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Improving Soybean Productivity

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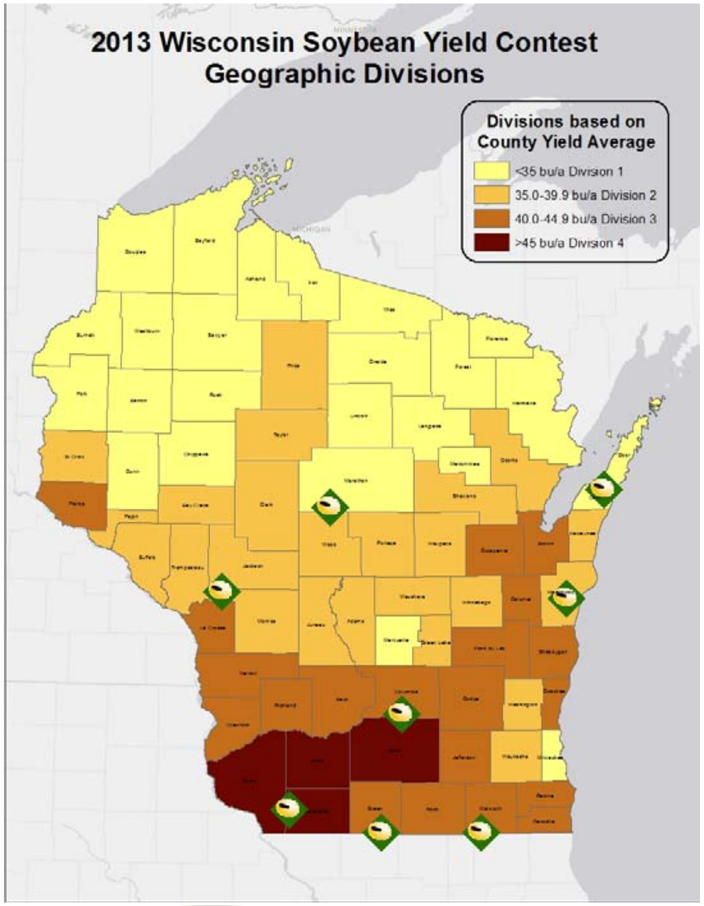
University of Wisconsin, Madison

UW Extension — University of Wisconsin-Extension

Wisconsin Soybean Marketing Board

Wisconsin — University of Wisconsin–Madison

2013 WI Soybean Yield Contest Winners



Division	Rank	Contestant	County	Variety		Yield (bu/a)
1	1	Paul Graf	Door	Pioneer	90Y90	57.8
1	2	Steven Kloos	Marathon	Pioneer	91Y30	55.0
2	1	Steve Stetzer	Jackson	Pioneer	91Y90	71.2
2	2	Kennard Wagner	Manitowoc	Renk	RS183NR2	65.0
3	1	Rick Devoe	Green	Pioneer	P28T33R	92.1
3	2	Ron Ellis	Walworth	Dairyland	DSR-2190/R2Y	74.4
3	Recognized	UW-Gaspar,Marburger, Smidt	Columbia	Pioneer	P28T33R	87.4
4	1	Dean Booth	LaFayette	Asgrow	AG 2431	82.7
4	2	Mary Kay Booth	LaFayette	Asgrow	AG 2433	81.8

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Winners Management Practices

Avg. Planting date	May 14th
Avg. Seeding rate (seeds/acre)	176,111
	% using this practice
Inoculant	33
Seed fungicide	67
Seed insecticide	56
Foliar fungicide	56
Foliar insecticide	22
Row spacing < 30"	89
Conventional tillage	56
Previous crop not corn	11

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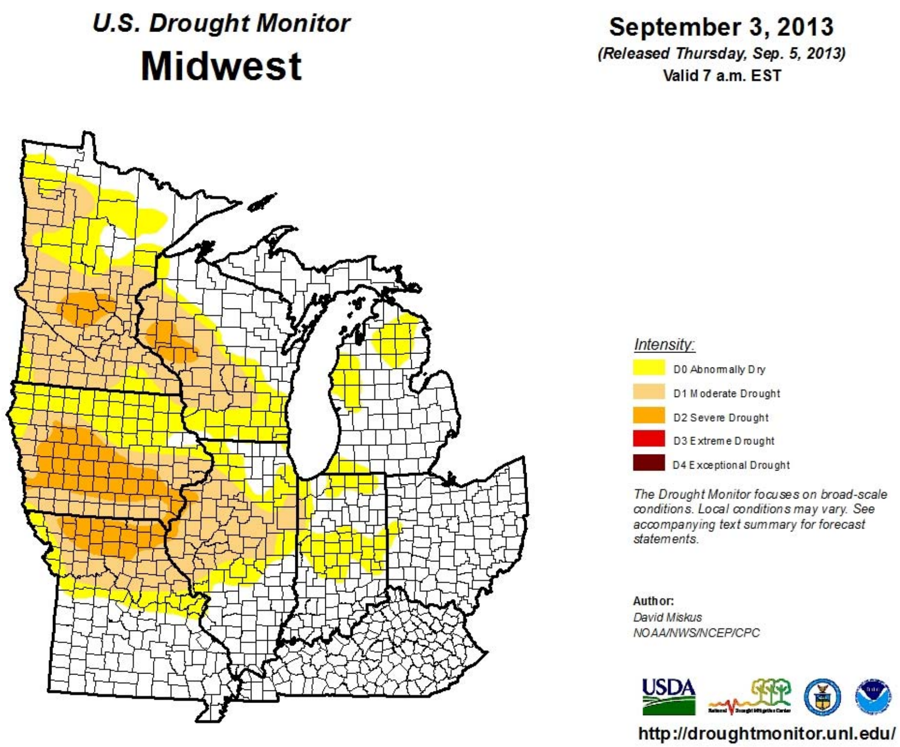
WI Soybean Program: The 5 W's



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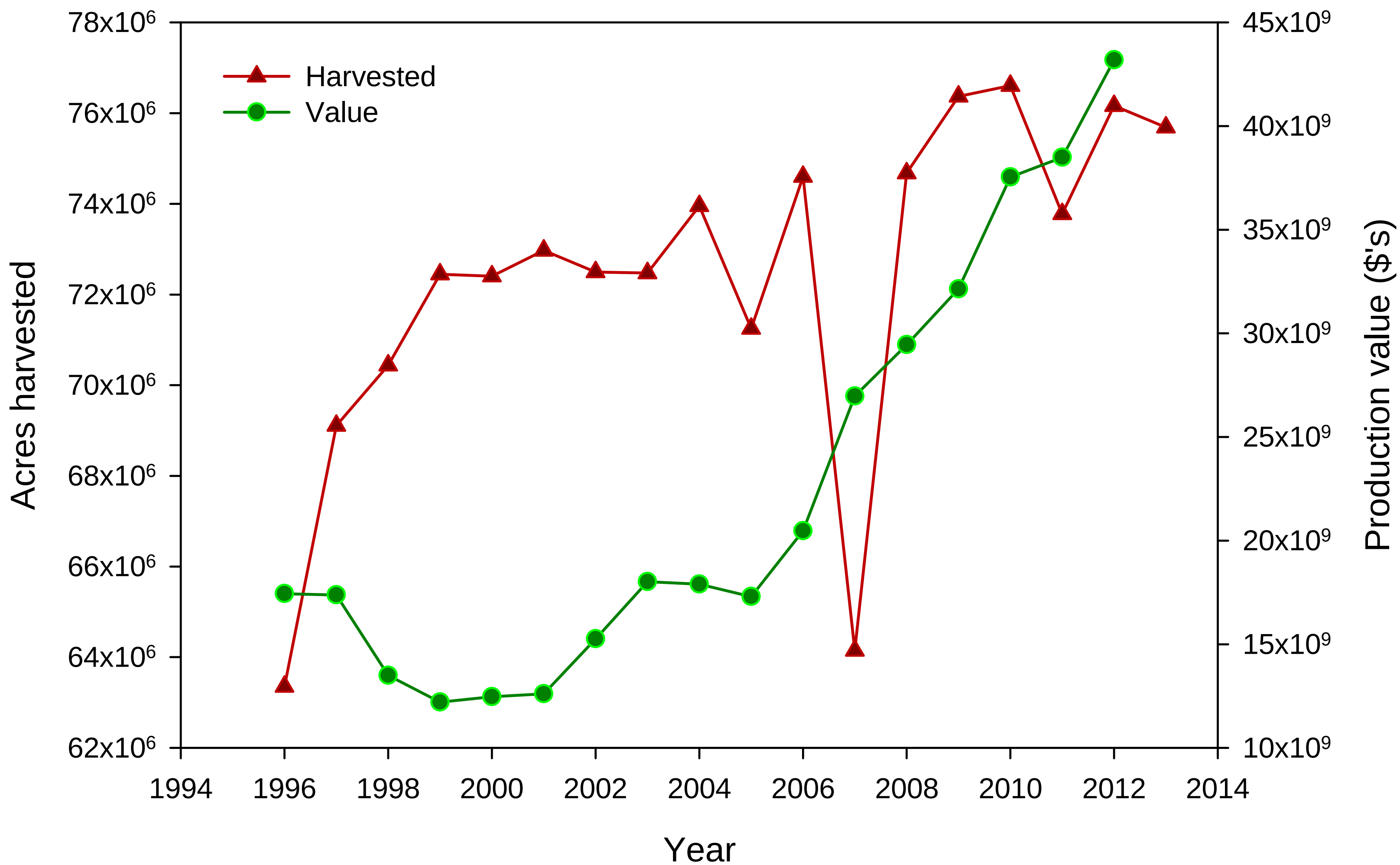
U.S. Soybean Acreage and Production Value 1996 - 2013



What input provides you the most consistent ROI annually?

