

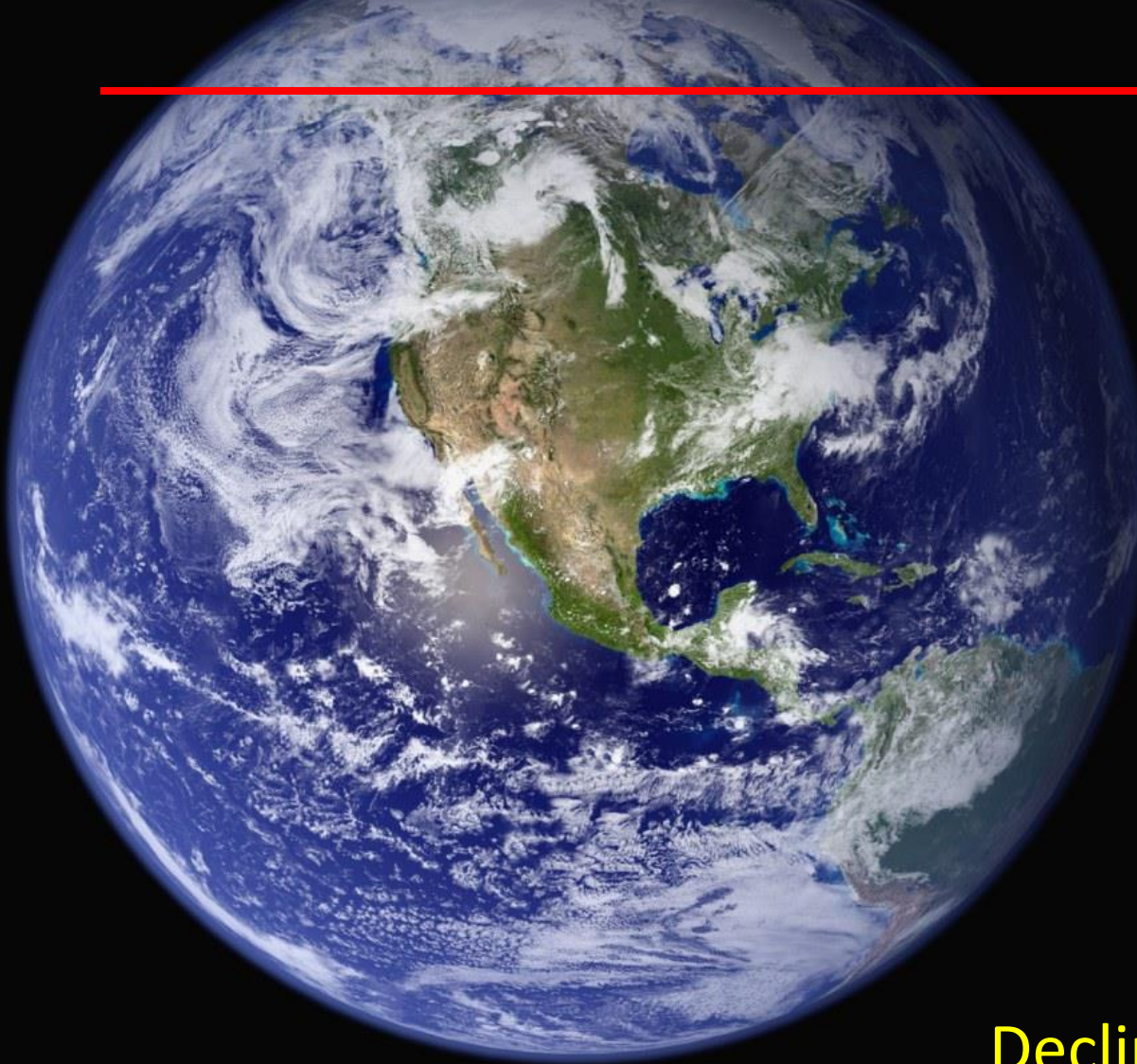
# Ecology Intensive Farming: Breaking Rules and Using Our Food Production System to Solve Planetary Scale Problems



Jonathan Lundgren  
Ecdysis Foundation  
Blue Dasher Farm

# Major Crises Facing the Planet

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Climate change

Pollution

Human health

Civil unrest

Declines in biodiversity



# Biodiversity is in Decline

## Birds

Mineau and Whiteside. 2013. PLoS ONE 8(2): e57457  
Hallmann et al. 2014. Nature 511: 341  
Rosenberg et al. 2019. Science 366: 120

