Biotechnology, Neonicotinoids and Organic Agriculture: An Economist's Perspective on Current Debates

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What do Economists do?

- Make assumptions about human behavior (theories), then apply them to the world and see which theories most consistent with data (test theories), then apply them
  - Economic Fundamentals: **Preferences**, Resources and Technology [*Expectations, Institutions, …*]
  - People do things to try to make themselves better off
- Main "contributions" of micro-economics

1. There are always Tradeoffs (No free lunch)
2. Human behavior and Preferences matter
   a. Unintended Consequences and Externalities
   b. "The Dismal Science" (Thomas Carlyle 1849)
3. Social Surplus: wealth left over after meeting our "wants"

Process Today

- Summarize some of my recent & on-going research on ag biotechnology, neonicotinoids and organic ag
- Focus on illustrating the contributions that economics and social science can make to some current debates
- 1) Provide evidence that economics and social sciences can be relevant to debates in the plant sciences
- 2) Help plant science graduate students understand types of research that social scientists can do that may be of interest to them
- Close with broader comments/opinions

Ag Biotechnology

- My initial focus: Estimation of stochastic yield loss functions for pest damage
  - **Link between biology and economics: how pests become economically relevant**
- Applications
  - Value of pest control technologies
  - Risk management benefits of pest control
  - Economics of managing pest resistance
  - Ways to incentivize resistance management
- Initial work: technical, disciplinary, but necessary
- You have to be good at some aspect of a discipline and if you are lucky, many other people will care about it!

Stochastic Yield Loss Function

- Stochastic yield loss functions: nested composed error model to separately estimate experimental error and random pest damage, solve the "Negative Loss Problem"
- Purge experimental error from estimated yield variably to more accurately estimate risk benefits of pest control when using field plot data

Part of Interest

Can cause "Negative Losses"

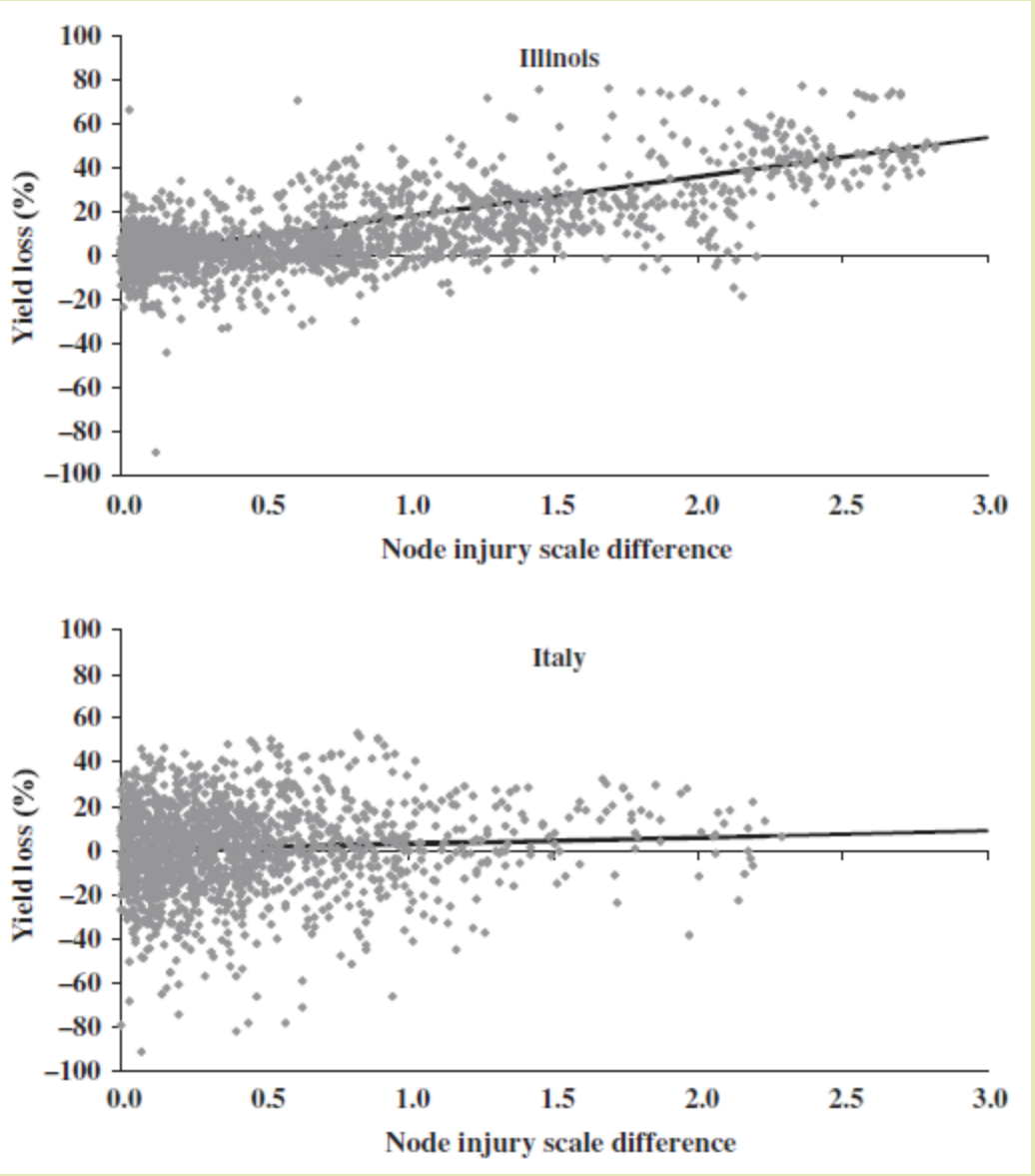
$$\lambda_{tli} = \underbrace{\sum_j \beta_j X_{jtlr} + \mu_t + \nu_{tl}}_{\text{regression coefficients}\quad \text{year}\quad \text{site}} + \underbrace{\varepsilon_{tlr}}_{\text{experimental}}$$

- Can now use this function for economic analysis

Dun et al. 2010

Proportional yield loss as a function of the rootworm Node Injury Scale (NIS) difference in Illinois and Italy

Region	Parameter	Estimate
Illinois, USA	Slope β	0.1788
	Year Effect σ^2_μ	0.0024
	Location Effect σ^2_ν	0.0007
	Experimental Error σ^2_ε	0.0146
Brescia, Lombardy,	Slope β	0.0292
	Year Effect σ^2_μ	0.0009
	Location Effect σ^2_ν	0.0005
	Experimental Error σ^2_ε	0.0392



Non-Pecuniary Benefits of Ag Biotech

- Conundrum of RR crops: many analyses found small to moderate and/or inconsistent impact on yield and profitability, yet farmers rapidly adopted them: **WHY?**
- Ag biotechnology offers a suite of values beyond just insect/weed control: non-pecuniary benefits
  - Convenience, human & environmental safety, timeliness & consistency of control, risk benefits, pest suppression
  - Can exceed pecuniary benefits (Shi et al. 2013)

What is the Value of RR Crops to Farmers?

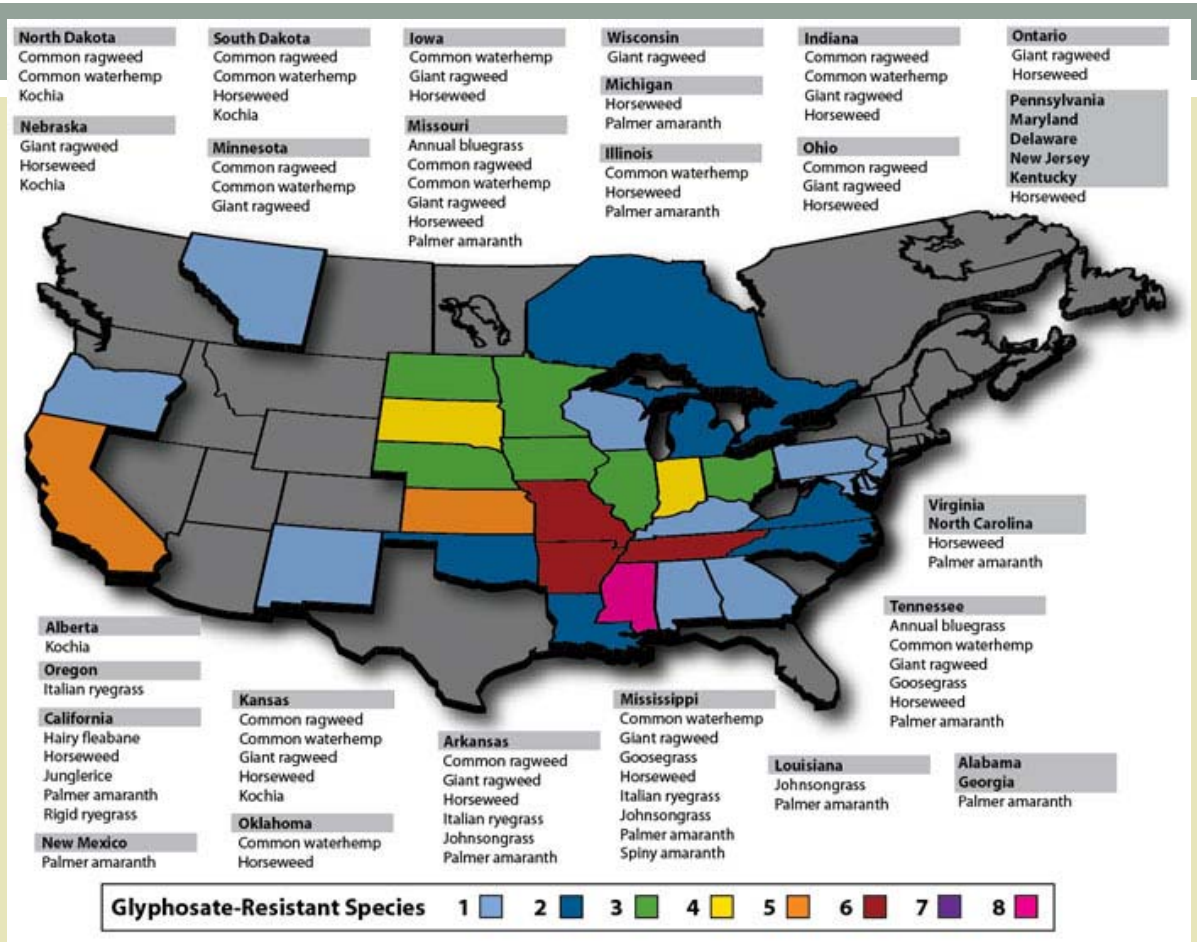
- Hurley et al. (2010): Stated preferences: Just ask farmers how much value they get from RR crop
- 2008 telephone survey, 400 corn, 400 soy, 400 cotton
- Average Value: $22/A corn, $23/A soybean, $51/A cotton
- Regress these values on preference intensity measures
- *When choosing whether to use a particular herbicide, how important is the cost of the herbicide application?*
- Rotated underlined part through 13 “non-pecuniary” factors that we thought contributed value to RR crops

Impact of Non-Pecuniary Factors on Stated Value of RR Crops (Hurley et al. 2010)

Factor	Corn	Soybean	Cotton
Cost	**-1.46****	**-3.57*****	**-1.17****
Yield Loss	8.96**	0.27	-12.26**
Consistency of Control	-3.38**	3.85***	9.39**
Application Frequency	3.01**	2.08	0.23
Crop Safety	-1.51**	-9.62**	-9.78**
Clean Field	-2.70**	-0.24	0.6
Time Needed to Apply	-1.37**	1.62*	0.54
Flexibility of Application	1.10**	1.01***	2.19*
Family Health	-1.49**	1.59	14.17**
Public Health	-0.53**	0.43	-1.90**
Wildlife Quality	-1.91**	-1.99***	1.4
Water Quality	1.53**	-0.92	4.66
Soil Erosion	2.10**	1.67***	-3.51**

