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Agronomic Advantages and Benefits of Soybean Seed Treatments

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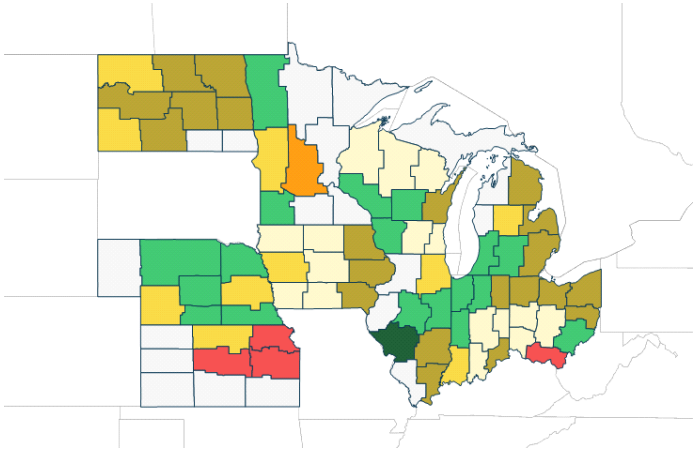
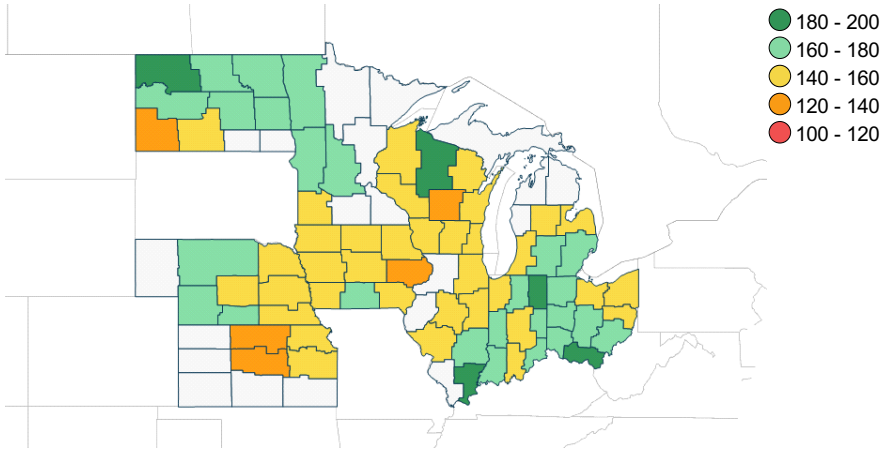
Agronomic Realities of U.S. Soybean Production a Benchmarking Project

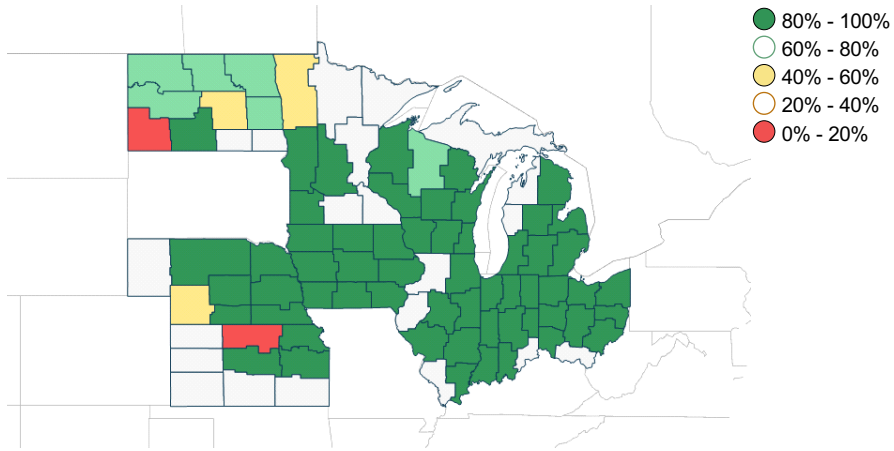
Average planting date



Average seeding rate (thousand seeds/ac)