## Butterflies

Swengel et al. 2011. J Insect Conserv 15: 327  
Pleasants and Oberhauser 2013. Insect Conserv Divers 6: 134

## Grassland habitats

Wright and Wimberley. 2013. PNAS 110: 4134  
Johnston. 2014. Landscape Ecol 29: 81

## Insect communities

Hallmann et al 2017. PLoS ONE 12: e0185809  
Sanchez-Bayo and Wyckhuys 2019. Biol Conserv 232:8

## Wetland habitats

Wright and Wimberley. 2013. PNAS 110: 4134

Butchart et al. 2011. Science 328: 1164  
Potts et al. 2010. TREE 25: 345  
Frick et al 2010. Science 329: 682  
Newton 2004. Ibis 146: 579



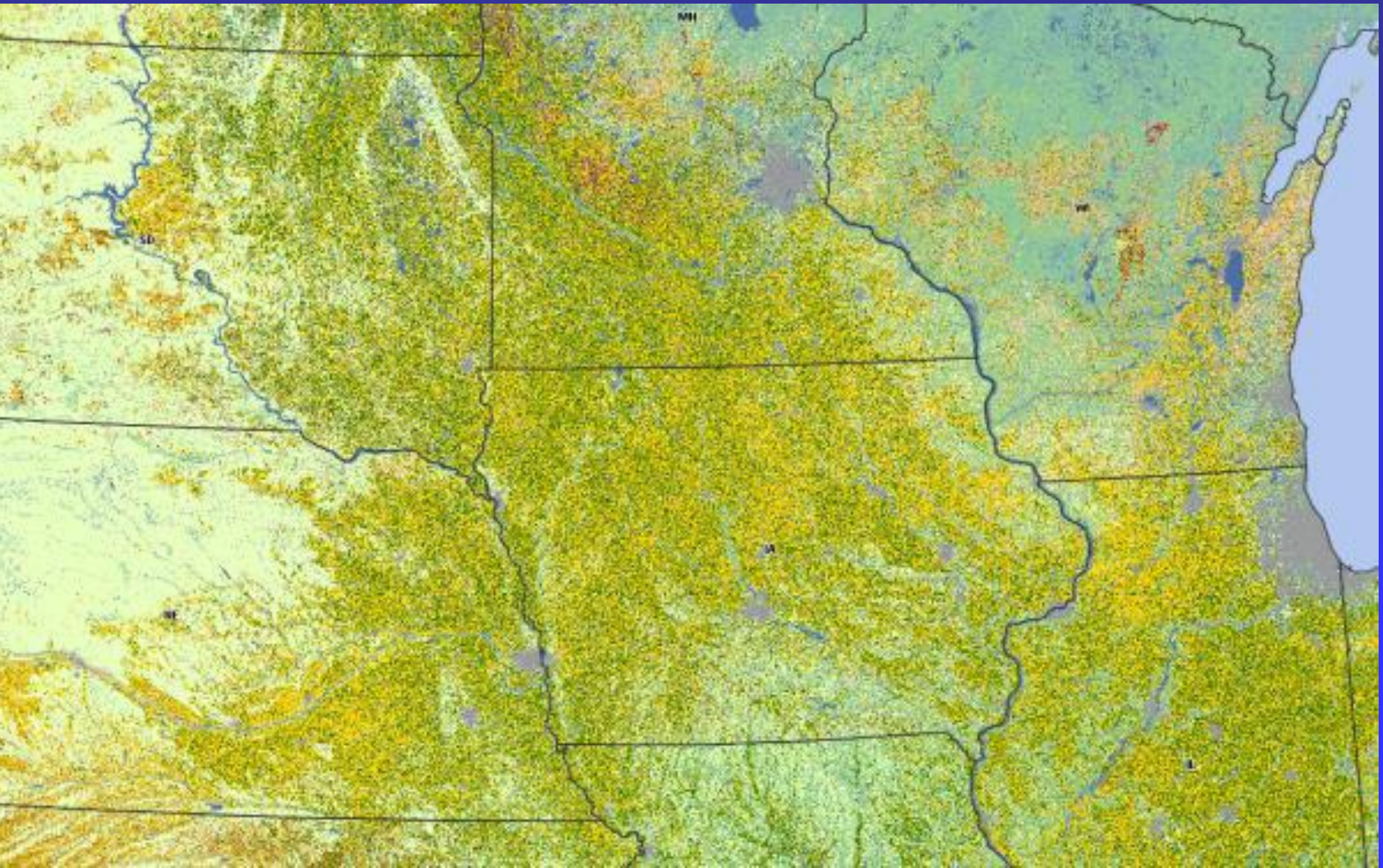
# Central Problem

Agriculture is far too simplified



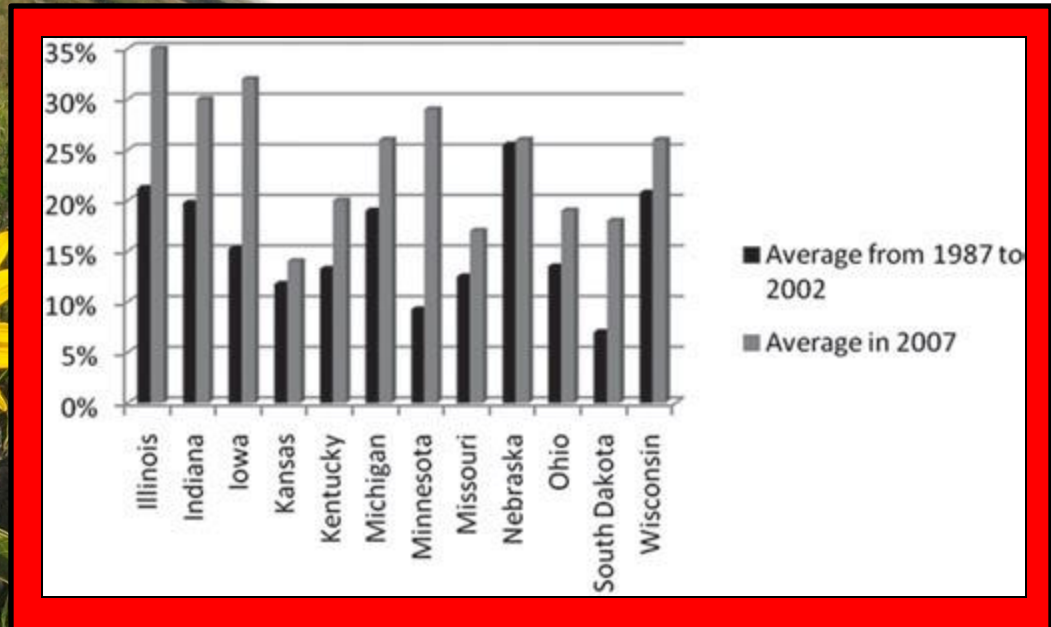