Herbicide Resistance

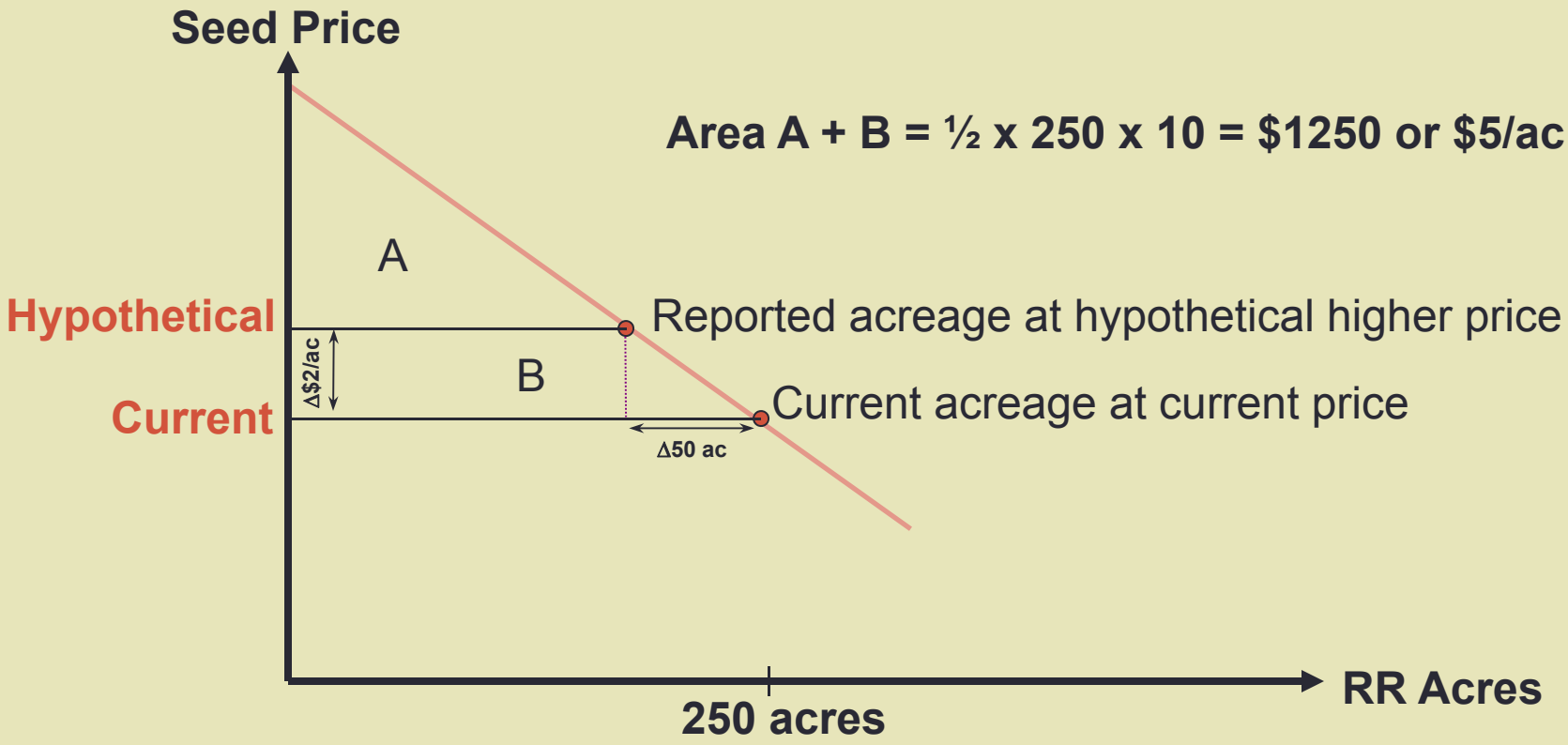
- No new herbicide MOA registered since early 1990s
- Has emerged as major weakness of RR crops
- **Unintended Consequence**



Source: https://www.pioneer.com/home/site/us/agronomy/library/template.CONTENT/guid.8C8F040A-9804-97F3-C650-1EA99776A1B3

- **How do we get farmers to use residual herbicides?**
- Rebates for residual herbicides? (Roundup Rewards)
- More sophisticated model to estimate value of RR crops

Contextually Stated Preferences



- **Area A + B is "Consumer Surplus": money willing to pay for RR crop, but did not have to**
- **Value a farmer gets from RR crop**

Hurley et al. (2015?)

- Estimate value of RR soybean and assess efficacy of a rebate program to encourage residual herbicide use to help slow weed resistance
- Glossing over lots of complexity
  - Also offered residual herbicide price decreases (i.e., rebates)
  - 4 acreage equations: RR & non-RR acres, plus use of residual herbicides on each
  - Econometric issues: restricted acreage responses (can't be negative), simultaneous estimation, correlated error structure, etc.
- **Value of RR soybeans: $17.02/A** (C.I. = [$9.44, $27.48])
- **Implies RR soybeans generated $1.2 Billion benefit for farmers in 2008**

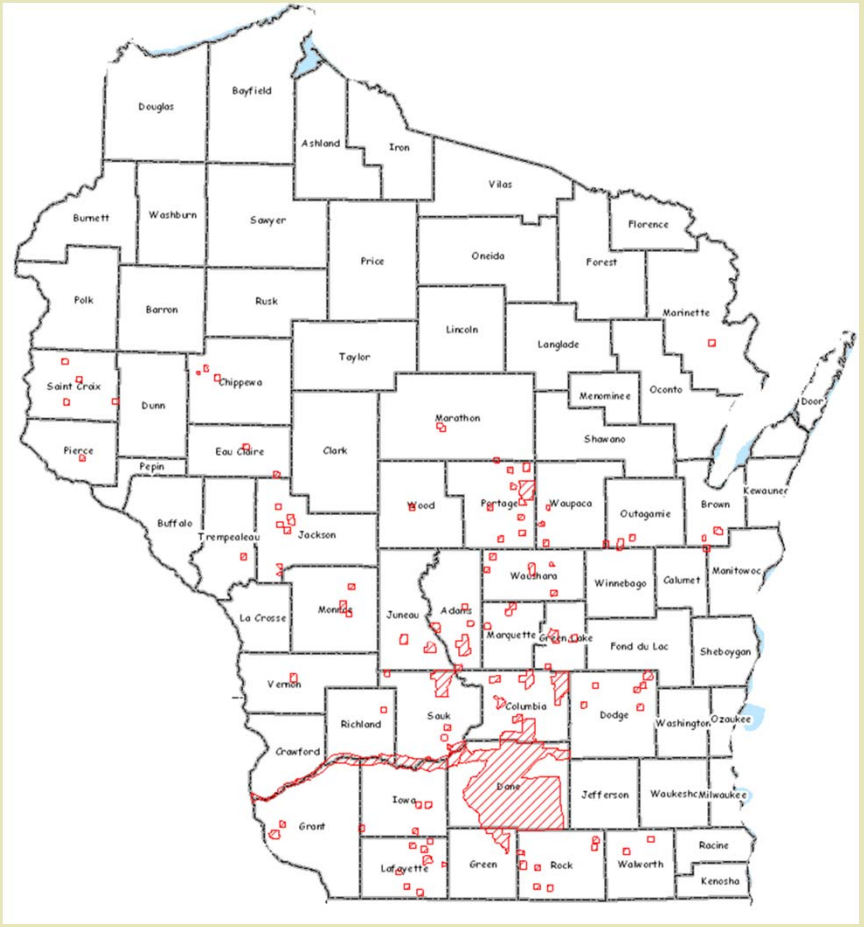
Can Rebates Increase Residual Herbicide Use?

Variable	Observed: No Rebate	Estimated: No Rebate	Estimated: Change With $1 Rebate
RR Acres Treated with a Residual Herbicide (Average Acres)	180	176 [142, 212]	92.0 [57.4, 127.6]
RR Acres Treated with a Residual Herbicide (% RR Soybean Acres)	30.3	30.1 [24.4, 36.2]	15.7 [9.8, 21.8]
All RR Acres Treated with a Residual Herbicide (% Growers)	23.9	26.2 [20.7, 31.7]	17.3 [12.0, 23.0]
No RR Acres Treated with a Residual Herbicide (% Growers)	63.1	60.8 [54.7, 66.7]	-11.3 [-17.2, -5.50]

- A small rebate ($1/A) would have increased residual herbicide use on RR acres by about 50% in 2008
- Substantially higher rebates (>$4/A) would be needed to further increase residual herbicide use
- Consistent with Monsanto increasing residual rebate

Atrazine, RR Corn Adoption and the Number of Herbicide Sites of Action Used

- Wisconsin has atrazine prohibition areas (PAs)
- 102 PAs covering over 1.2 million acres
- 2010 USDA ARMS surveyed WI farmers inside and outside atrazine PAs
- **How does atrazine ban affect RR corn use, tillage practices, and the number of herbicide SOAs used?**
- Nuanced view of impacts of atrazine ban



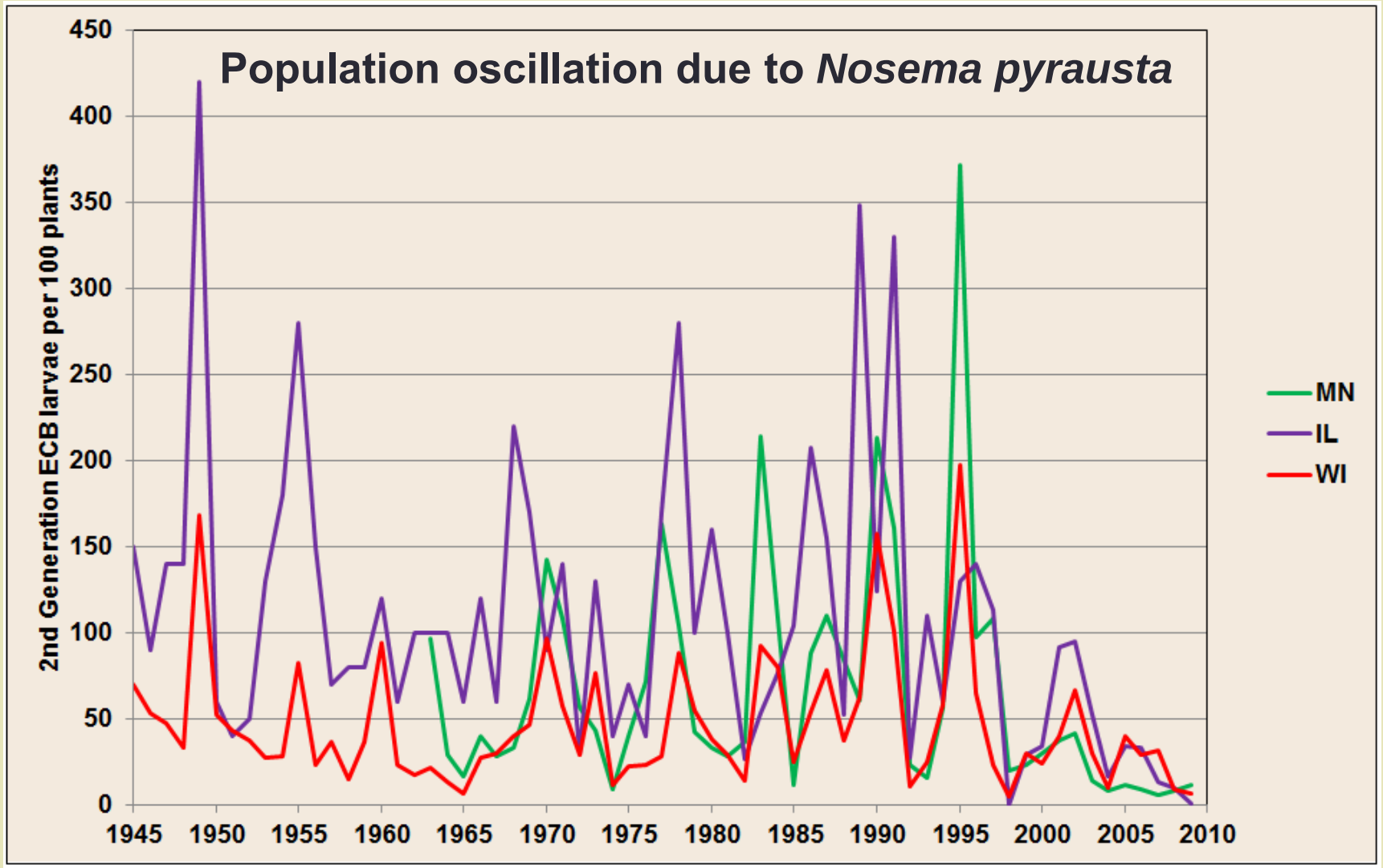
Dong, Mitchell, Davis & Recker (2015?)