	Responses	
	Percent	Count
Seed treatment	64.83%	188
Foliar feed	8.97%	26
Foliar insecticide	9.66%	28
Foliar fungicide	5.86%	17
No clue I just throw the kitchen sink at it and hope something pays	10.69%	31
Totals	**100%**	**290**

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Soybean Yield response to Trait and Management

- No published University data supporting that the soybean yield plateau can be overcome solely by
  - Intensive management (high input)
  - Adoption of new yield/input responsive traits (i.e. RR2Y)
- Goal is to quantify the effect of soybean trait and agronomic practice in soybean yield
  1. Characterize the effect of multiple input interactions on soybean yield
  2. Quantify soybean trait response to intensive management
- 3 sites
  - Arlington, Fond du Lac, Janesville
- 3 years
  - 2011 to 2013

Multiple Input Interactions on Yield

Main effect	P-value
Trait	0.3968
RR1/RR2Y	
Seed treatment	0.8825
ApronMaxx (1.5 fl oz/cwt)	
Optimize 400 (2.8 fl oz/cwt)	
Foliar fertilizer	0.9262
3-18-18 (3 gal per acre @ V6)	
Foliar insecticide	0.7701
Warrior w/Zenon (3.0 fl oz @ R2/3)	
Foliar fungicide	0.0281*
Quilt Xcel (14 fl oz @ R2/3)	

*Difference of Least Squares Means = 2.2075 bu/A

RR1 Variety	
Pioneer 92Y30	

RR2Y Varieties	
Dairyland DSR-2375/R2Y	(2011)
Dairyland DSR-2411/R2Y	(2012-13)

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Trait Response to Intensive Management

Main effect	P-value
Trait	0.7477
RR1/RR2Y	
Intensive Management	<.0001*
ApronMaxx (1.5 fl oz/cwt)	
Optimize 400 (2.8 fl oz/cwt)	
3-18-18 (3 gal per acre @ V6)	
Warrior w/Zenon (3.0 fl oz @ R2/3)	
Quilt Xcel (14 fl oz @ R2/3)	
Trait x Intensive Management	0.8558

*Difference of Least Square Means = 3.2748 bu/A

RR1 Varieties
Dairyland DSR-2011/RR
Pioneer 92Y30
Pioneer 92Y51
NK Brand S19-A6
NK Brand S21-N6

RR2Y Varieties	
Asgrow AG2631	(2011)
Asgrow AG2431	(2011-13)
Asgrow AG2232	(2013)
Dairyland DSR-2375/R2Y	(2011)
Dairyland DSR-2411/R2Y	(2012-13)
FS HiSoy HS24A01	(2011-12)
Renk RS241R2	(2011-13)
Trelay 25RR26	(2012)
Trelay 25RR91	(2013)

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U.S. trend toward earlier planting

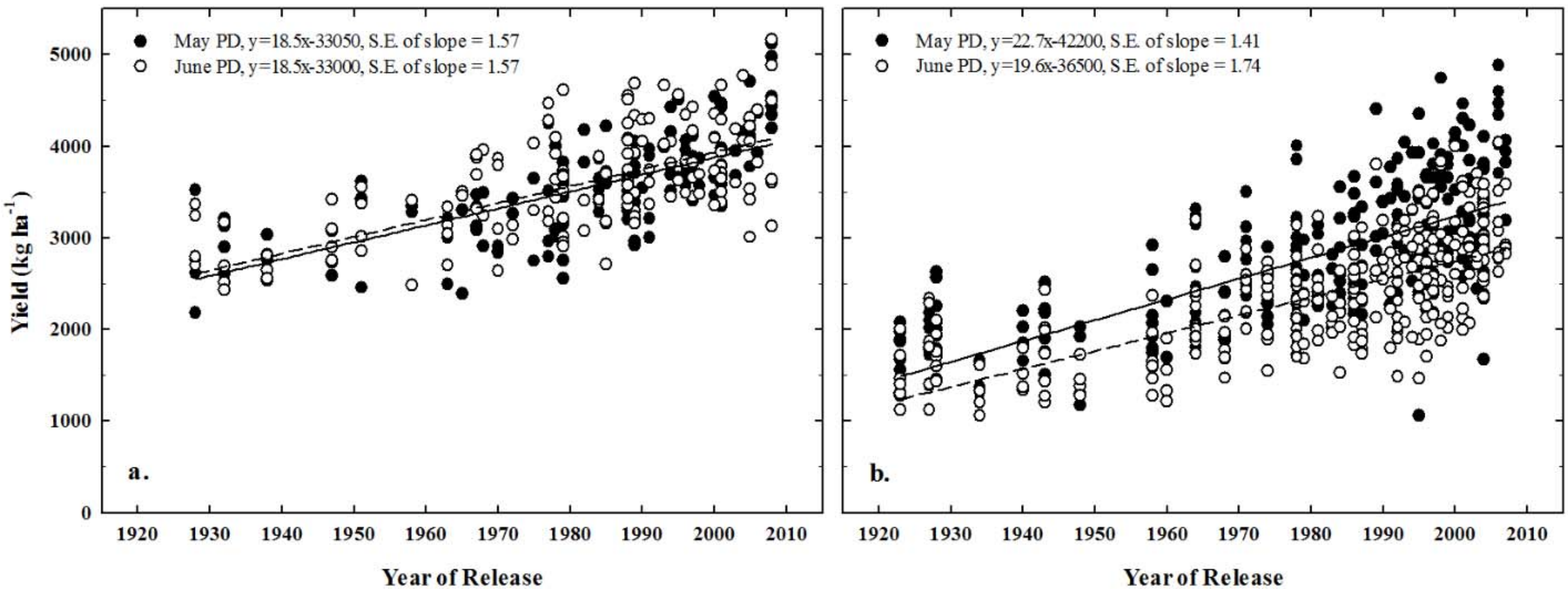
Percent of U.S. Soybean Area Planted by Week for the Period 1980-2010 (5-Year Avg.)‡

Week # †	17 24-Apr	18 1-May	19 8-May	20 15-May	21 22-May	22 29-May	23 5-Jun	24 12-Jun	25 19-Jun	26 26-Jun
Year										
1980	---	---	11	28	49	62	77	85	92	95
1985	---	3	11	23	40	55	71	81	88	94
1990	---	8	23	43	60	73	82	88	93	96
1995	---	---	19	37	53	67	78	86	93	---
2000	3	8	19	37	55	67	78	---	---	---
2005	9	23	39	56	71	82	90	94	---	---
2010	8	19	35	57	75	84	90	94	97	---

† -Date nearest corresponding week number ***Source: USDA-NASS, 2011**

‡ -Average percent planted of previous 5 years

MG II(a) & MG III(b) yield at early and late planting (2010-2011)



- **Within MGs, yields have improved over cultivar year of release (P<0.001). Represents the successful efforts made by breeders to improve soybean yield over time.** (Luedders, 1977; Wilcox et al., 1979; Specht and Williams, 1984; Wilcox, 2001; De Bruin and Pedersen, 2008b).
- **Within MG IIIs, there was a difference (P<0.05) in the rate of yield improvement over time between early and late plantings. *A synergistic interaction!***

Introduction

- *Fusarium virguliforme* causes sudden death syndrome of soybean

- Delaying planting has shown to reduce SDS symptoms
  - This work was done ~20 years ago (Hershman et al., 1990; Wrather et al., 1995)
    - Planting dates used in those studies started in mid May
  - Planting dates are trending earlier

F. virguliforme spores

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I have experienced SDS on my Farm/Territory

	Responses	
	Percent	Count
Yes	44%	132
No	37%	110
Not sure	19%	55
Totals	**100%**	**297**

Objective

- Quantify the impact of planting date on SDS development and yield loss
  - In other words, will planting earlier and increasing risk of SDS development be better or worse on yield than delaying planting and reducing risk of SDS development?

Materials and Methods

- Hancock Ag Research Station (irrigated)
- Experimental design
  - Split-split plot RCBD with 4 reps
    - o Main plots: Planting date (5/6, 5/24, 6/17)
    - o Subplots: 10 varieties ranging in susceptibility to SDS
    - o Sub-subplots: 2 inoculation treatments
      - Uninoculated vs. inoculated
        - Oat grains infested with *F. virguliforme* was placed in furrow at planting