# Agriculture





# Rising Insecticide Use Rates





# Insecticides: What pests are we shooting at?

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Systemic insecticides are present on most crop seeds

Imidacloprid

Thiamethoxam

*What effects are these insecticides having on insect communities?*



# Compared Soybean Plots Treated with Insecticidal Seed Treatments to Untreated

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2-year, replicated study

Three treatments  
(thiamethoxam, imidacloprid,  
untreated)



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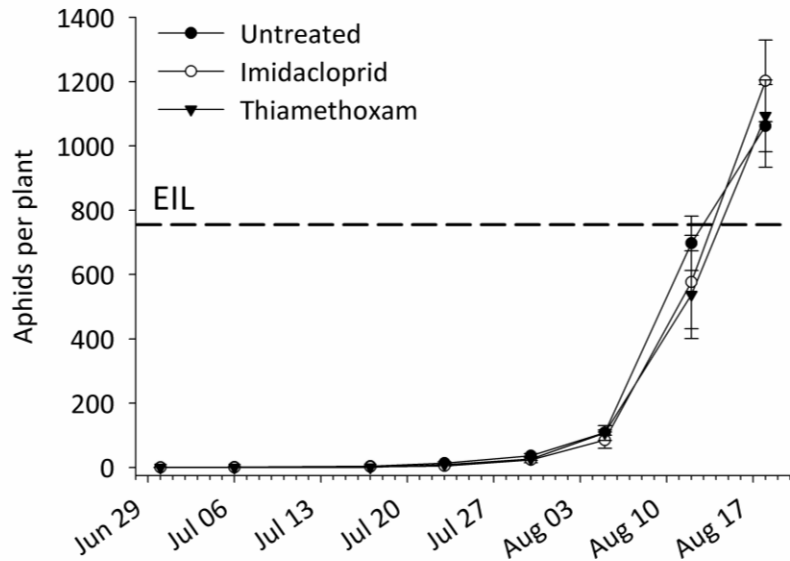
Aphid populations (other pests too)  
Populations of predators  
Soybean performance