- Positive connection between RR crops and adoption of conservation tillage/no-till well established
- How does atrazine PA affect RR-tillage connection?
- How does atrazine PA affect the number of SOAs used?
- 1) Atrazine PA increases probability use RR corn (+0.26)
- 2) RR corn increases probability use conservation tillage or no till (+0.36) with no separate effect for atrazine PA
- 3) RR corn farmers use fewer SOAs (x0.87)
  - Farmers in atrazine PAs use fewer SOAs (x0.80)
  - Larger farms use more SOAs (x1.4 and x1.7)
- **Tradeoffs: Atrazine ban means more RR (with less tillage) and more resistance likely in long-term**

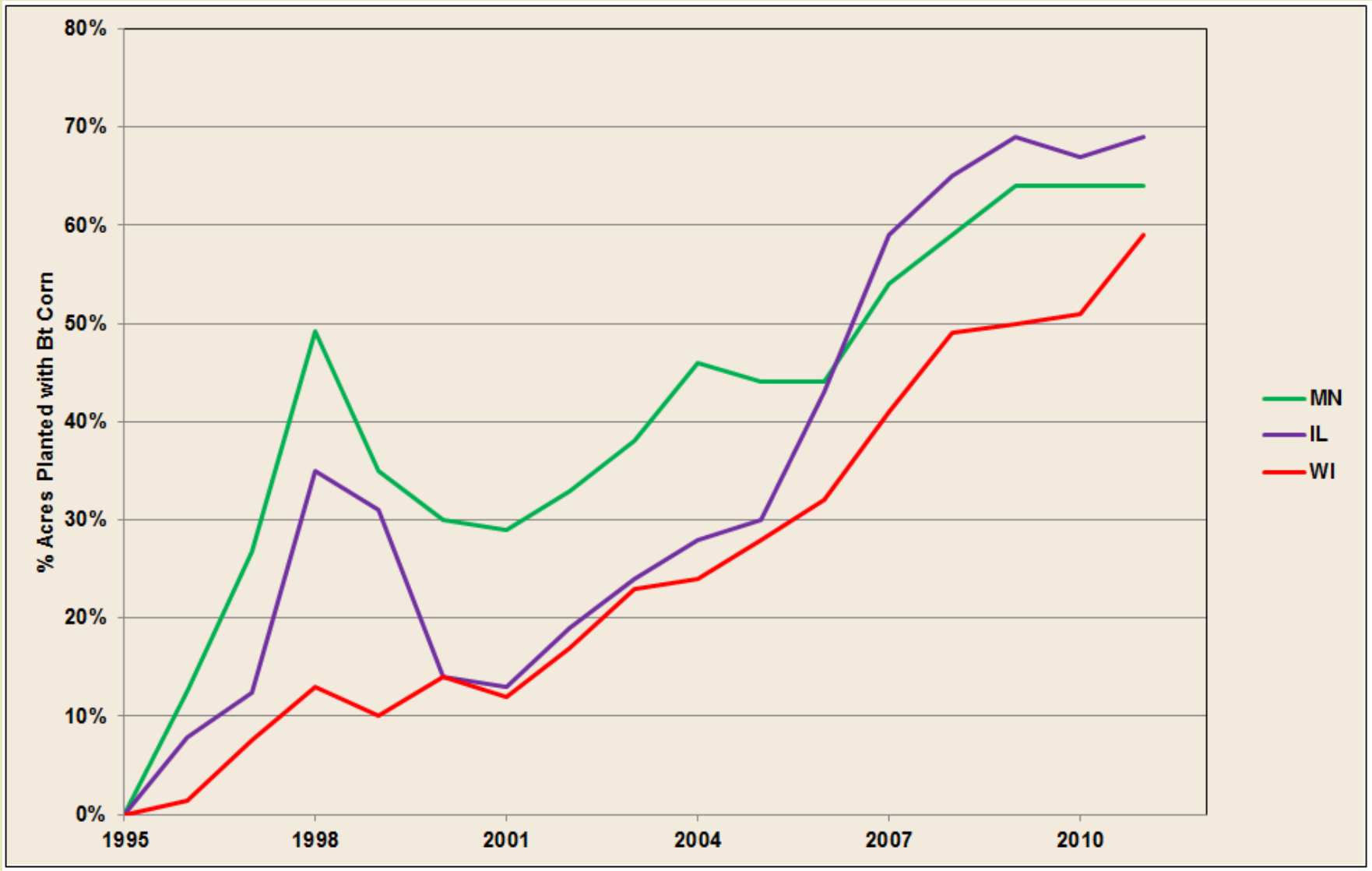
What is the Value of Areawide Pest Suppression of ECB by Bt Corn?

- Widespread adoption of corn borer Bt corn associated with a decrease in European corn borer populations (unintended consequence)
- Hutchison et al. (2010): long-term ECB population data and state-level Bt corn adoption data to demonstrate areawide suppression and estimate its economic value
- Not all externalities are bad!

Fall Survey of ECB Larvae Entering Diapause (State Average 1945-2009)



Adoption of Bt Corn in MN, IL, and WI



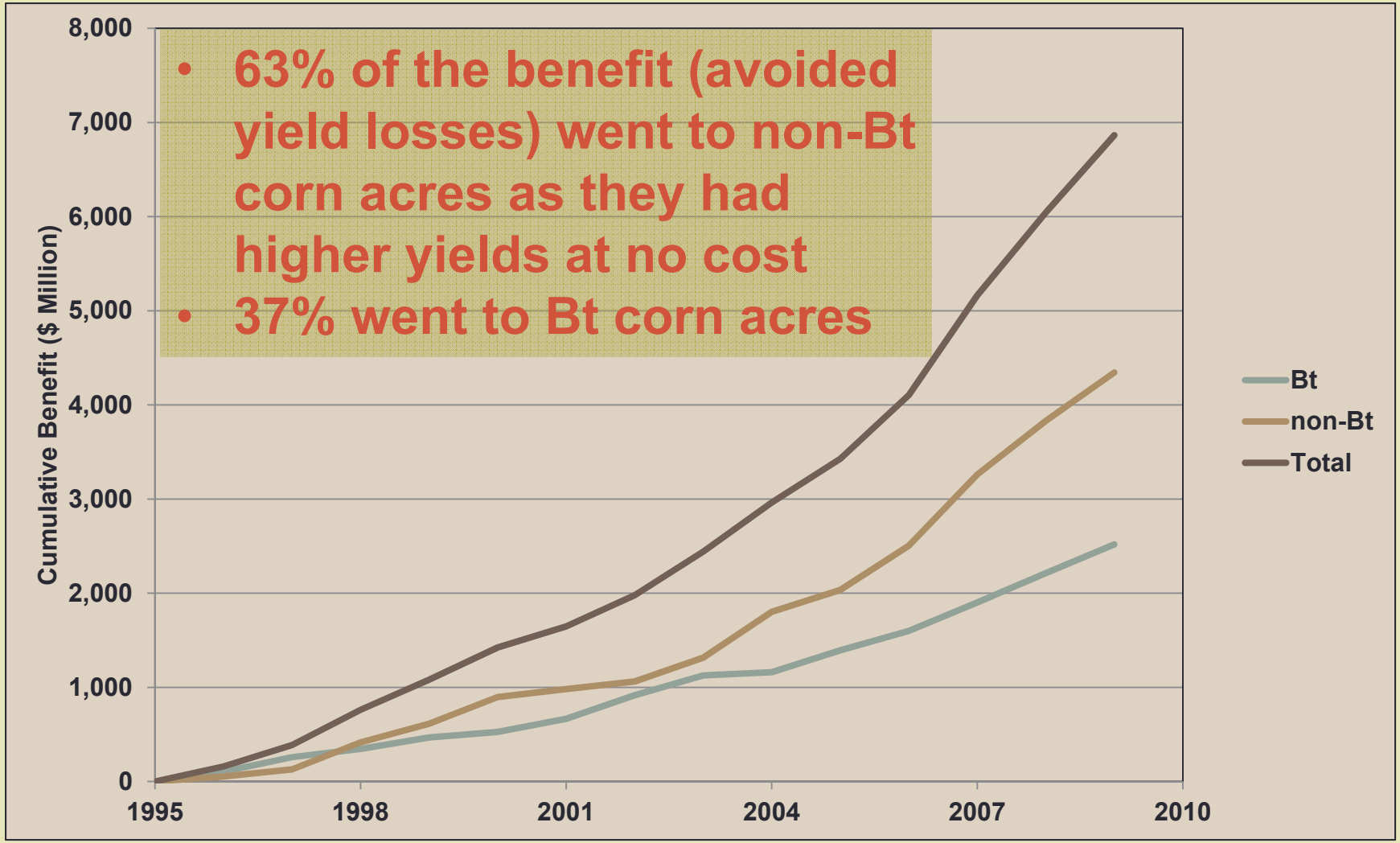
Statistical Analysis of ECB Data

- Estimate $\mathbf{r = \ln(N_{t-1}/N_t) = \beta_0 + \beta_1 \ln(N_{t-1}) + \beta_2 \%Bt}$
- General Equilibrium Level (ECB larvae per 100 plants)
- Set per capita growth rate r to zero and solve for N*
- $\mathbf{N^* = \exp(-(\beta_0 + \beta_2 \%Bt)/\beta_1)}$

State	Pre-Bt Mean	Confidence Interval	Avg %Bt	Bt-Era Mean	Confidence Interval
MN	59	40-88	0.40	16	9-29
IL	105	87-128	0.32	38	26-56
WI	40	31-51	0.23	29	19-44

- Widespread planting of Bt corn has reduced the equilibrium ECB population in these states
- Turn ECB population estimates into $$: Yield loss function

Cumulative Benefit to MN, WI, IL, IA, & NE Corn Growers = $6.8 billion up thru 2009



Market-Level Analysis of the ECB Suppression Benefit (Dun 2014)

- Estimate supply & demand and supply shift from Bt & pest suppression, then estimate producer & consumer Surplus generated by Bt corn with and without pest suppression
- (**Zhe Dun dissertation, Aug 2014**)

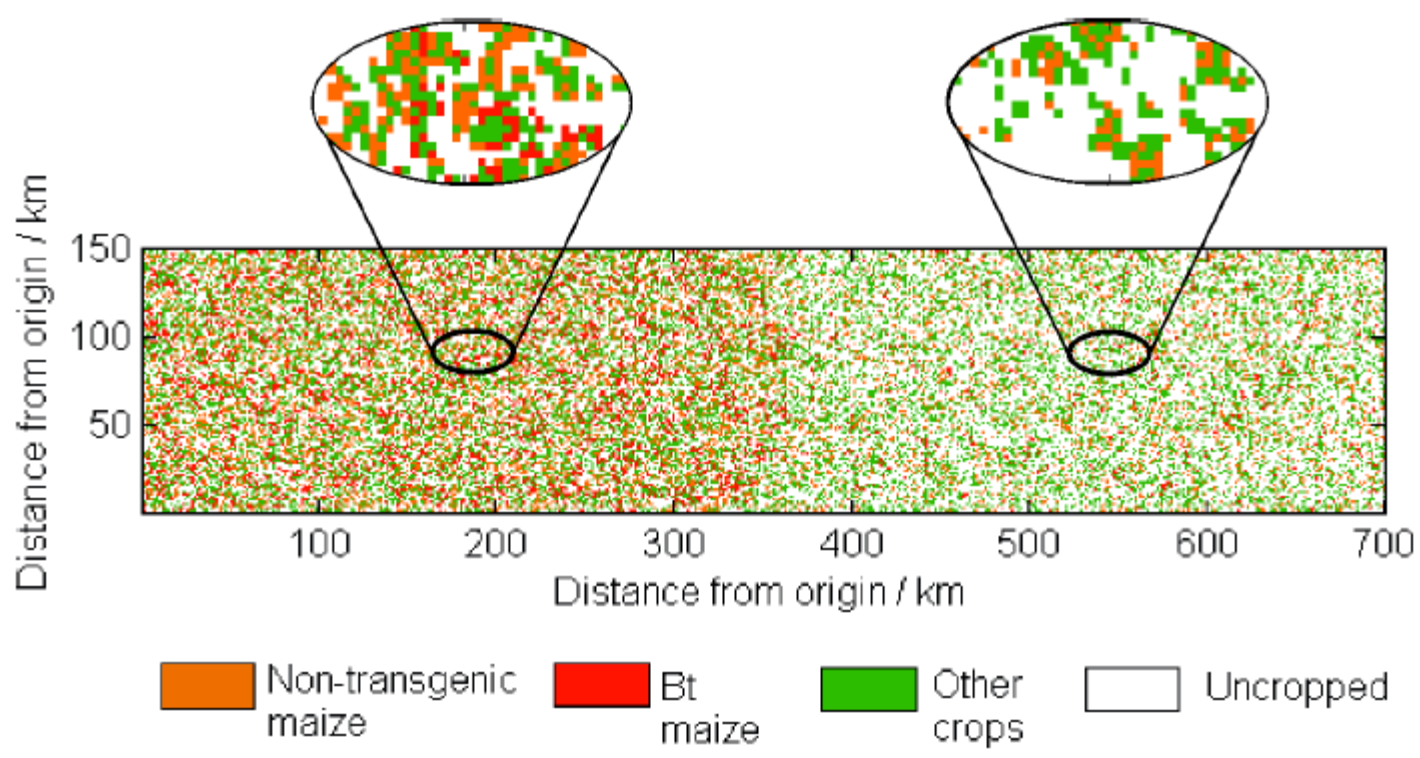
Cumulative Value ($ Billion) of Surplus 1996-2009			
Category	**With ECB Suppression**	**Without ECB Suppression**	**Suppression Benefit**
Bt Acres	$15.6	$15.5	$0.1
Non-Bt Acres	$28.6	-$3.8	$32.4
Consumers	$12.5	$5.6	$6.9
Total	**$56.7**	**$17.3**	**$39.4**