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Materials and Methods

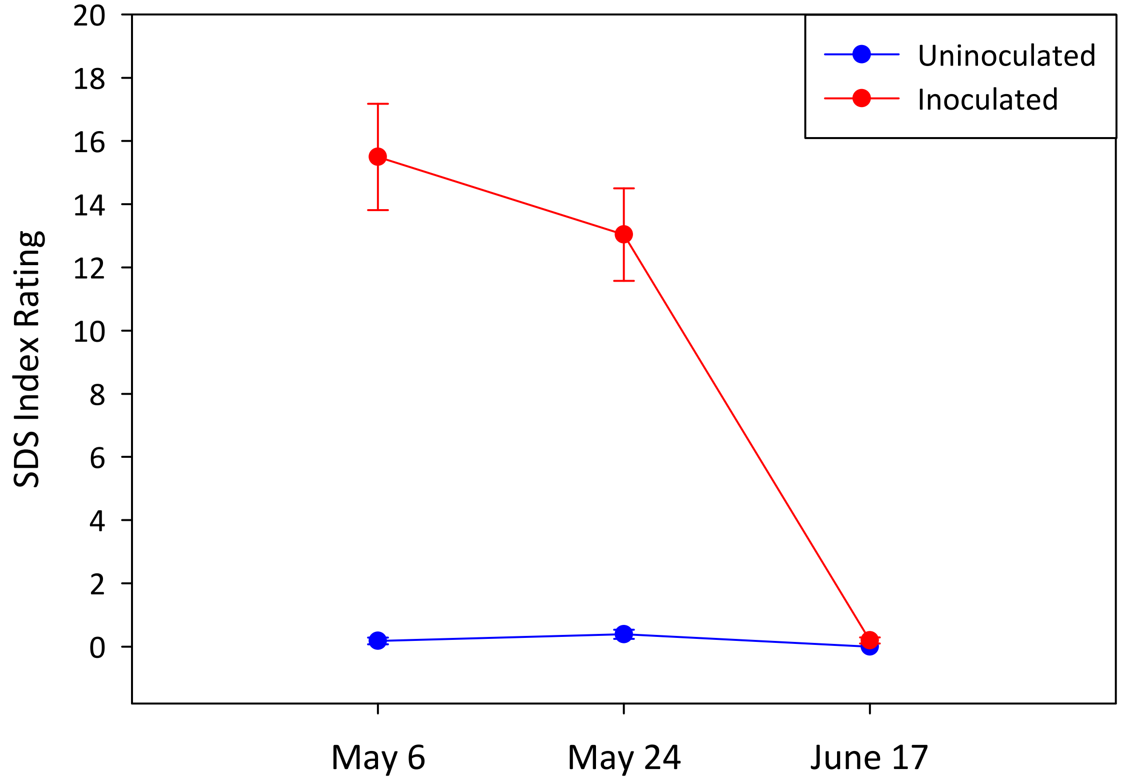
- Data collected
  - Soil samples at planting and R8 to determine SCN egg counts and *F. virguliforme* populations
  - Spring and fall stand counts
  - Weekly NDVI measurements
  - SDS ratings from R5.5/R6 to R7
  - Yield

Materials and Methods

- SDS rating protocol gives a Disease Index (DX)
  - DX is a combination of disease incidence (DI) and disease severity (DS). It is calculated as DI x DS/9, and has a range of 0 (no disease) to 100 (all plants prematurely dead at or before R6).
  - Disease Incidence (DI) DI = % of plants with leaf symptoms, recorded in increments of 5.
  - Disease Severity (DS) Record in increments of 0.5, scoring ONLY those plants showing symptoms:

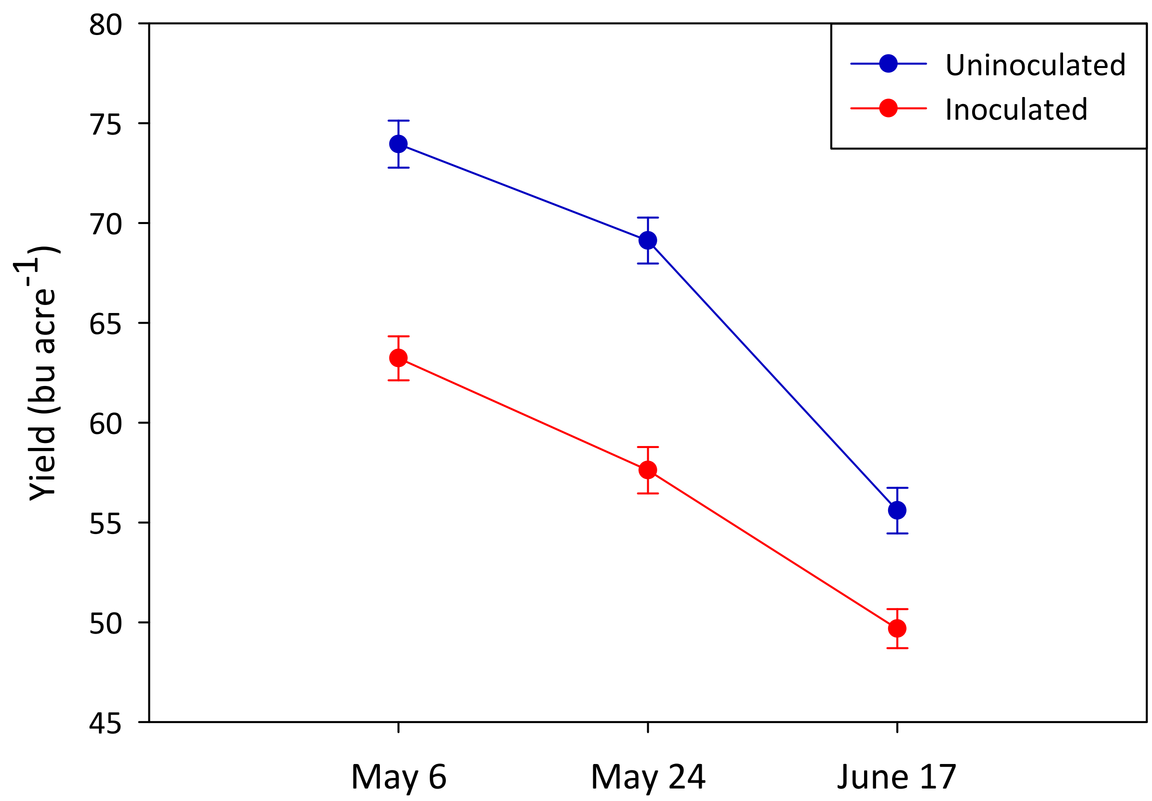
Score	Description of Symptoms
1	1-10% of leaf surface chlorotic, OR 1-5% necrotic
2	10-20% of leaf surface chlorotic, OR 6-10% necrotic
3	20-40% of leaf surface chlorotic, OR 11-20% necrotic
4	40-60% of leaf surface chlorotic, OR 21-40% necrotic
5	Greater than 60% of leaf surface chlorotic, OR greater than 40% necrotic
6	Premature leaf drop up to 1/3 defoliation
7	Premature leaf drop up to 2/3 defoliation
8	Premature leaf drop GREATER than 2/3 defoliation
9	Premature death

SDS Ratings



SDS Index Rating
20
18
16
14
12
10
8
6
4
2
0
Uninoculated
Inoculated
May 6
May 24
June 17

Yield



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Relationship Between SCN and SDS

- Has been studied for almost 30 years and results have been inconsistent
  - Some research says more severe SDS symptoms occur when SCN is present
  - Other research reports weak or no association

- Relationship between the actual presence of *F. virguliforme* in the soil as it relates the presence of SCN has been under- studied

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Objectives

- Determine the incidence of SCN and *F. virguliforme* in commercial soybean fields in WI
- Determine if establishment of these pathogens is interrelated

Materials and Methods

- Study was possible through the check-off funded Wisconsin Soybean Marketing Board (WSMB) SCN soil testing program which offers free testing to WI growers.

- Soil samples that were voluntarily submitted during 2011 and 2012 were tested for SCN and *F. virguliforme*.

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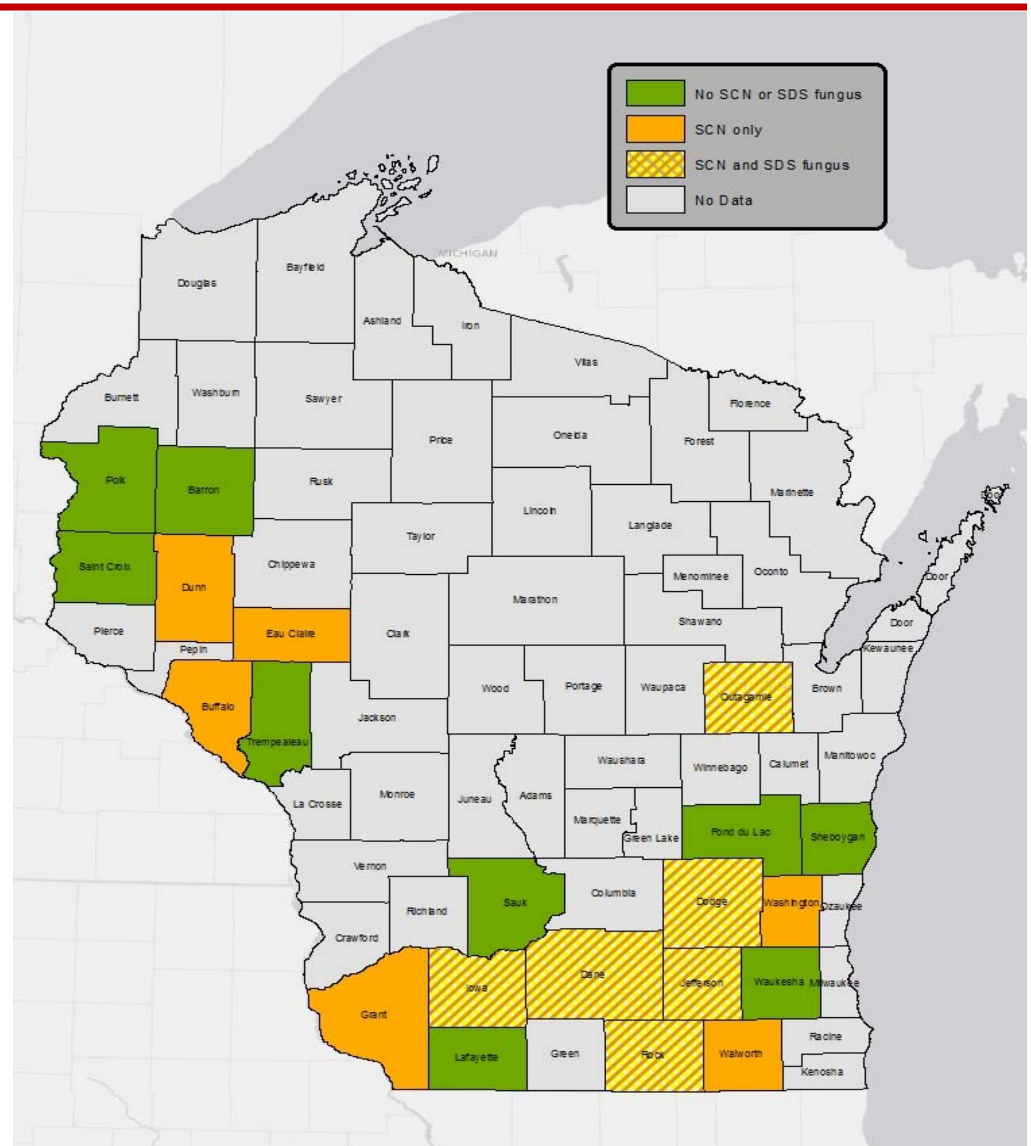
2011 Results