% of fields with seed treatment



NCSRP NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

University of Nebraska Lincoln

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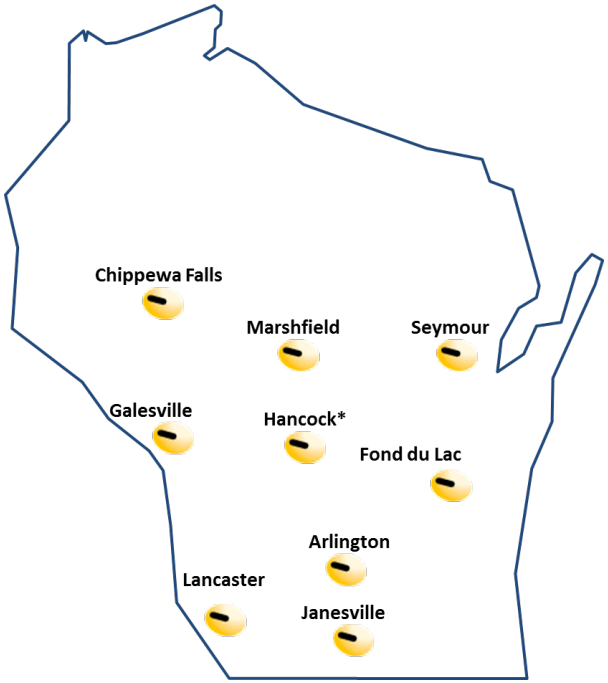
Grassini et al. 2016; N=3386

Probability of ROI: Gen 1 Trials

- Years: (2008 to 2010) **N =1,296**
- Locations: 9 each year (27 environments)
- Design: randomized complete block
- Three seed treatments:
  - Untreated control
  - ApronMaxx RFC
  - CruiserMaxx
- Seed rate: 172,000 seeds a^{-1}
- Row Spacing: 15 inch
- Four soybean varieties each year (not all used in all trial years)



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WISCONSIN SOYBEAN MARKETING BOARD