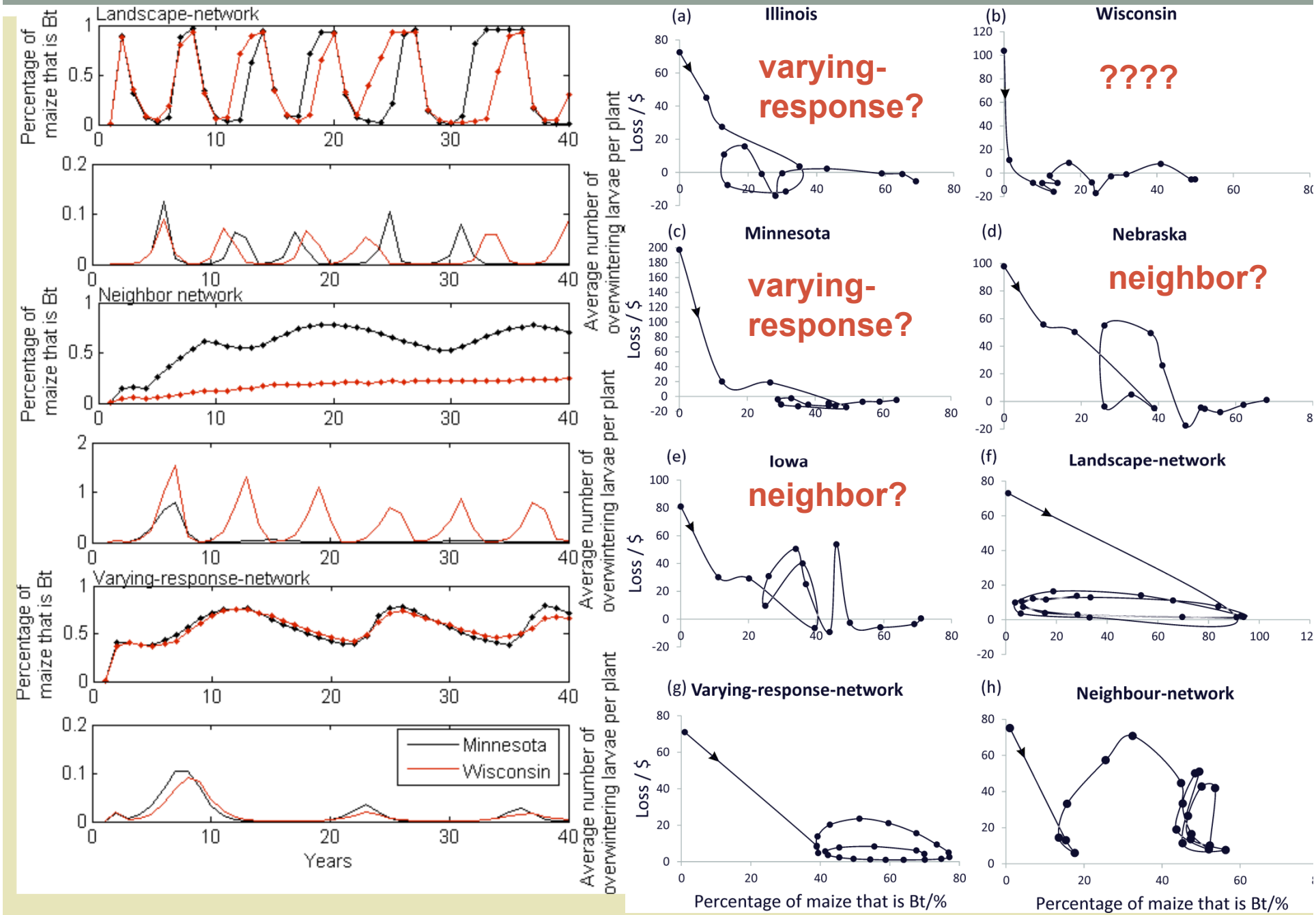
Effect of Farmer Decisions on Pest Population Dynamics

- **A. Milne, J. Bell, W. Hutchison** et al. (PNAS? 2015?)
- Spatially-explicit ECB population model that endogenizes (models) human decisions (cellular automata)
  - "Farmers" in the model choose Bt corn adoption based on their available information on returns from Bt adoption
- Four Information Networks
  - 1) Landscape: use state average returns
  - 2) Neighbor: use average returns of adjacent cells
  - 3) Kaup: weighted average of state, county & neighbor
  - 4) Varying-Response: tend to stay with Bt if it was previously valuable to you

Spatially Explicit ECB Model

- 700 x 150 km band of 25 ha cells with corn (Bt or non-Bt), other crops and non-cropped cells
- ECB population model with dispersal, reflective edges
- Parameterized as though cuts across MN-WI border




Landscape-network
Neighbor network
Varying-response-network
Percentage of maize that is Bt
Average number of overwintering larvae per plant
Minnesota
Wisconsin
Years
(a) Illinois
varying-response?
(b) Wisconsin
????
(c) Minnesota
varying-response?
(d) Nebraska
neighbor?
(e) Iowa
neighbor?
(f) Landscape-network
(g) Varying-response-network
(h) Neighbour-network
Loss / $
Percentage of maize that is Bt/%

Milne et al. (2015)

- 1) Human social/economic systems part of the ecosystem
  - Farmer behavior key driver of pest population dynamics
- 2) System exhibits emergent behavior: farmers "seem" to cooperate to suppress the pest for their mutual benefit
- Caveat: We do not incorporate company behavior
  - With constant tech fees, farmers oscillate Bt adoption: adopt when pest population high, dis-adopt when low
  - Reality: To maintain profits, companies decrease tech fees and bundle traits to keep farmers buying Bt corn (i.e., no adoption oscillation occurs), which likely increases probability of resistance developing

Ag Biotechnology

- Humans are part of the Agro-Ecosystem: All parts are connected and affect one another
- To understand impacts of Ag Biotechnology, need to understand humans and incorporate their behavior
  - Spatially explicit ECB population model with Bt corn
- Human preferences matter
  - Non-pecuniary benefits can be just as or more important than yield/profit gains (pecuniary benefits)
- Unintended Consequences/Externalities
  - Herbicide and Insect Resistance, Pest Suppression
- No free lunch: Tradeoffs exist
  - Atrazine prohibition and fewer herbicide SOA

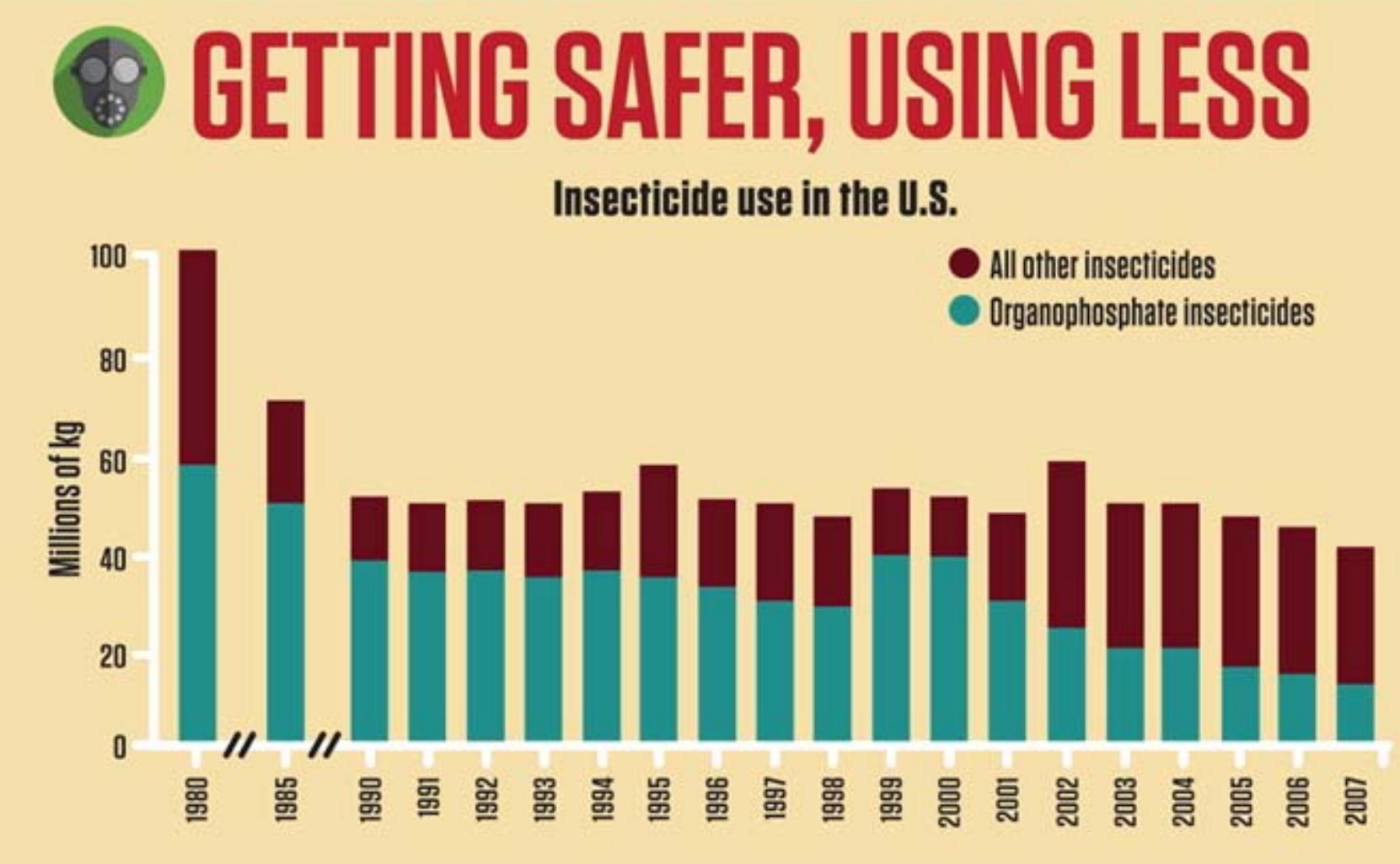
Ag Biotechnology

- Companies and Governments are human too: Industrial Organization and Regulation/Policy also matter
  - Monopolists restrict access to technology and seek economic advantages through policy (biotech risk endorsement)
  - Unintended consequences of biofuels, subsidy policies
  - Regulatory creep: EPA to require herbicide resistance management plans now for new products
- Is ag biotechnology valuable? Definitely!
  - Even more than originally thought: substantial non-pecuniary benefits, ECB suppression benefit
- Is it perfect? No! Herbicide and insect resistance are serious problems with additional consequences