- 135 samples submitted
- 56 positive for SCN
- 10 positive for *F. virguliforme*



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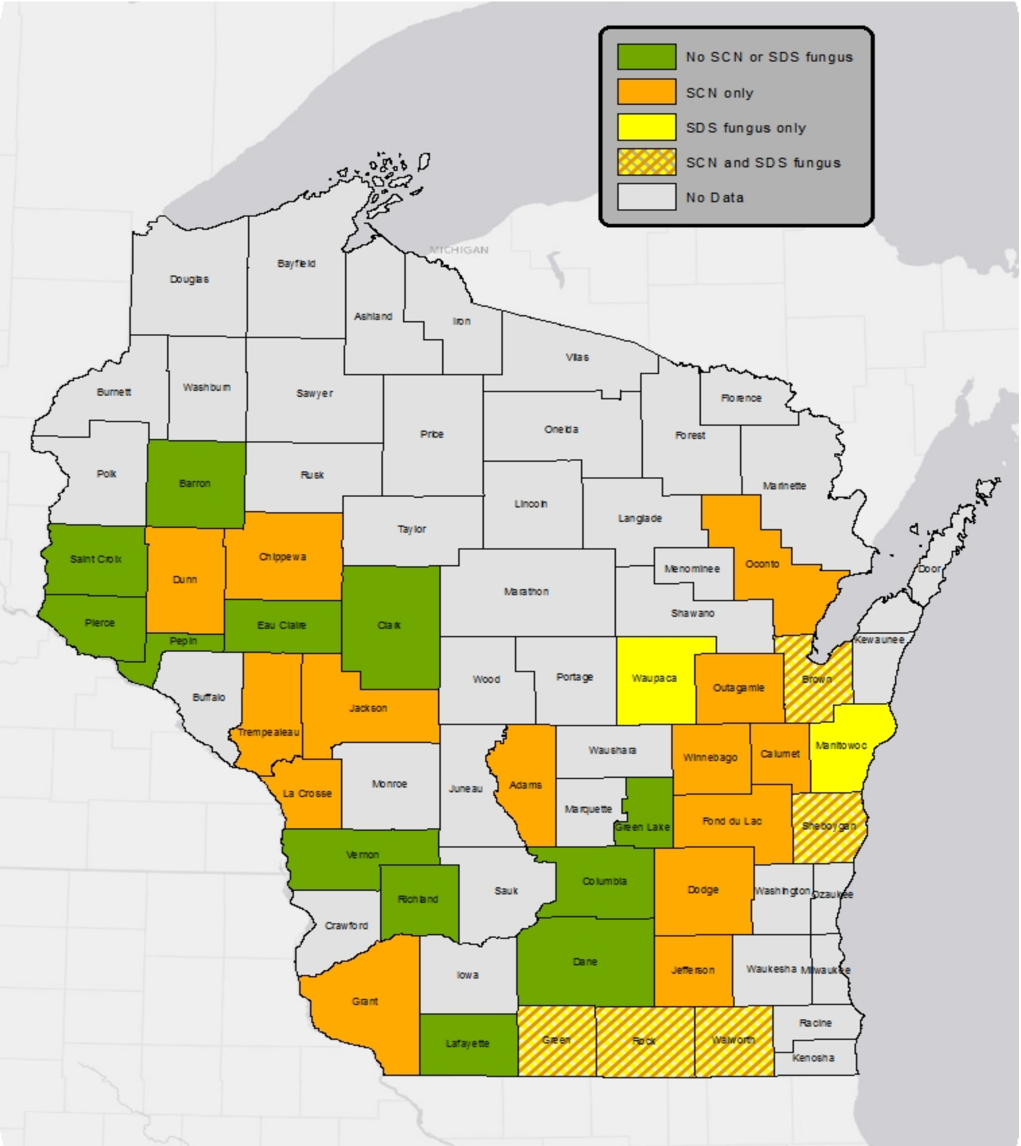
2012 Results

- 318 samples submitted
- 63 positive for SCN
- 13 positive for *F. virguliforme*



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Results

- Soil samples where both SCN and *F. virguliforme* were found in the same sample occurred infrequently (data not shown).
- Counties where both SCN and *F. virguliforme* were found were not common.
  - Our results also show *F. virguliforme* was found in counties farther west and north of the area where Bernstein et al. (2007) first found the pathogen.

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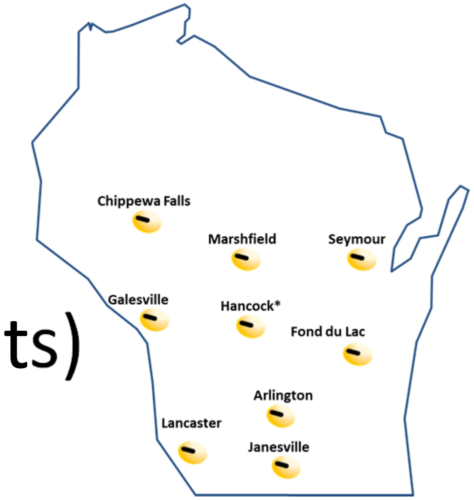
Conclusions

- Our study found a negative correlation between SCN and *F. virguliforme*, indicating that as the probability of finding *F. virguliforme* in a soil sample increases, the probability of finding SCN in the same soil sample decreases.
  - As the odds of detecting *F. virguliforme* in soil approach 100%, the likelihood of finding SCN in Wisconsin soybean fields is estimated at just 60%.
- This negative correlation suggests that SCN and *F. virguliforme* do not rely on each other to colonize fields.
  - Therefore, fields with heavy SCN pressure are not at greater risk for colonization by *F. virguliforme*.
  - However, in the infrequent case where SCN and *F. virguliforme* do occur together, symptoms of disease and damage by both pathogens can be synergistic.
    - Therefore, disease management practices for both pathogens should be implemented in these fields.

Generation 1 Trials



- Years: 2008 to 2010
- Locations: 9 each year (27 environments)
- Design: randomized complete block
- Three seed treatments:
  - Untreated control
  - ApronMaxx RFC
  - CruiserMaxx

Pathogens: *Pythium*, *Phytophthora*, *Fusarium*, *Rhizoctonia* spp., *Sclerotinia* and *Phomopsis* spp. (suppression)

Insects: aphids, bean leaf beetle, and seed corn maggot

- Four soybean varieties each year (not all used in all trial years)

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Esker and Conley. 2012. Crop Science 52:351-359.

Seed treatments?