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

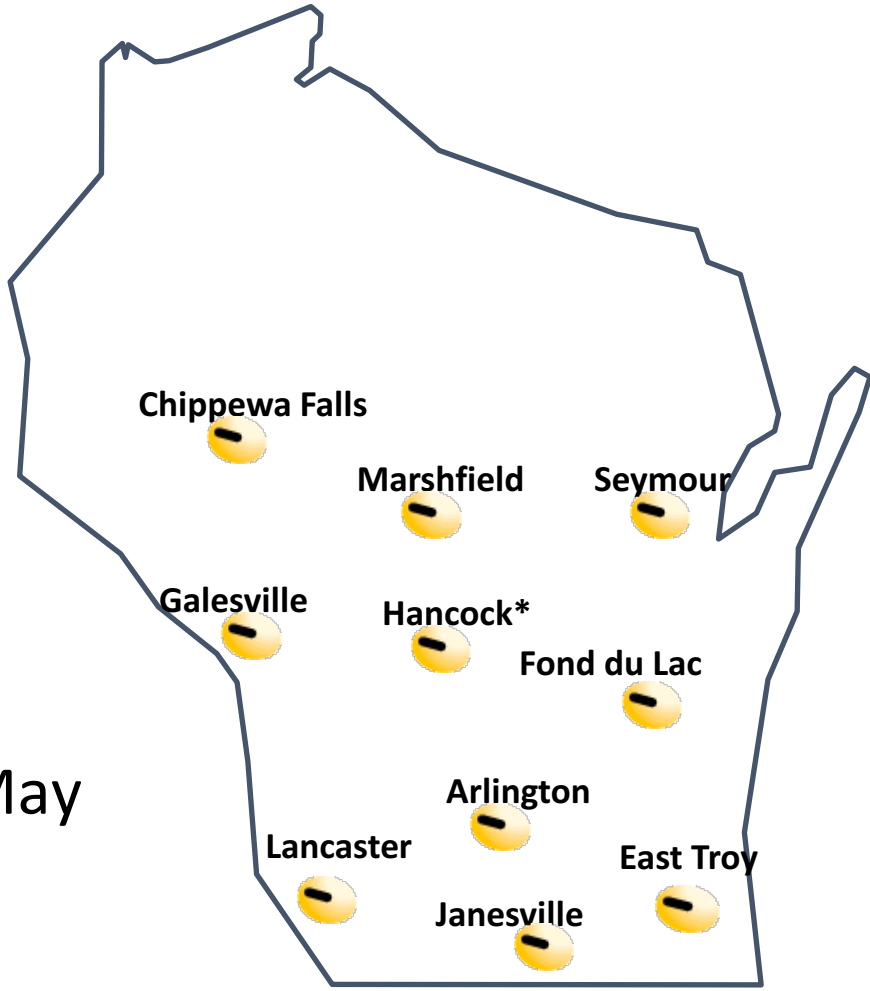
What is the Probability of ROI

			GSP = $6 bu^{-1}			GSP = $9 bu^{-1}			GSP = $12 bu^{-1}		
			AY =	AY =	AY =	AY =	AY =	AY =	AY =	AY =	AY =
Seed			**40**	**60**	**80**	**40**	**60**	**80**	**40**	**60**	**80**
treatment	**RR**	***P***	--------- -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

Lots' of Options…Who Wins?

- Years (2011-2013) **N =2,880**
- RCBD 3x8 factorial (4 reps)
- Seed Treatments (8)
- Varieties (3)
  - Pioneer 92Y30
  - Asgrow 2332
  - Syngenta 21-N6
- Row Spacing: 15 inch
- Planting Date: First 3 weeks in May
- Seeding Rate: 140,000 seeds a^{-1}



WISCONSIN SOYBEAN MARKETING BOARD

Gaspar et al. 2014. Agronomy Journal. 106: 6: 1955-1962

- Seed Treatments (8)
  - Syngenta Cruiser platform
  - Monsanto Acceleron platform
  - Bayer Trilex/Evergol & P/V platform

- Neonicotinoids included
  - Thiamethoxam
  - Clothianidin
  - Imidacloprid

Seed treatment trade name(s)	Seed treatment code†	Pesticide component‡	Active ingredients (a.i.)	Application rate
				Mg a.i. seed^{-1}
ApronMaxx®	AM	F	fludioxonil (F)	0.0038
			mefenoxam (F)	0.0056