Neonicotinoid Insecticides

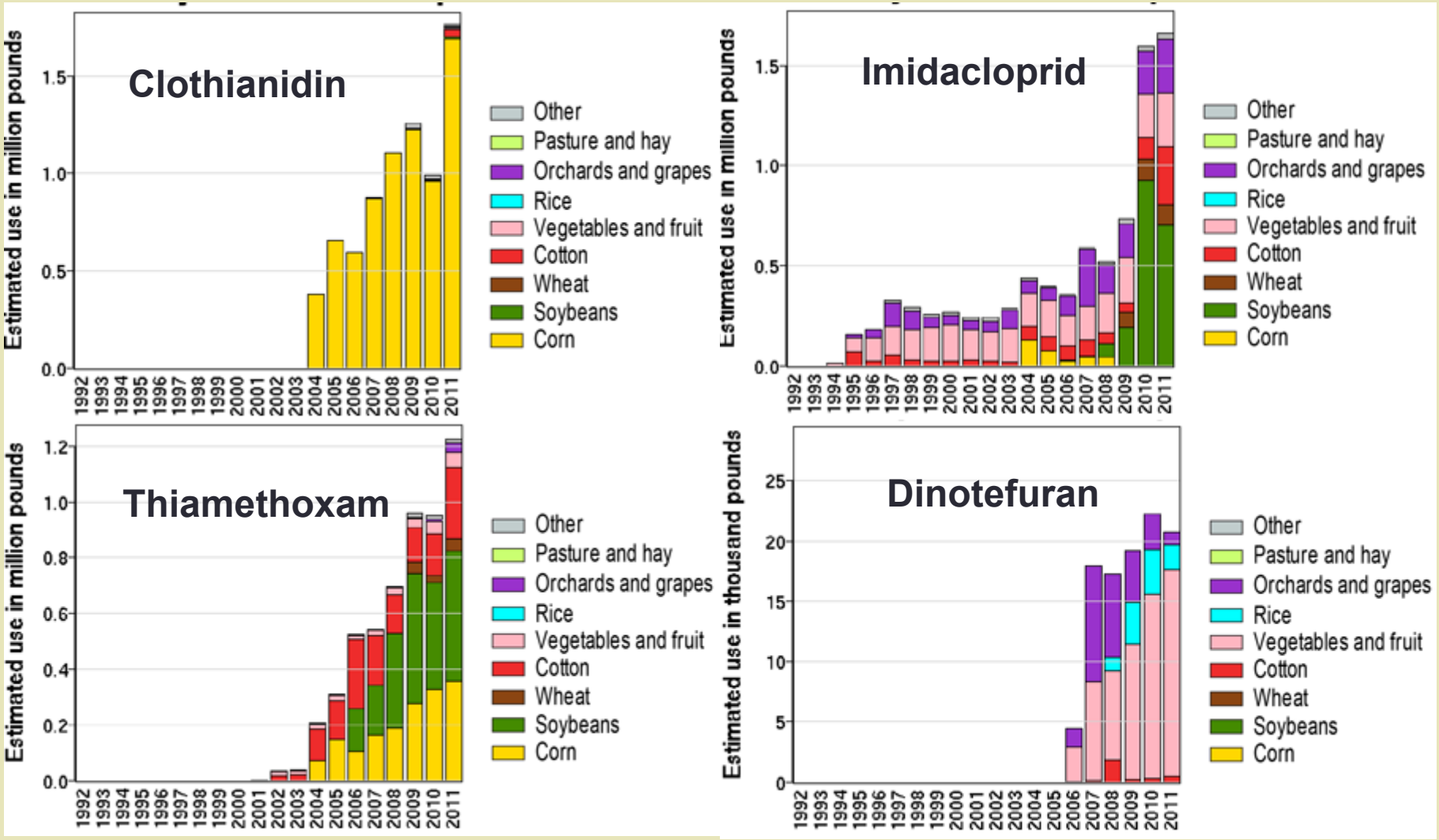
- Most widely used class of insecticides in the US
  - Widely used on many crops: Around 90% corn, 40% soybeans, 50% cotton, 20% wheat, ⅓ potatoes, almost ½ citrus & grapes, ⅔ apples, almost ⅔ tomatoes
- A relatively new class, qualified as Reduced Risk Pesticides with expedited registration review under the FQPA, so companies and EPA moved that way
- Seed treatments became the most common way to apply neonicotinoids, especially for row crops
  - Save time, precise amount of a.i. applied, often less a.i. per acre (more targeted placement), less human exposure, less risk of non-target effects

Trends in US Insecticide Use

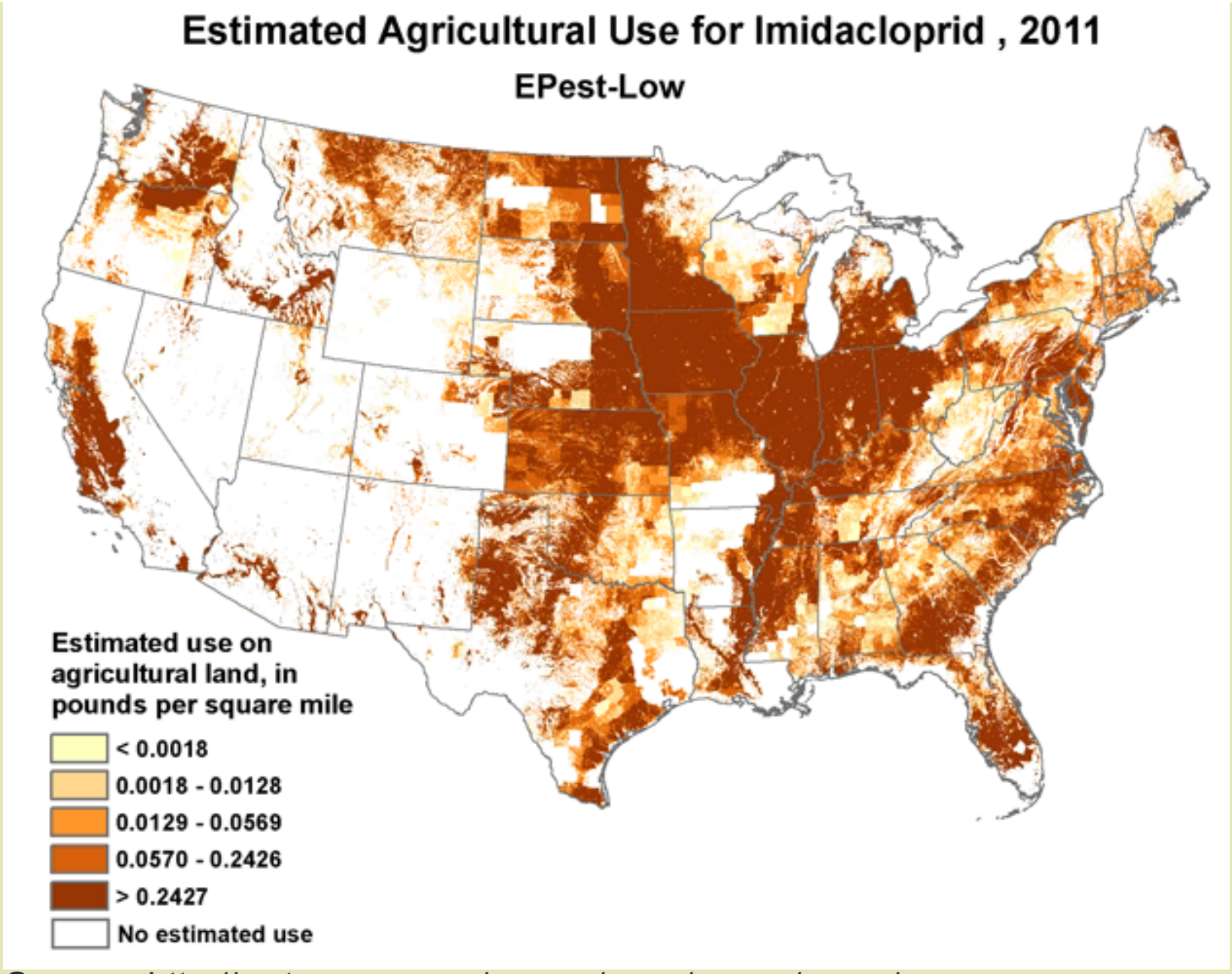


Source: E. Stokstad *Science* 2011:
http://www.sciencemag.org/site/special/pesticides/infographic.xhtml

Trends in Neonicotinoid Use

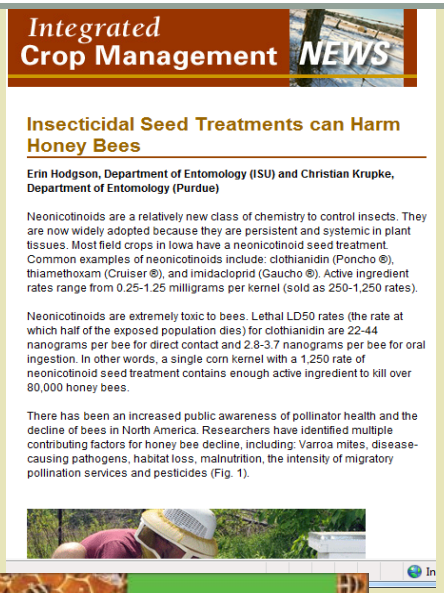


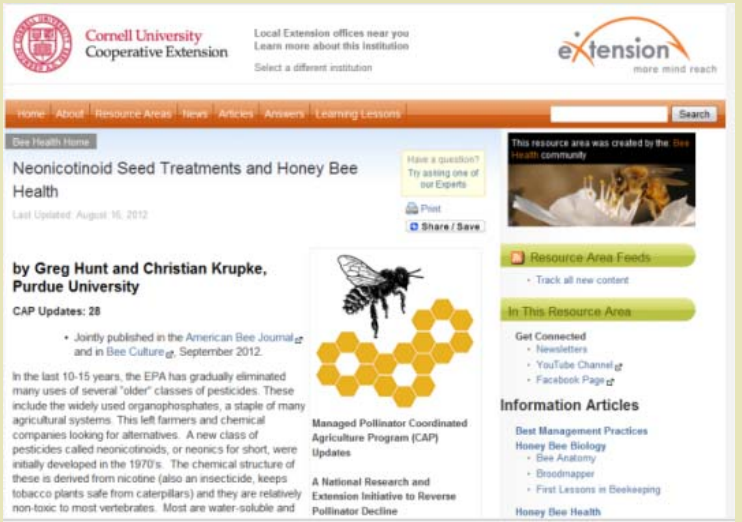
Source: http://water.usgs.gov/nawqa/pnsp/usage/maps/



Source: http://water.usgs.gov/nawqa/pnsp/usage/maps/

Neonicotinoid Insecticides in the News





Courtesy of Dr. Russell Groves, UW Entomology

Accidental and Inappropriate Uses

(Crystal River, FL March 2013) (Wilsonville, OR June 2013)

treehugger

DESIGN | TECHNOLOGY | TRANSPORTATION | SCIENCE | BUSINESS

Florida citrus grower fined $1,500 for killing millions of honeybees

Stephen Messenger
Business / Corporate Responsibility
August 29, 2013

Courtesy of Dr. Russell Groves, UW Entomology

OREGONLIVE
The Oregonian

NEWS | BUSINESS | SPORTS | H.S. SPORTS | ENTERTAINMENT | LOCAL

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Bumblebee memorial scheduled for Sunday at Wilsonville Target

Unintended Consequences of Corn Dust

Corn Dust Research Consortium Formed to Address Honey Bee Questions

Unique Stakeholder Consortium Sponsors Research to Reduce Honey Bee Exposure to Corn Planting Dust

Courtesy of Dr. Russell Groves, UW Entomology

USDA and EPA Release New Report on Honey Bee Health - 2 May 2013

Parasites and Disease Present Risks to Honey Bees:
The parasitic Varroa mite and new virus species have been found in the U.S. and several of these have been associated with Colony Collapse Disorder (CCD).

Increased Genetic Diversity is Needed:
Genetic variation improves bees thermoregulation, disease resistance and worker productivity.

Poor Nutrition Among Honey Bee Colonies:
Bees need better forage and a variety of plants to support colony health.

Need for Improved Collaboration and Information Sharing:
Best Management Practices associated with bees and pesticide use, exist, but are not widely or systematically followed by members of the crop-producing industry.

Additional Research is Needed to Determine Risks Presented by Pesticides:
The most pressing pesticide research questions relate to determining actual pesticide exposures and effects of pesticides to bees in the field.