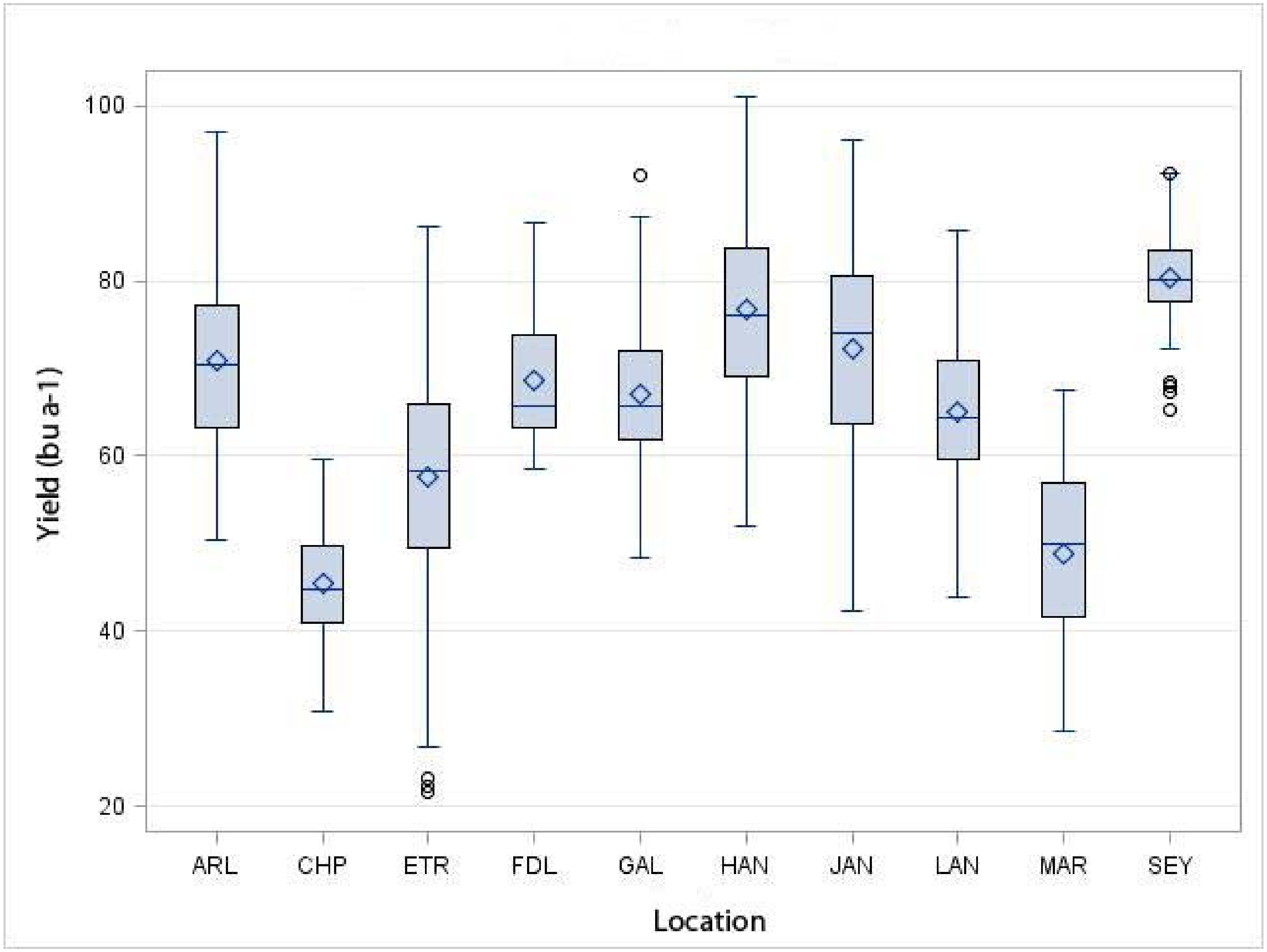
Seed treatment	RR	*P*	GSP = \$6 b^{-1}			GSP = \$9 bu^{-1}			GSP = \$12 bu^{-1}		
			AY = 40	AY = 60	AY = 80	AY = 40	AY = 60	AY = 80	AY = 40	AY = 60	AY = 80
			--------- -bu ac^{-1}-----------			------------bu ac^{-1}----------			------------bu ac^{-1}----------		
Apron Maxx	1.5	0.030	**42**	72	84	**72**	87	92	**84**	92	94
Cruiser Maxx	2.9	<0.001	**3**	56	88	**56**	93	100	**88**	98	98

The relative ratio means that the range in yield protected is ~ +0.6 bu ac^{-1} @ 40 bu ac^{-1} to 2.3 bu ac^{-1} @ 80 bu ac^{-1} for +1.5% or +2.9%, respectively

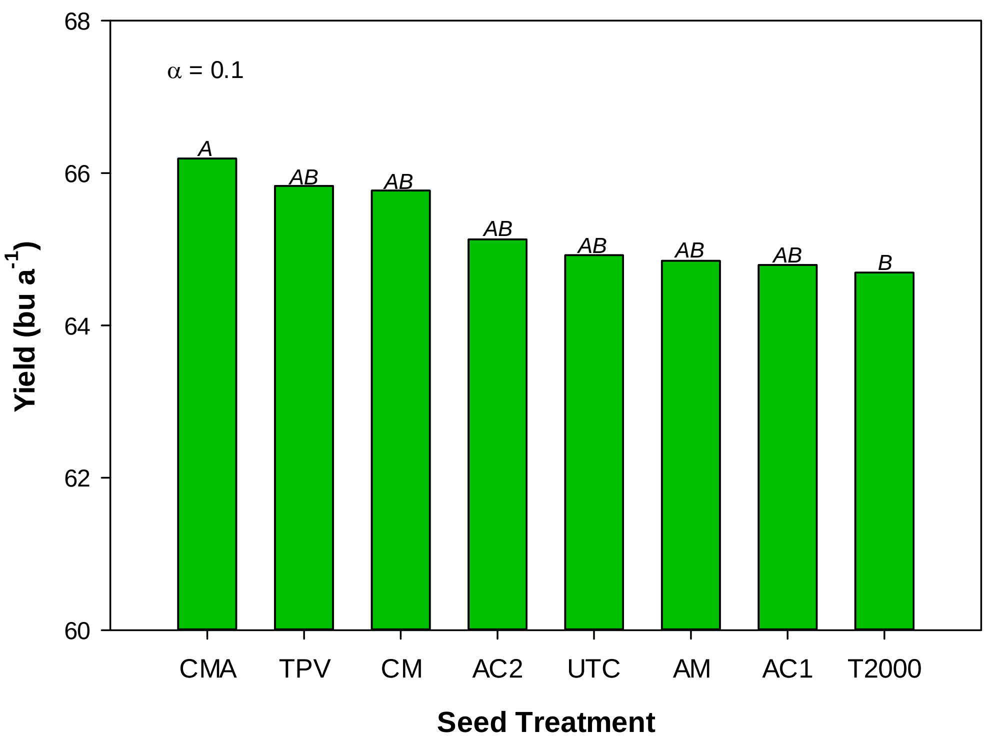
Soybean Seed Treatments

- Lots of options: Who wins!
- 10 sites
  - Arlington, Chippewa Falls, East Troy, Fond du Lac, Galesville, Hancock, Janesville, Lancaster, Marshfield, and Seymour
- 3 years
  - 2011 to 2013

Distribution of Yield (2011-12)



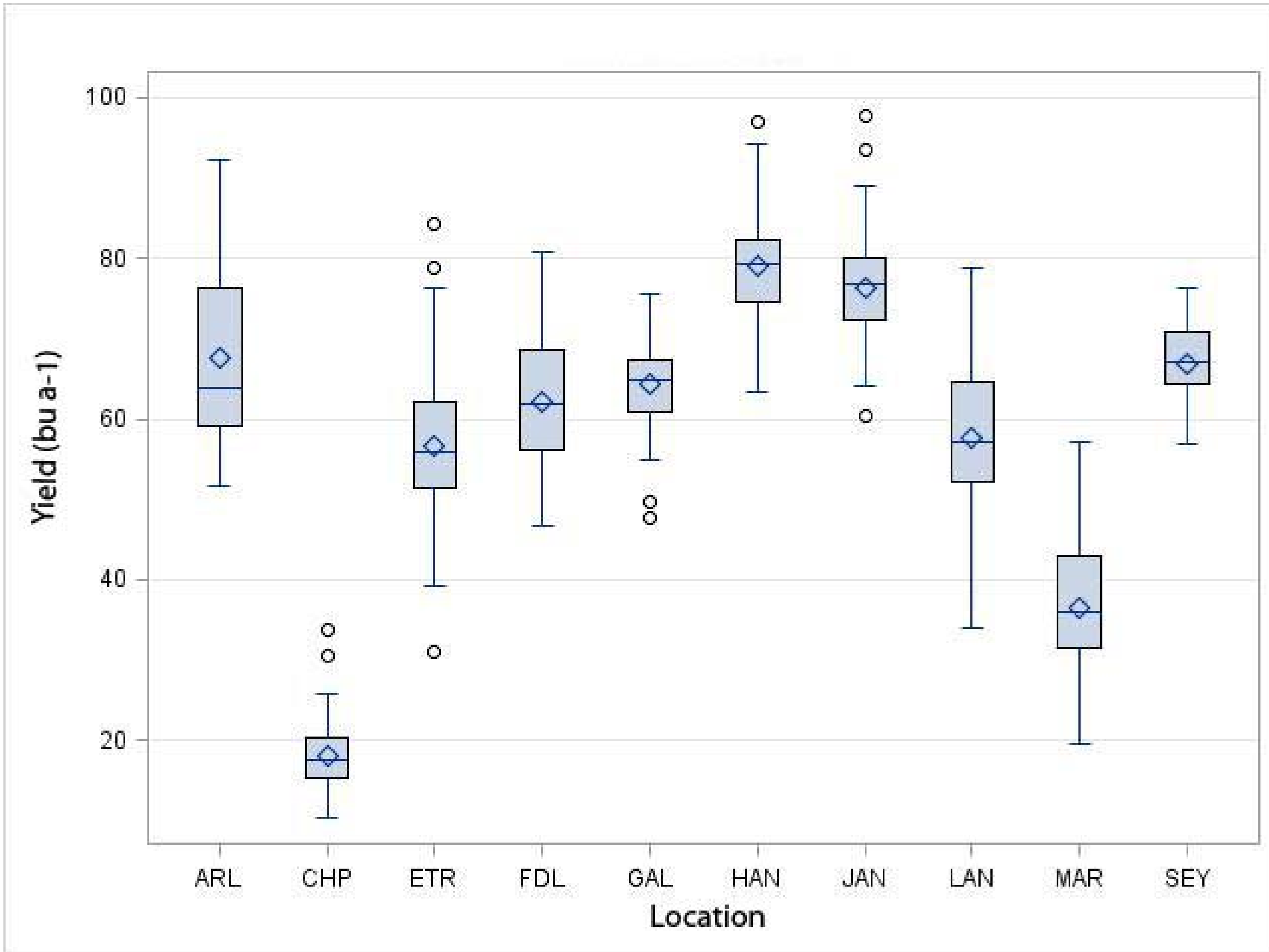
Soybean Seed Treatments (2011-12)