Trilex® 2000	T2000	F	trifloxystrobin (F)	0.0081
			metalaxyl (F)	0.0065
EverGol™ Energy	EVG	F	prothioconazole (F)	0.0081
			penflufen (F)	0.0041
			metalaxyl (F)	0.0065
Acceleron®	AC1	F	pyraclostrobin (F)	0.0084
			metalaxyl (F)	0.0262
Acceleron®	AC3	F	pyraclostrobin (F)	0.0084
			metalaxyl (F)	0.0262
			fluxapyroxad (F)	0.0082
CruiserMaxx®	CM	FI	fludioxonil (F)	0.0038
			mefenoxam (F)	0.0056
			thiamethoxam (I)	0.0756
Acceleron®	AC2	FI	pyraclostrobin (F)	0.0084
			metalaxyl (F)	0.0262
			imidacloprid (I)	0.1266
Acceleron®	AC4	FI	pyraclostrobin (F)	0.0084
			metalaxyl (F)	0.0262
			fluxapyroxad (F)	0.0082
			imidacloprid (I)	0.1266
Trilex® 2000 + Yield Shield® + Gaucho® 600 + Poncho®/VOTiVO®	TPV	FIN	trifloxystrobin (F)	0.0081
			metalaxyl (F)	0.0065
			Bacillus pumilus (F)	0.000028
			imidacloprid (I)	0.1013
			clothianidin (I)	0.1056
			Bacillus firmus (N)§	0.0213
EverGol™ Energy + Poncho®/VOTiVO®	EPV	FIN	prothioconazole (F)	0.0081
			penflufen (F)	0.0041
			metalaxyl (F)	0.0065
			clothianidin (I)	0.1056
			Bacillus firmus (N)	0.0213
Avicta® Complete Beans 500	CMA	FIN	fludioxonil (F)	0.0038
			mefenoxam (F)	0.0056
			thiamethoxam (I)	0.0756
			abamectin (N)	0.1500