Courtesy of Dr. Russell Groves, UW Entomology

Huseth and Groves (2014)

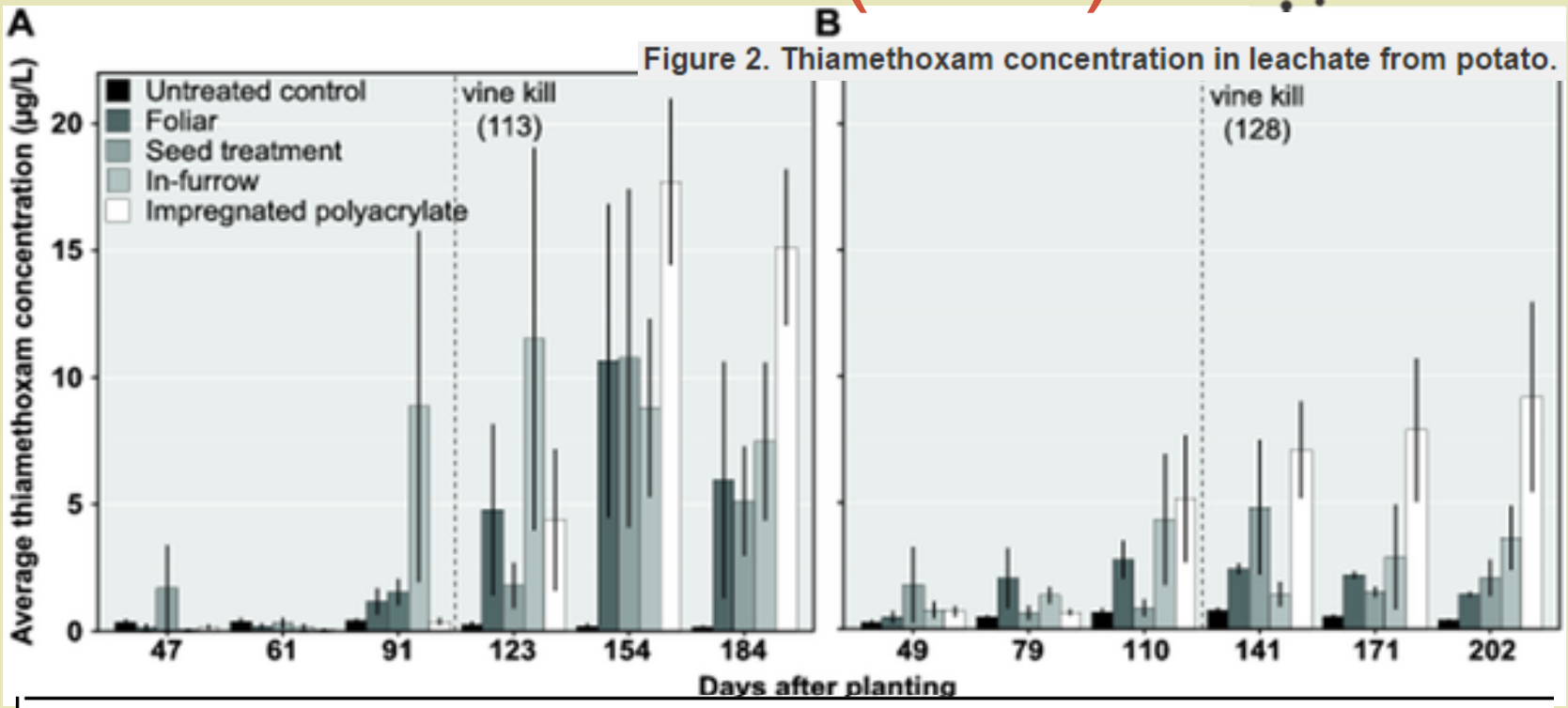


Figure 2. Thiamethoxam concentration in leachate from potato.

Table 2. Neonicotinoid concentration from irrigation water, 2011 and 2012.

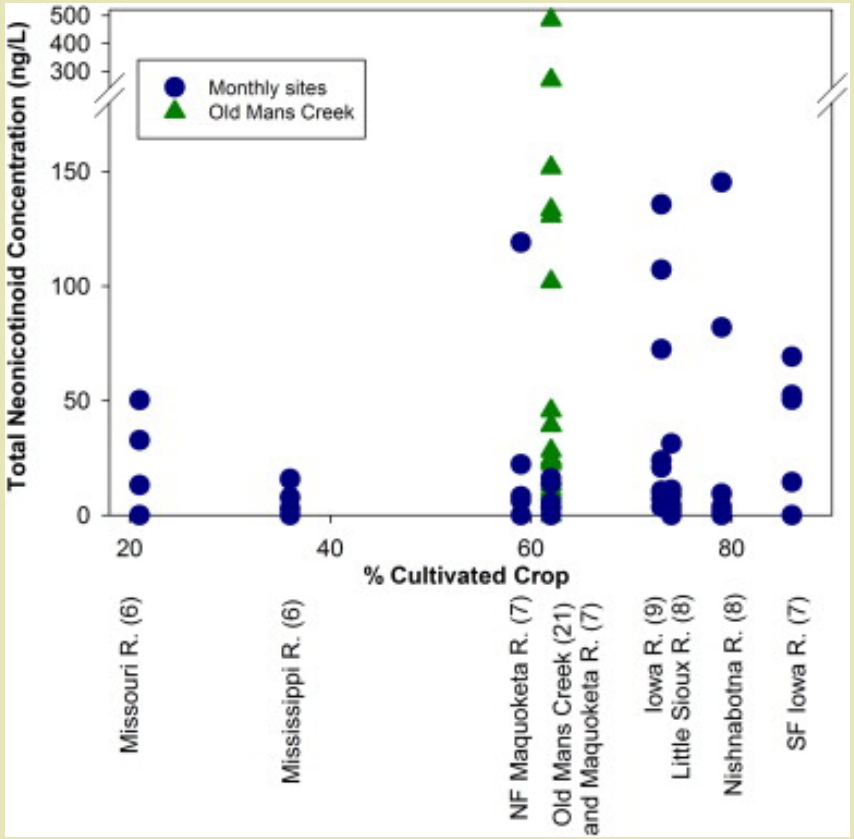
		Insecticide concentration (µg/L)[a]	
Date	**Days after planting**	**clothianidin**	**thiamethoxam**
28 June 2011	39	-	0.310
1 September 2011	114	-	0.327
10 July 2012	60	-	0.533
15 August 2012	96	0.225	0.580

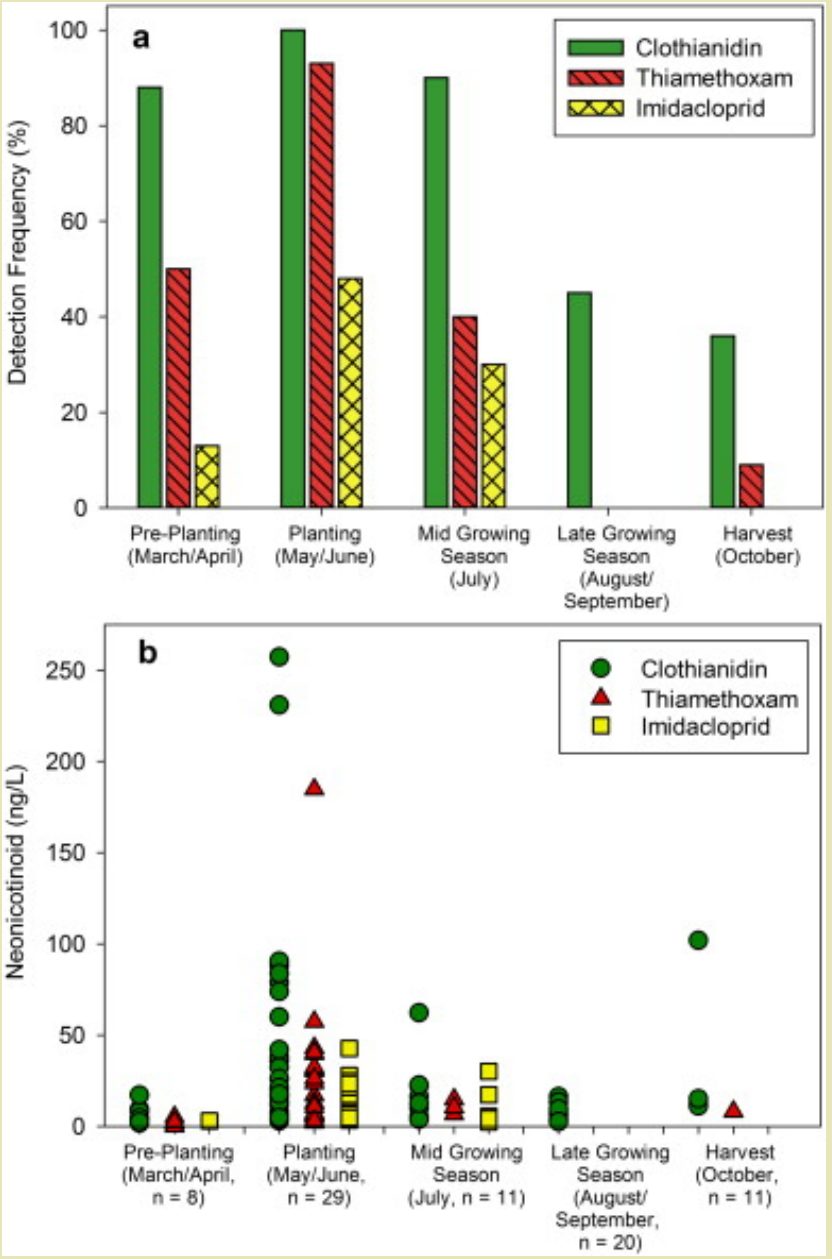
[a]Samples obtained from irrigation pivots while under operation in potato fields containing lysimeter experiments.
doi:10.1371/journal.pone.0097081.t002

Huseth AS, Groves RL (2014) Environmental Fate of Soil Applied Neonicotinoid Insecticides in an Irrigated Potato Agroecosystem. PLoS ONE 9(5): e97081. doi:10.1371/journal.pone.0097081 http://www.plosone.org/article/info:doi/10.1371/journal.pone.0097081

Hladik et al. (2014)

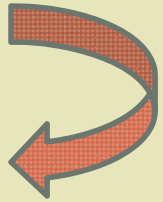
What is the ecological relevance of these levels?





Neonicotinoid Benefits Assessment in Progress with Funding from Registrants

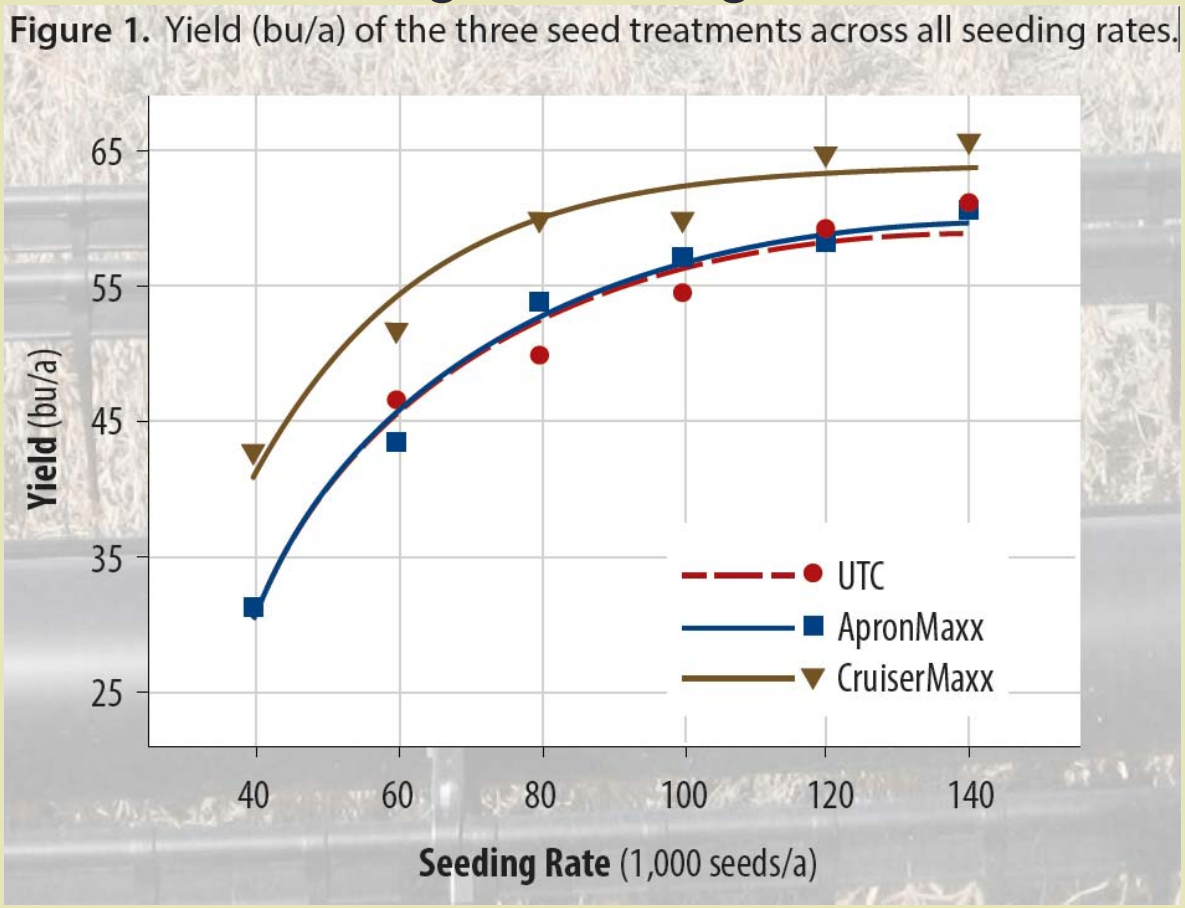
- **Counterfactual: What would farmers do for insect management without neonicotinoid seed treatments?**
  - Use older, "hotter" chemistries (OPs, pyrethroids)
  - More foliar applications and scouting-based IPM
    - Concerns about resistance and non-target effects
  - No soil insecticide alternatives for some crops, so higher seed density/replant for soil dwelling pests
- Other effects: Higher costs of production and yield losses
- Neonicotinoids generate consumer and producer benefits in the $ Billions annually
- Reports will start coming out mid/late October