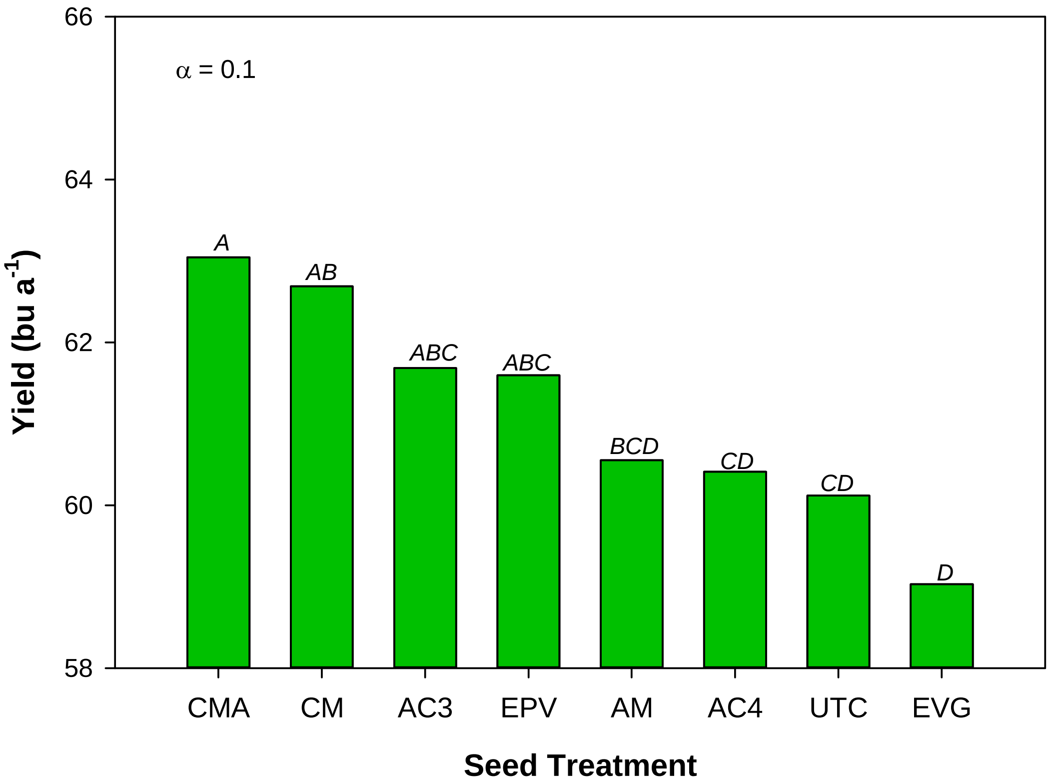
Code	Product	Rate	
UTC	none	--	
AM	ApronMaxx RFC	0.0094 mg ai/seed	
CM	ApronMaxx RFC	0.0094 mg ai/seed	
	Cruiser 5FS	0.085 mg ai/seed	
CMA	ApronMaxx RFC	0.0094 mg ai/seed	
	Cruiser 5FS	0.085 mg ai/seed	
	Avicta 500FS	0.15 mg ai/seed	
T2000	Trilex 2000	1.0 fl oz/cwt	
	Allegiance	0.55 fl oz/cwt	
TPV	Trilex 2000	1.0 fl oz/cwt	
	Allegiance	0.55 fl oz/cwt	
	Poncho/Votivo	2.0 fl oz/cwt	
	Precise 1010	1.5 fl oz/cwt	
	Gaucho	1.6 fl oz/cwt	*only in 2011
	Yield Shield	0.1 oz/cwt	*only in 2011
AC1	Acceleron DX-109	12.9 g/cwt	
	Acceleron DX-309	25.9 g/cwt	
AC2	Acceleron DX-109	12.9 g/cwt	
	Acceleron DX-309	25.9 g/cwt	
	Acceleron IX-409	72.8 g/cwt	

There was a significant variety
by treatment interaction

Distribution of Yield (2013)

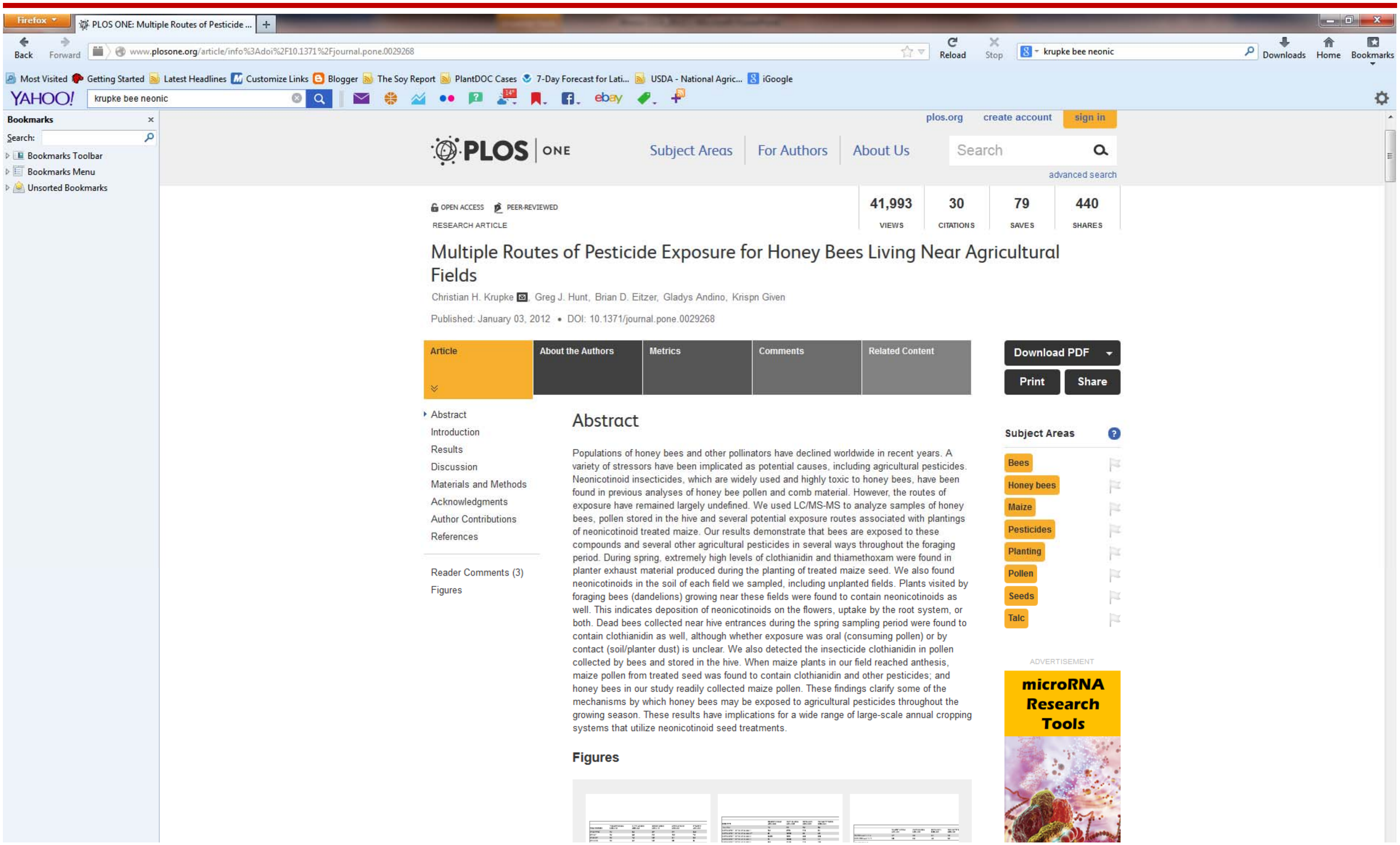


Soybean Seed Treatments (2013)



Code	Product	Rate
UTC	none	--
AM	ApronMaxx RFC	0.0094 mg ai/seed
CM	ApronMaxx RFC	0.0094 mg ai/seed
	Cruiser 5FS	0.0756 mg ai/seed
CMA	ApronMaxx RFC	0.0094 mg ai/seed
	Cruiser 5FS	0.0756 mg ai/seed
	Avicta 500FS	0.15 mg ai/seed
EVG	EverGol Energy	1.0 fl oz/cwt
	Precise 1010	1.5 fl oz/cwt
EPV	EverGol Energy	1.0 fl oz/cwt
	Poncho/Votivo	2.0 fl oz/cwt
	Precise 1010	1.5 fl oz/cwt
AC3	Acceleron DX-109	12.9 g/cwt
	Acceleron DX-309	25.9 g/cwt
	Acceleron DX-612	8.0 g/cwt
AC4	Acceleron DX-109	12.9 g/cwt
	Acceleron DX-309	25.9 g/cwt
	Acceleron DX-612	8.0 g/cwt
	Acceleron IX-409	72.8 g/cwt

No Free Lunch: Neonics and Honey Bees



NSSI: How Soy Sustainability Can Help you Meet Your Customers' Demands and Expand Your Markets

Shawn Conley, Deana Knuteson, AJ Bussan, Jeff Wyman, Paul D. Mitchell and Fengxia Dong: University of Wisconsin-Madison