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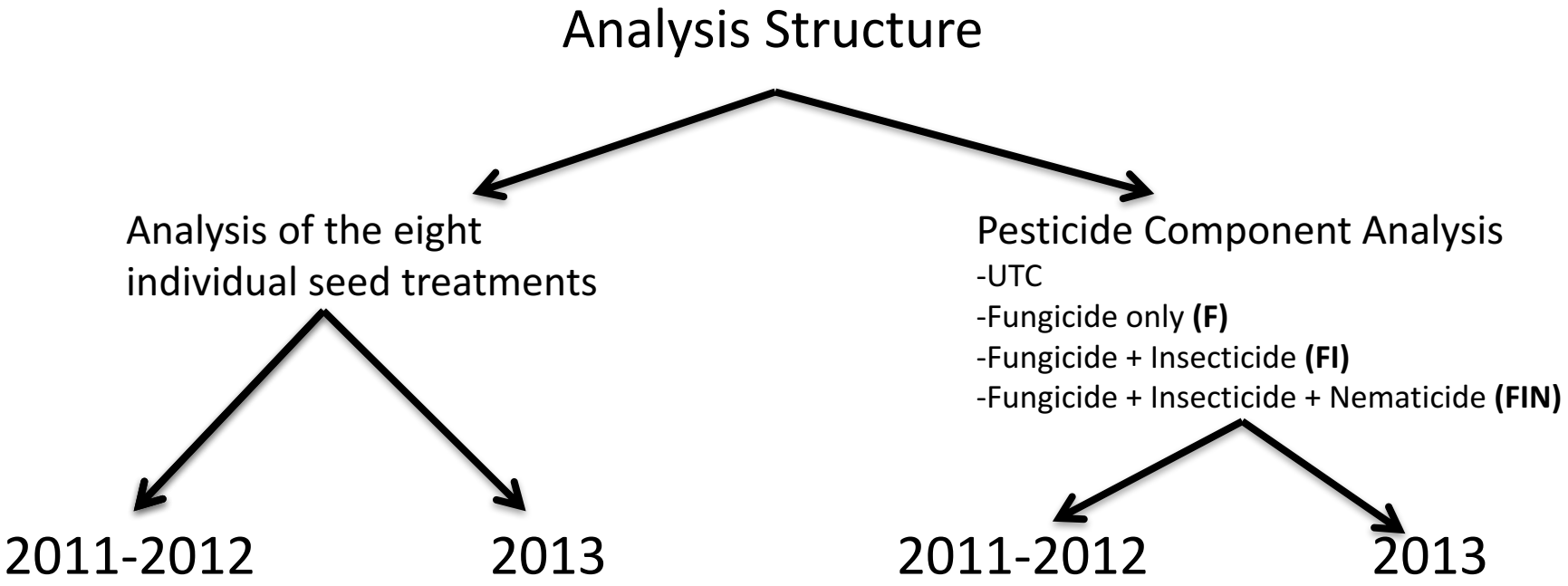
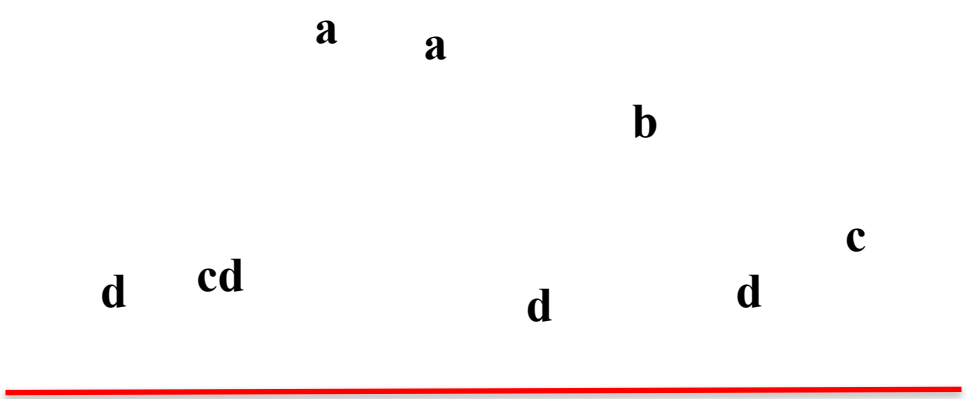
Statistical Analysis