Gaspar et al. 2014

- 9 locations in WI, 2012 and 2013
- Treatments: multiple seeding densities and 3 seed treatments: UTC, fungicide, fungicide and neonicotinoid

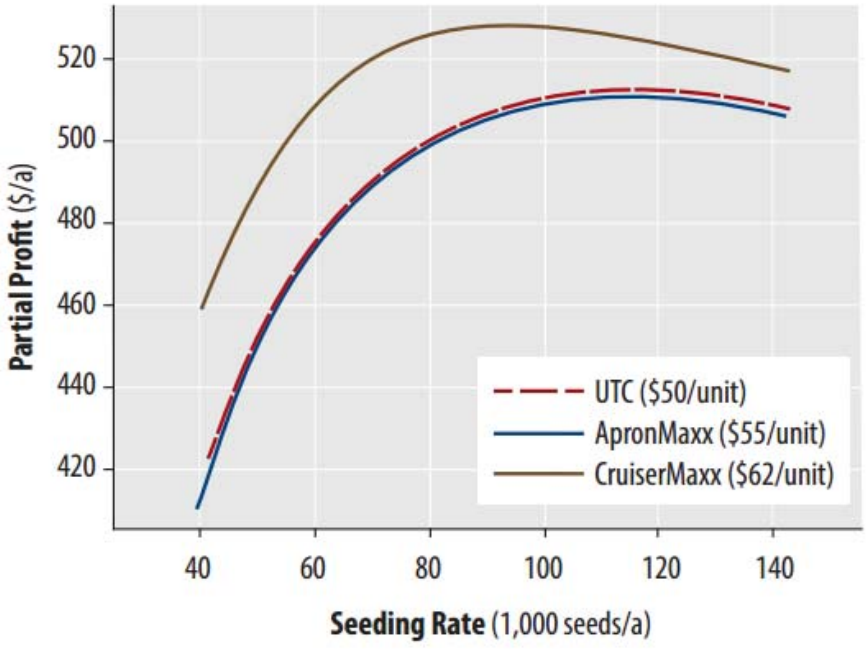
Figure 1. Yield (bu/a) of the three seed treatments across all seeding rates.



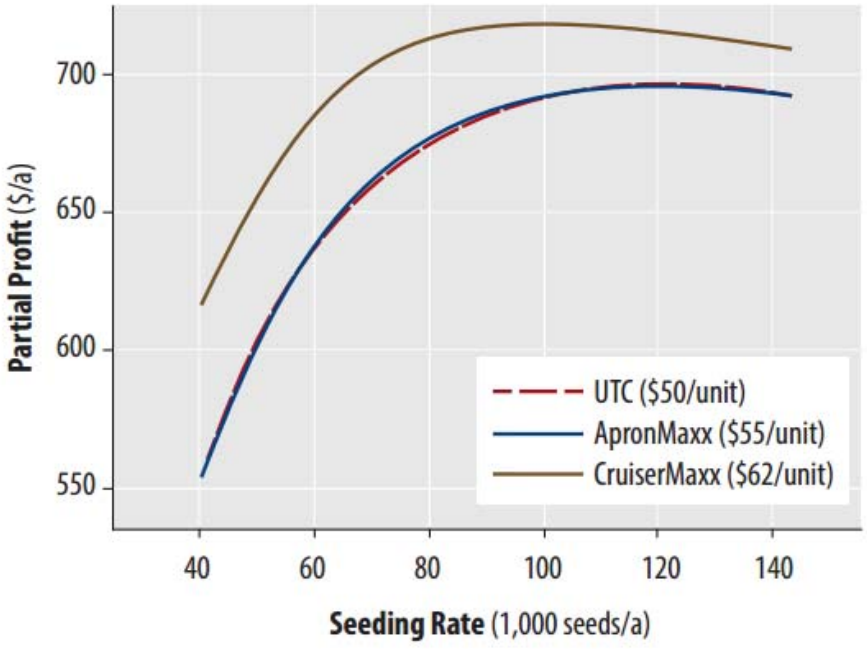
Source: http://www.coolbean.info/library/documents/SoybeanTreatmentRisk_2014_FINAL.pdf

Optimal Seeding Rates and Comparison to the Base Case of 140,000 seeds/A

Treatment	Optimal Seed Rate $9/bu	Optimal Seed Rate $12/bu	Break-Even Probability $9/bu	Break-Even Probability $12/bu	Expected Gain $9/bu	Expected Gain $12/bu
UTC	111,500	119,500	**0.84**	**0.76**	$4/A	$3/A
ApronMaxx	111,000	119,000	**0.54**	**0.52**	$14/A	$19/A
CruiserMaxx	94,000	100,500	**0.89**	**0.87**	$23/A	$30/A



grain sale price of **$9/bu**



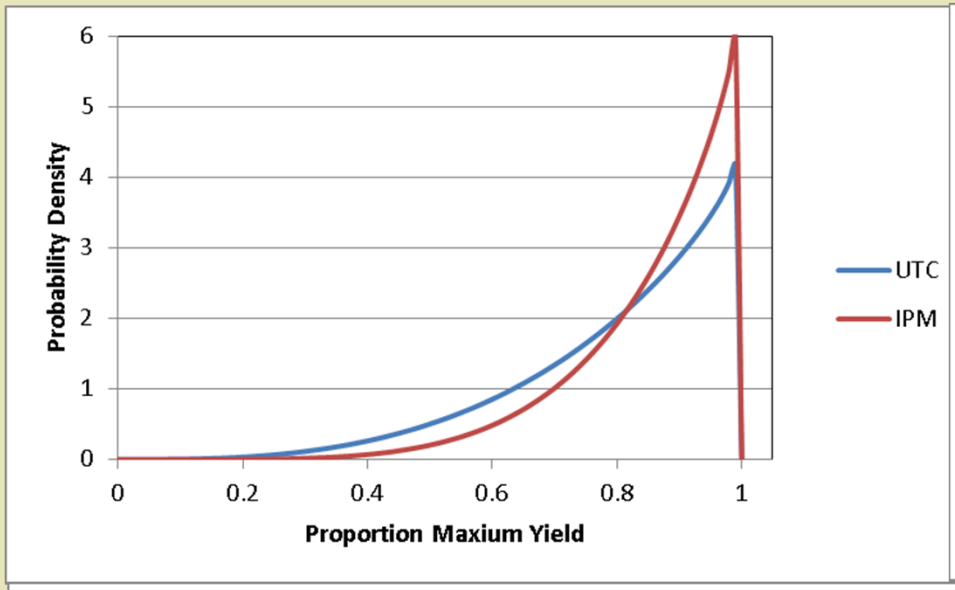
grain sale price of **$12/bu**

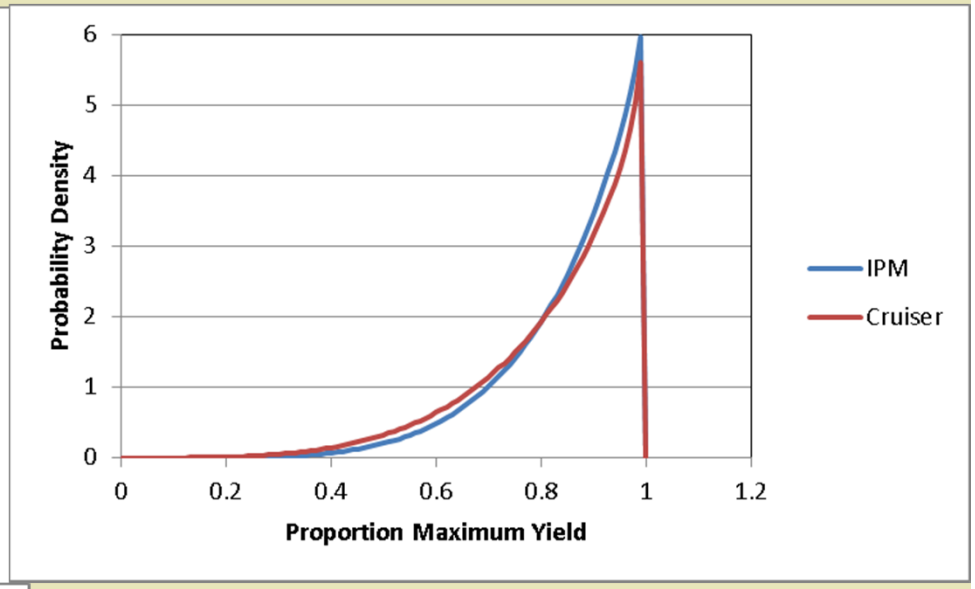
Neonicotinoid Seed Treatment versus Scouting-Based IPM for Soybean Aphids

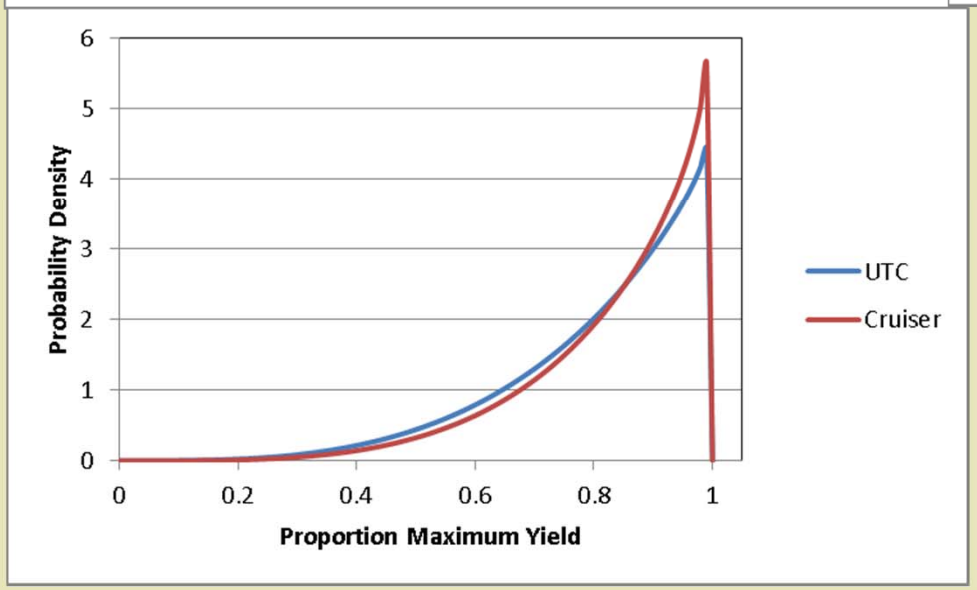
- North Central Soybean Research Program (IN, IA, KS, MN, ND, SD, WI)
- Field trials: UTC, UTC + IPM, Neonic Seed Treatment
- Estimate yield distribution with 2013 data
- Estimate returns distribution: SoyPrice x Yield – Cost

- IPM Costs: Scouting $7/A, Lambda-cyhalothrin $4/50/A, Application $7/A, range of treatment probabilities
- Seed Treatment Cost $7.50/A
- Price: $12/Bu and $9/Bu, base yield of 50 bu/A

Yield PDF







- In 2013 at these locations, both treatments significantly different than untreated, but not from each other