Chuck Prellwitz and Ron Moore

ASA/USB/USSEC Joint Sustainability Task Force

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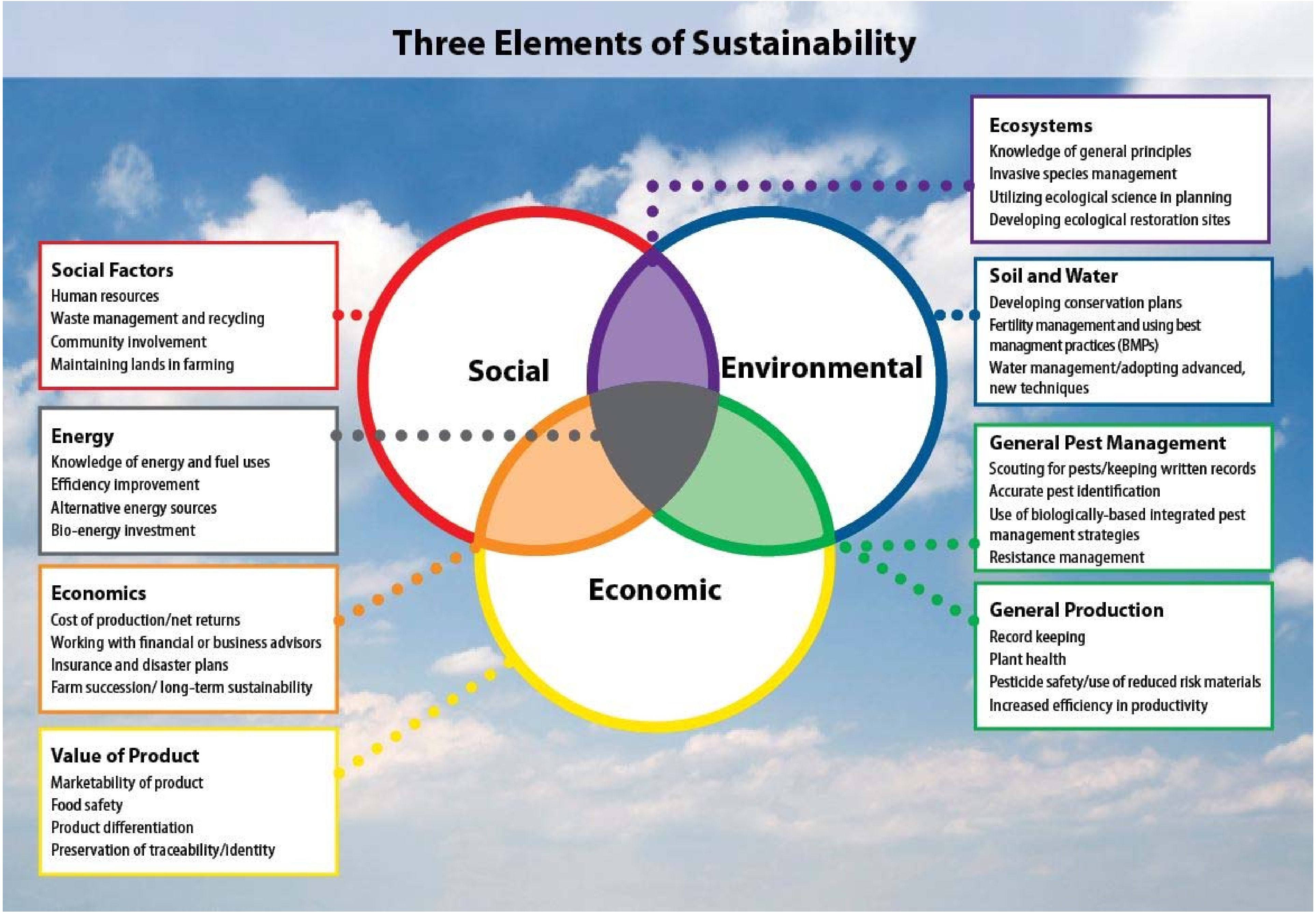

Three Elements of Sustainability
Social
Environmental
Economic
Social Factors
Human resources
Waste management and recycling
Community involvement
Maintaining lands in farming
Energy
Knowledge of energy and fuel uses
Efficiency improvement
Alternative energy sources
Bio-energy investment
Economics
Cost of production/net returns
Working with financial or business advisors
Insurance and disaster plans
Farm succession/ long-term sustainability
Value of Product
Marketability of product
Food safety
Product differentiation
Preservation of traceability/identity
Ecosystems
Knowledge of general principles
Invasive species management
Utilizing ecological science in planning
Developing ecological restoration sites
Soil and Water
Developing conservation plans
Fertility management and using best managment practices (BMPs)
Water management/adopting advanced, new techniques
General Pest Management
Scouting for pests/keeping written records
Accurate pest identification
Use of biologically-based integrated pest management strategies
Resistance management
General Production
Record keeping
Plant health
Pesticide safety/use of reduced risk materials
Increased efficiency in productivity

Soybean Data Collection

- Dec 2012 and Jan 2013 in WI and IL, plus online
- Data used for analysis
  - > 600 respondents
  - > 275,000 soybean acres
  - > 700,000 total acres
  - Expanding across the U.S. this winter
  - 70 questions from Soybean-specific survey
- Questions on pest scouting, rotational practices, nutrient management, etc.

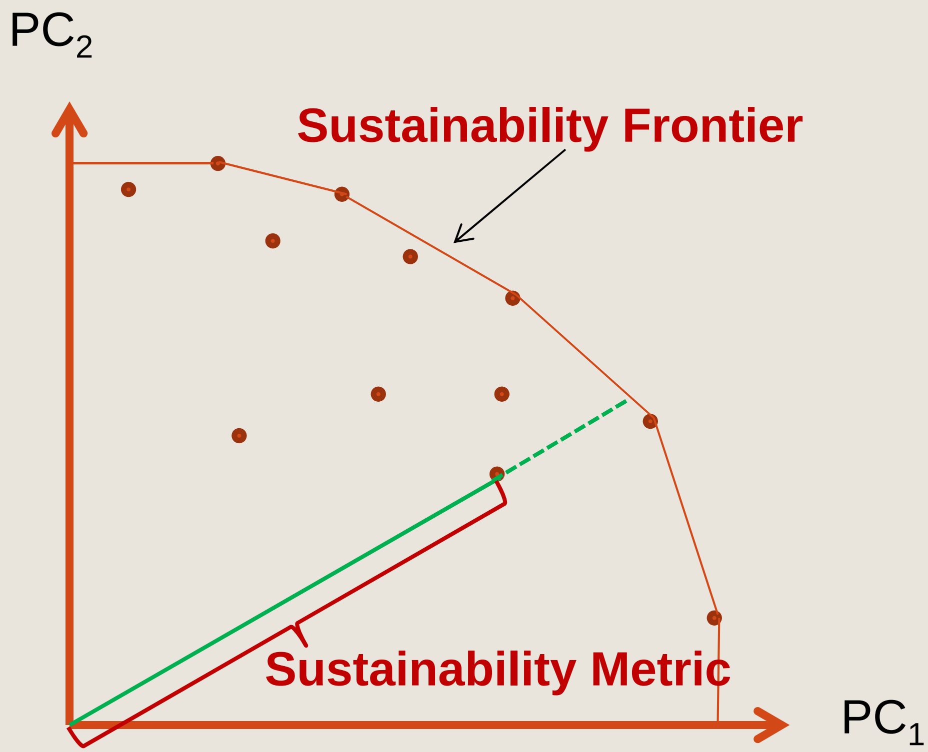
Principal Components

- Principal Component Analysis (PCA)
- Mathematically creates a new set of principal components (PCs) from the data that
  - Reduces number of variables
  - Removes correlation
  - Converts discrete to continuous variables
- Each PC measures intensity of farmer practice adoption, so larger PC is better

How do we Measure Sustainability?

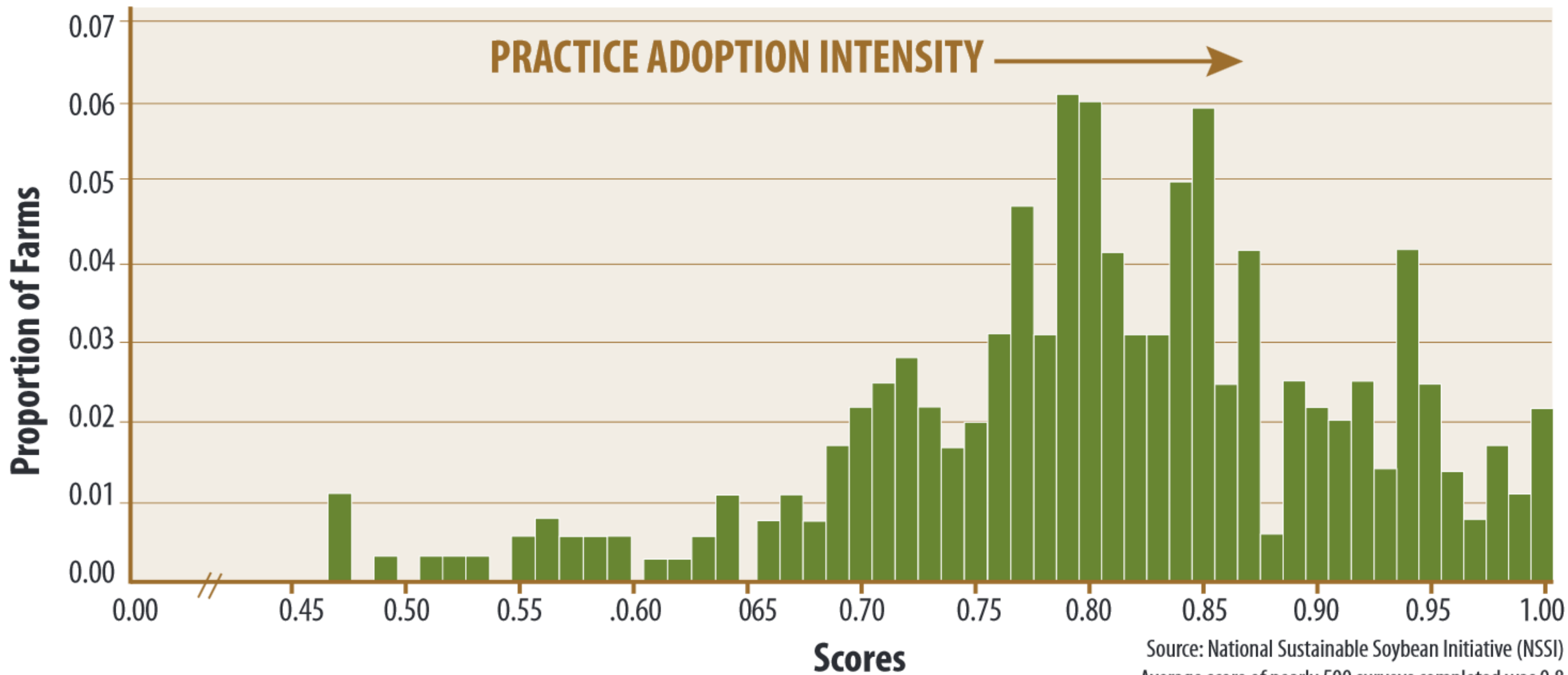
- After PCA, still lots of variables: 40 instead of 70
- Data Envelope Analysis (DEA) measures how intensely each farmer adopts sustainable practices relative to the best of his peer group
- Define a "Frontier of Sustainability" for the PC's – the best anyone has done = the most intense sustainable practice adoption
- Distance from origin relative to frontier gives a numerical measure of sustainability practice adoption that ranks each farmer relative to peers