- Seed treatment effects on plant stand and seed yield
- Mix model analysis
  - **Fixed effects:** seed treatment or pesticide component
  - **Random effects:** environment, variety, and replicate



Results: Plant Stand 2011-2012

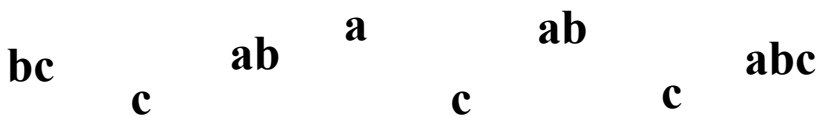
P < 0.0001



- Values followed by the same letter are not significantly difference at ***p* ≤ 0.10**

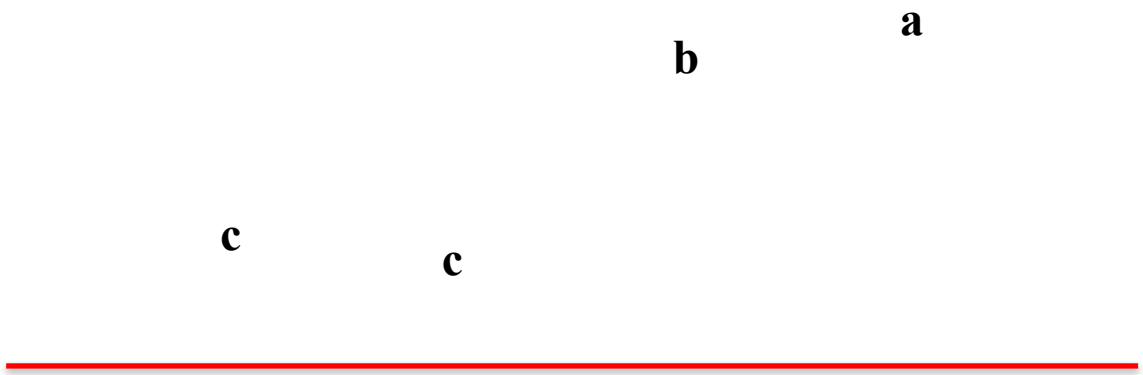
Results: Seed Yield 2011-2012

***P* = 0.06**



Results: Plant Stand 2011-2012

***P* < 0.0001**

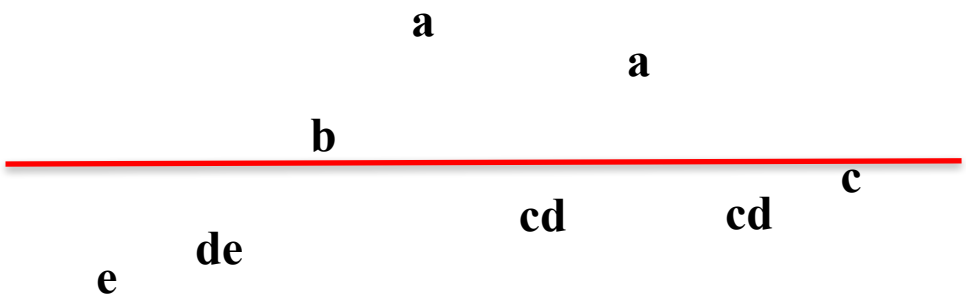


Results: Seed Yield 2011-2012

P = 0.0115

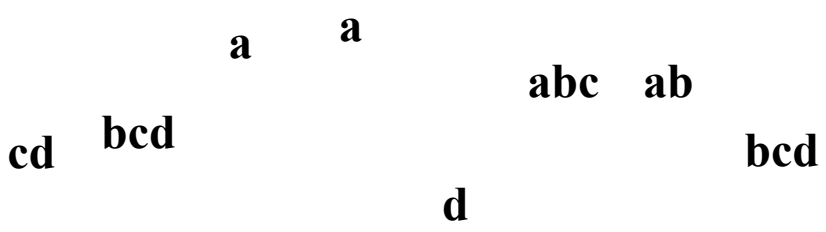
Results: Plant Stand 2013

***P* < 0.0001**



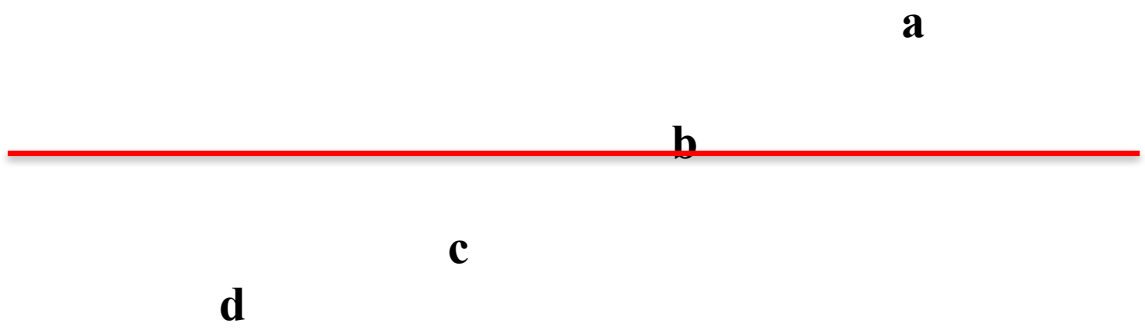
Results: Seed Yield 2013

P = 0.0002



Results: Plant Stand 2013

***P* < 0.0001**



Results: Seed Yield 2013

***P* = 0.006**

So Who Won?

- Depends upon who you are asking…..

- Results were variable and driven by stand population and active ingredient…primary driver appeared to be insecticide seed treatments…….