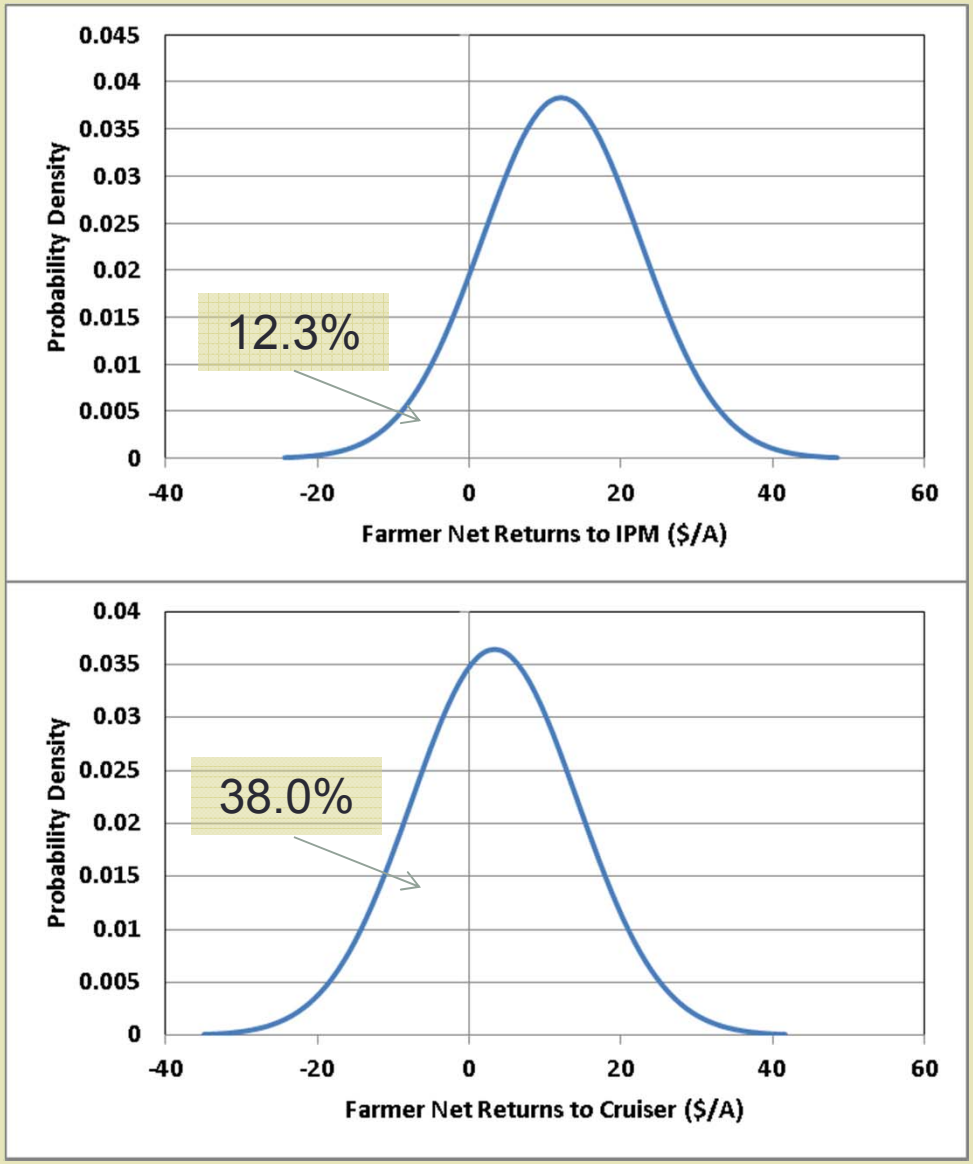
Net Return Results

$9/bu Soybeans	Cruiser	IPM (25%)	IPM (50%)	IPM (75%)
Cost ($/A)	$7.50	$9.88	$12.75	$15.63
Expected Net Return ($/A)	$3.34	$14.98	$12.10	$9.23
Break Even Probability	0.620	0.925	0.877	0.812
$12/bu Soybeans	Cruiser	IPM (25%)	IPM (50%)	IPM (75%)
Cost ($/A)	$7.50	$9.88	$12.75	$15.63
Expected Net Return ($/A)	$6.96	$23.26	$20.38	$9.23
Break Even Probability	0.683	0.953	0.929	0.812

Item	IPM	Cruiser
Soy Price ($/bu)	$9.00 & $12.00	
Soy Yield (bu/A)	50 for both	
Scouting ($/A)	$7.00	$0.00
Appplication ($/A)	$7.00	$0.00
AI cost ($/A)	$4.50	$7.50

- For 2013 data under these assumptions, IPM outperforms seed treatment based on mean return & break even probability
- Note: only one case is barely statistically significant at 5%

Net Return Distribution assuming Normal pdf



Item	IPM	Cruiser
Soy Price ($/bu)	$9.00	
Soy Yield (bu/A)	50	
Scouting ($/A)	$7.00	$0.00
Appplication ($/A)	$7.00	$0.00
AI cost ($/A)	$4.50	$7.50
Treatment Freq	50%	

- Neither is statistically significant at 5%
- Then why are neonicotinoid seed treatments so popular among farmers?
- **Managerial significance ≠ Statistical significance**

Managerial Significance does not require Statistical Significance

$9/bu Soybeans	Cruiser	IPM (25%)	IPM (50%)	IPM (75%)
Expected Net Return ($/A)	$3.34	$14.98	$12.10	$9.23
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Break Even Prob	0.683	0.953	0.929	0.812

- Most of these choices are not significantly different from $0/A, but most people would take these monetary bets
- When it comes to profit, people are not interested in statistical significance, but the mean, variability, and the likelihood of bad outcomes
- Extensive economic literature on decision making under risk (Mitchell and Hutchison 2008)

Why are neonicotinoid seed treatments so popular among farmers?

- IPM and neonicotinoid seed treatments both generate value for farmers
- My opinion: neonicotinoid seed treatments have substantial non-pecuniary benefits compared to scouting-based IPM
  - Survey of IL and WI soybean farmers (Dong et al. 2014) shows they do not like to use IPM/scouting
- Farmers like the yield gains at reasonable cost, plus the simplicity/convenience and the human and environmental safety of seed treatments

Neonicotinoid Summary

- Assessment of yield and economic benefits of neonicotinoids in progress, including estimates of reduction in use of OP and pyrethroids
- Farmer value of insect pest management (Bt, neonicotinoid seed treatments, foliar applications) and non-pecuniary factors in progress
- Managerial significance does not imply statistical significance: Farmers do not need statistical significance to adopt a technology
  - When combined with non-pecuniary benefits, helps explain why farmers use neonicotinoid seed treatments more than scouting-based IPM

Organic Ag

- **Wisconsin a national leader**
- **Agricultural "Big Tent"**
- Abundant research opportunities
- My work: vegetable growers

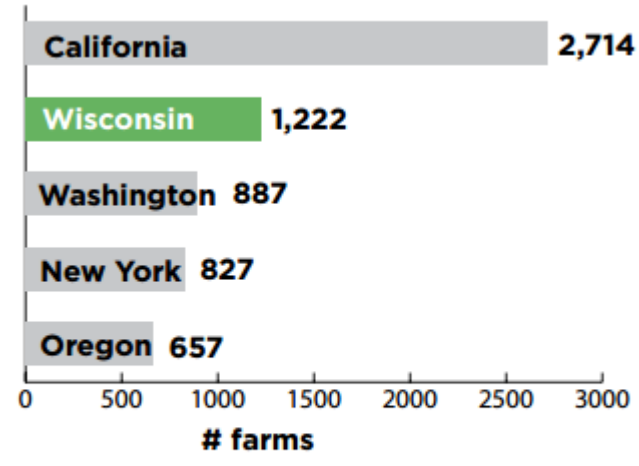


Figure 1. Top five states in number of organic farms, 2008
Source: USDA. 2008. *Organic Production Survey*, Table 1.

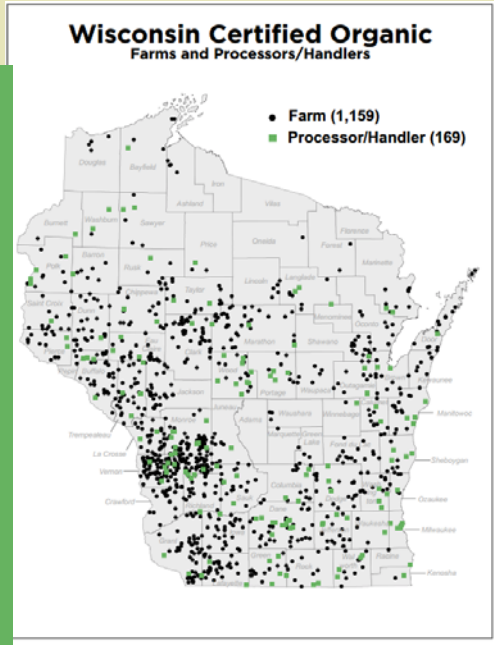


Figure 8. Wisconsin Certified Organic Farms and Processors/Handlers
Source: USDA NOP data, 2011, unpublished.
Map by Lisa Morrison, DATCP, 12/19/2011.

Source: http://www.cias.wisc.edu/wp-content/uploads/2012/02/org12finalnewlowres021612.pdf

Top states in number of farms producing organic products, 2008

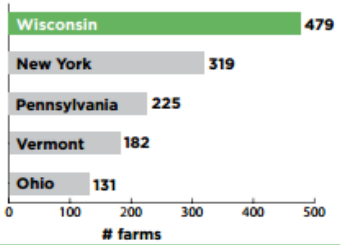


Figure 2. Dairy farms
Source: USDA. 2008. *Organic Production Survey*, Table 10.

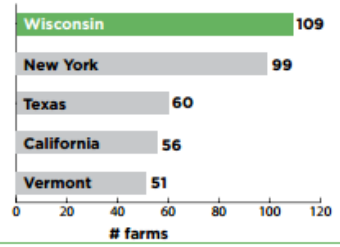


Figure 3. Beef farms
Source: USDA. 2008. *Organic Production Survey*, Table 10.

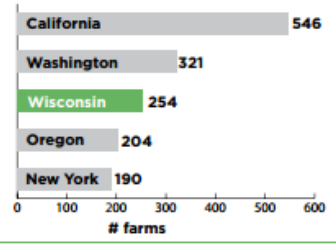


Figure 4. Vegetable/ melon farms
Source: USDA. 2008. *Organic Production Survey*, Table 4.

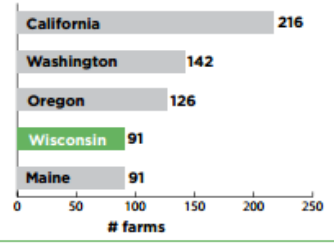


Figure 5. Berry farms
Source: USDA. 2008. *Organic Production Survey*, Table 6.

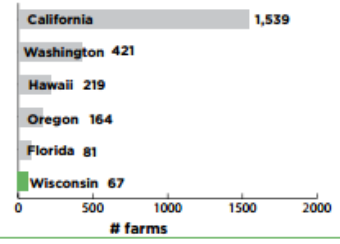
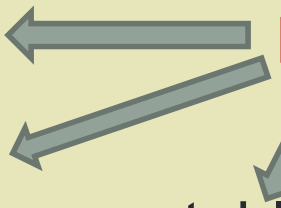


Figure 6. Fruit/ tree nut farms
Source: USDA. 2008. *Organic Production Survey*, Table 5.

Small Wisconsin Vegetable Growers

- Madison known for its Farmers Markets and CSA
- Less well known: wholesale (Organic Valley), produce auctions, direct marketing to restaurants
- Public policy goal is to help this industry grow: How?
- Issues:
  - Low profitability for many farmers
  - Don't know/understand their cost of production

- VeggieCompass
- Labor data collection
- Survey of WI small organic vegetable growers



Erin Silva's leadership

Silva et al. (2014)

- Impact of marketing channels on perceived profitability and quality of life for small WI organic vegetable growers
- **How satisfied are you with your farm's profitability?**
- **How satisfied are you with your quality of life?**
  - Very dissatisfied, dissatisfied, neutral, satisfied, very satisfied
- Analysis: estimate the effect of variables on the probability that a farmer reports a specific option
- Here: just report interesting significant variables

Satisfaction with farm profitability

Variable	Dissatisfied	Neutral	Satisfied
Female			--
Farm Debt	++	++	----
Operating Loan	++++		---
CSA	+++		----
Quality of Life	--		+++

Satisfaction with quality of life

Variable	Neutral	Satisfied	Very Satisfied
Female	-	--	+++
Operating Loan	-		+++
Restaurant/Institutions	+	+	---
Farm Profitability	-		++

Discussion/Questions

- CSA farmers: higher than average dissatisfaction with profitability, but does not impact their quality of life
  - Farmers market same results, almost significant
- **Is the CSA/Farmer Market model failing in WI?**
  - Do CSA/Farmers Market growers accept lower profit, but enjoy lifestyle? Is this a viable business model?
  - Is it a lack of knowledge of their cost of production?
  - Are there too many entrants driving prices down?
- Focus: VeggieCompass, more business training

What do Economists do?

- Try to understand why people do what they do and the implications of their behavior. We estimate
  - Unintended consequences, externalities, and tradeoffs
  - Economic surplus and non-pecuniary benefits
  - Identify factors driving behavior/diagnose problems
  - Predict behavior under hypothetical situations (policy)
- We analyze data with sophisticated econometric models and address technical issues
  - Very concerned about proper analysis methods and endogeneity (spurious correlation)
- We need your help understanding the science and data
  - Economists learn science or scientists learn economics

Closing Comments

- Preferences are an economic fundamental
  - *De gustibus no est diputandem*
  - Economists can't change people, only understand their preferences and behavioral implications
- Personal preferences about biotechnology and organics: Can't just "inform" people to change preferences
  - Partly imagined, social constructs: it's more than science, it's faith-based agriculture
  - Lima bean ice cream or eating insects
- Humans have a strong proclivity for magical thinking
  - See things not there, ignore data that don't fit our view
  - Be aware of magical thinking in your self: critical but open

Thanks for Your Attention