Frontiers of Sustainability (Theory)



- Farmer practice adoption gives PC1 and PC2
- Plot these points: Each grower is a point
- DEA Frontier: outer envelope of points
- Distance from origin to point measures practice adoption intensity relative to frontier
- Max score = 1.0
- Min score = 0.0

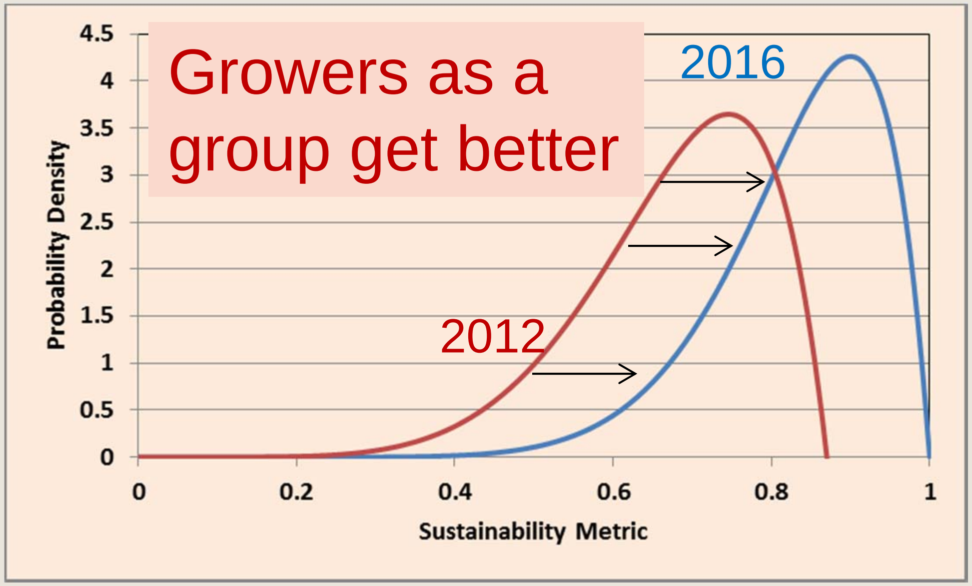
NSSI Sustainability Scores

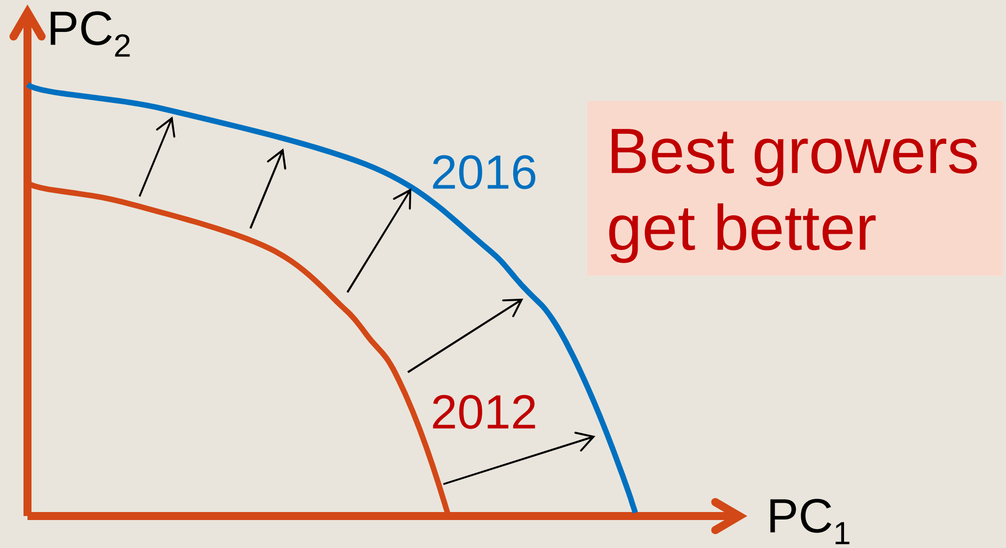


Source: National Sustainable Soybean Initiative (NSSI)
Average score of nearly 500 surveys completed was 0.8

Survey Results: Sustainability Practice Adoption and Percentage of Growers in Illinois and Wisconsin Implementing Research-based Practices:

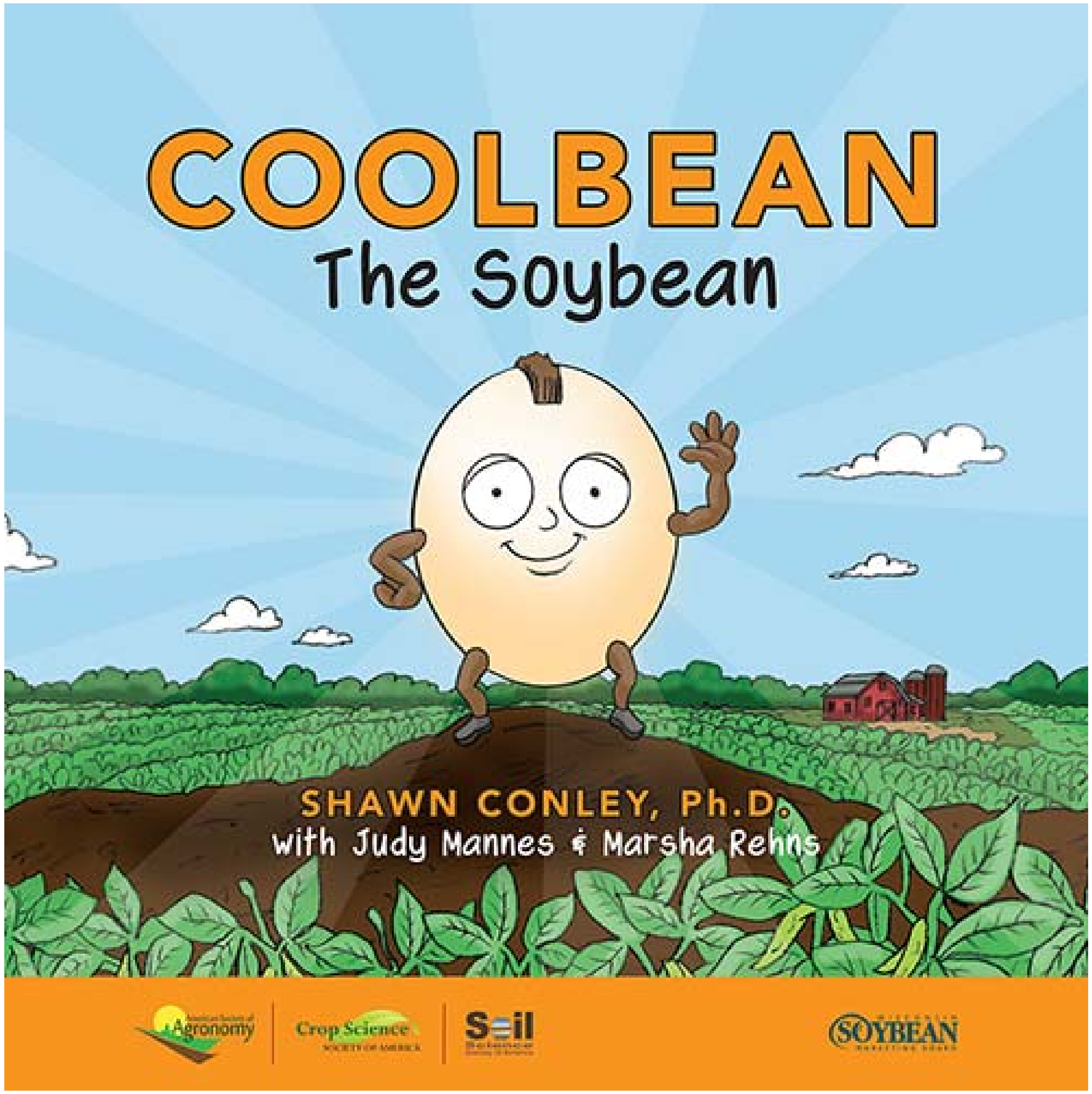
Sustainability Shifts over Time





- Recollect data and analyze to measure improvement over time by shift in sustainability score distribution and shift in sustainability frontier
- Documents that more growers are adopting more of the sustainable practices

Meet "Coolbean the Soybean"



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