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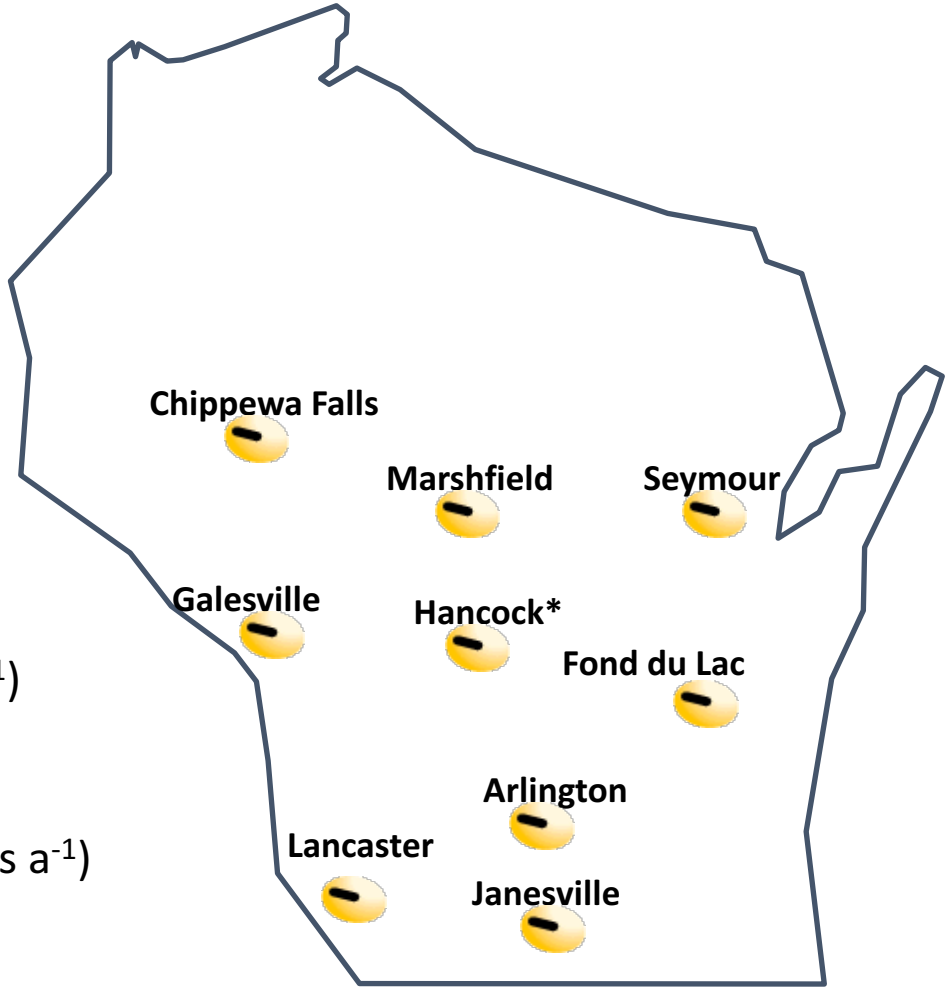
Economic Risk and Profitability of Soybean Fungicide Insecticide Seed Treatments at Reduced Seeding Rates

- Years (2012-2013) N =1296
- Regions
  - Southern
  - Central
  - N. Central
- Variety: NK Brand S20Y2
- Planting Date: First 3 weeks in May
- Row Spacing: 15 inches
- Seed treatments
  - UTC
  - ApronMaxx RFC (0.0094 mg ai seed^{-1})
  - CruiserMaxx (0.0858 mg ai seed^{-1})
- Seeding rates
  - 40, 60, 80, 100, 120, 140 (1000 seeds a^{-1})



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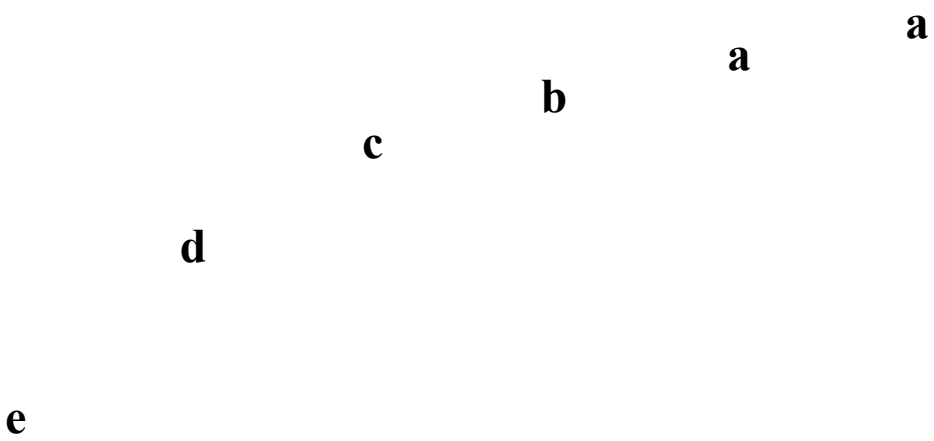
‡Gaspar, A., **S.P. Conley**, and P.D. Mitchell. 2015. Economic Risk and Profitability of Soybean Fungicide and Insecticide Seed Treatments at Reduced Seeding Rates. Crop Sci. 55:1-10. doi: 10.2135/cropsci2014.02.0114

Main Effect: Seeding Rate

LSD (.05) **= 1.2 bu a^{-1}**



Main Effect: Seed Treatment

LSD (.05) **= 0.84 bu a^{-1}**

a

b

b

CIPAR & CumNDVI
Planting Date x Seed Treatment

Table 7. CIPAR and CumNDVI means for the planting date by seed treatment interaction pooled across all seeding rates at Arlington, WI during 2012 and 2013.

