management response in irrigated system

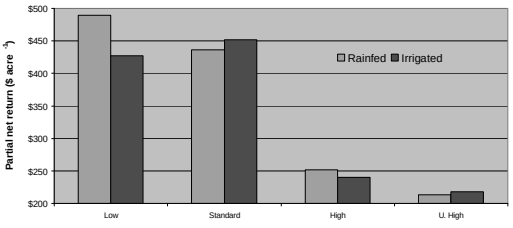
WI data from Shawn Conley

Differential Input Costs per Acre

		Irrigated				Rain-fed			
Input	Product	Low	Stnd	High	U. High	Low	Stnd	High	U. High
Irrigation		64.80	64.80	64.80	64.80				
Biocide	Contans WG			42.00	42.00			42.00	42.00
Manure	Chickity Doo Doo			43.00	43.00			43.00	43.00
N + P + K	dry fertilizer			68.00	68.00			68.00	68.00
Inoculant	Optimize		2.13	2.13	2.13		2.13	2.13	2.13
Seed treatment	Cruiser Maxx		9.50	9.50	9.50		9.50	9.50	9.50
Seed	DSR-2200	35.00	35.00			35.00	35.00		
Seed	DSR-2200			52.00	52.00			52.00	52.00
PGR	Pistill				31.09				31.09
Foliar fungicide	Headline		15.00	30.00	30.00		15.00	30.00	30.00
Foliar fungicide	Quilt			15.00	15.00			15.00	15.00
Foliar nutrients	Mangro DF+ plus B			13.00	13.00			13.00	13.00
Foliar nutrients	EB Mix			13.49	20.23			13.49	20.23
Foliar nutrients	28%	10.05	10.05	10.05	10.05				
Insecticide	Warrior		6.00	6.00	6.00		6.00	6.00	6.00
Total		109.85	142.48	368.97	406.80	35.00	67.63	294.11	331.95

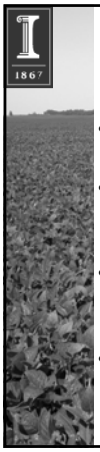
WI data from Shawn Conley

Comparison of System Profitability



- High input practices may not pay

WI data from Shawn Conley



Increasing soybean yield brings challenges

- Fundamental research questions need to be addressed
- Focus on proper agronomics: variety selection, fertility, planting date, row spacing, seeding rate, and scouting
- Technology to 'over come' time constraints and logistics of 'good' planting need to be developed/adopted
- There is no "magic pill" and increasing inputs may not pay, many products entering the market needs to be evaluated

Why talk about drift?

- **Complaints from specialty crop growers are on the rise.**
- **79% were from applications made to agronomic crops.**
- **Of agronomic crop drift complaints, 67% were from commercial applications and 25% from private applications.**

Why talk about drift?

- **Spotty pest control**
- **Wasted chemicals**
- **Off-target damage**
- **Litigious Society**
- **Result-higher costs-$$$**
- **Environmental impact**
- **More populated areas?**
- **Public more aware of pesticide concerns! (Negative)**

Why talk about drift?

- **Issues with giant ragweed, horseweed (marestail), waterhemp, lambsquarters**
- **Dicamba soybean**
- **DHT soybean**

Will Drift Affect You?

"One out of 10 will have to deal with a drift complaint." (Fred Whitford, Purdue Pesticide Program)

www.driftwatch.org