	Planting date			
Seed treatment	**Early**	**Mid**	**Late**	**Avg.**
CIPAR, MJ m^{-2}				
UTC†	631	599	541	590
ApronMaxx	631	601	542	591
CruiserMaxx	645	606	544	598
LSD (0.05)		11		
Avg.	635	602	542	
CumNDVI‡				
UTC	34.0	30.8	28.1	31
ApronMaxx	33.8	30.9	27.9	30.9
CruiserMaxx	35.2	31.2	28.6	31.7
LSD (0.05)		0.8		
Avg.	34.4	31.0	28.2	

†UTC, untreated control

‡ CumNDVI, has no units for measurement because it is a relative number.

- Delaying planting decreases CIPAR & CumNDVI
- CruiserMaxx increased CIPAR & CumNDVI within first planting date.

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‡Gaspar, A. and **S.P. Conley**. 2015. Responses of canopy reflectance, light interception and soybean seed yield to replanting sub-optimum stands. Crop Sci.55: 377-385.

Yield at Various Seeding Rates for Different Seed Treatments

LSD (.05) **= 2.1 bu a^{-1}**

Economic Risk

- Uncontrollable factors during the growing season
  - Planting date (2012 vs. 2013)
  - Cool and wet condition
  - Inclement weather shortly after planting
  - In field variability
  - Lowering grain markets

- Products and practices that are valuable:
  - Show consistent yield gains
  - Provide profit stability over a wide range of situations and environments
  - Help manage long term margins and economic risk

- Assessing Economic Risk at Various Seeding Rates & How Seed Treatment Affects Risk
  - "Base case" = 140k seeds a^{-1} with no seed treatment (UTC)
  - Our trial allows us 20 comparisons to the base case.
  - The break-even probability shows us the probability that a certain seeding rate x seed trt. combination will increase profit over the base case.
    - Or essentially the risk of a certain treatment combination

Economic Risk Table for $9 bu^{-1} Soybeans

Treatment combination		Break-even probability	Avg. profit increase over the Base Case		
Seed Treatment	Seeding Rate		Positive outcomes	All outcomes	Negative outcomes
	Seeds acre^{-1}		$ acre^{-1}		
UTC	120,000	0.91	3	3	-2
	100,000	0.69	5	2	-5
	80,000	0.26	4	-8	-12
	60,000	0.01	2	-34	-34
	40,000	0.00	na	-94	-94
ApronMaxx	140,000	0.46	14	-2	-15
	120,000	0.54	15	2	-13
	100,000	0.51	14	1	-13
	80,000	0.28	10	-9	-17
	60,000	0.02	6	-36	-37
	40,000	0.00	na	-98	-98
CruiserMaxx	140,000	0.71	18	10	-11
	120,000	0.83	21	16	-9
	100,000	0.89	23	20	-8
	80,000	0.86	21	17	-8
	60,000	0.51	14	0	-15
	40,000	0.01	5	-51	-52
EOSR					
UTC	111,500	0.84	4	3	-3
ApronMaxx	111,000	0.54	14	2	-13
CruiserMaxx	94,000	0.89	23	20	-8

Summary and Conclusions

- The GRAND challenge is how do we predict stand loss, crop yield response and grower risk while balancing IPM stewardship when dealing with an insect complex that does not have well established thresholds and for many pests have no rescue treatment….
- A national across the board ban of neonicotinoids is not the answer
- We need a balance of the Three Pillars of Sustainability:
  - Economic, Environmental and Social

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