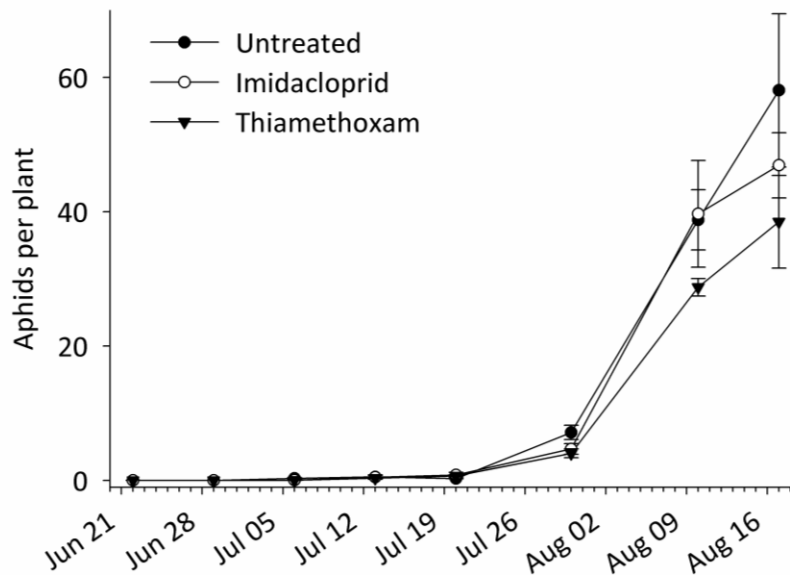
# Pest Populations and Crop Performance

Soybean yields were equivalent in all treatments in 2009 and 2010

2009

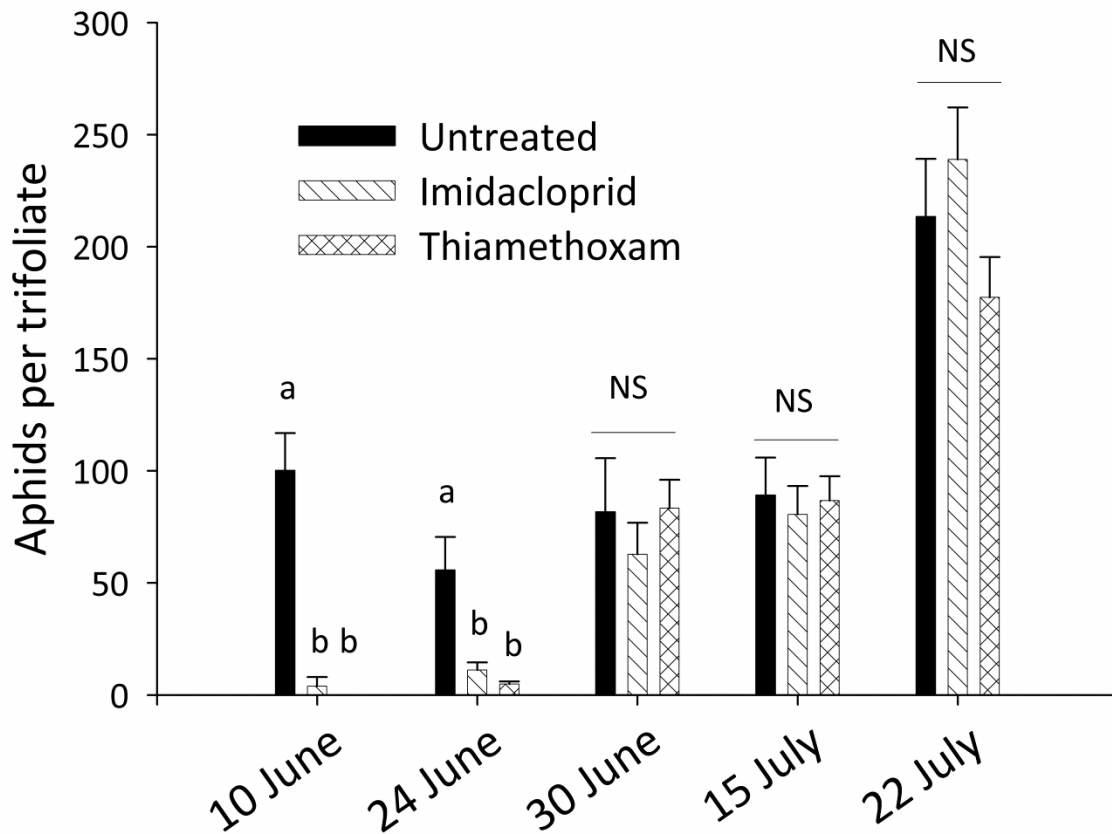


2010



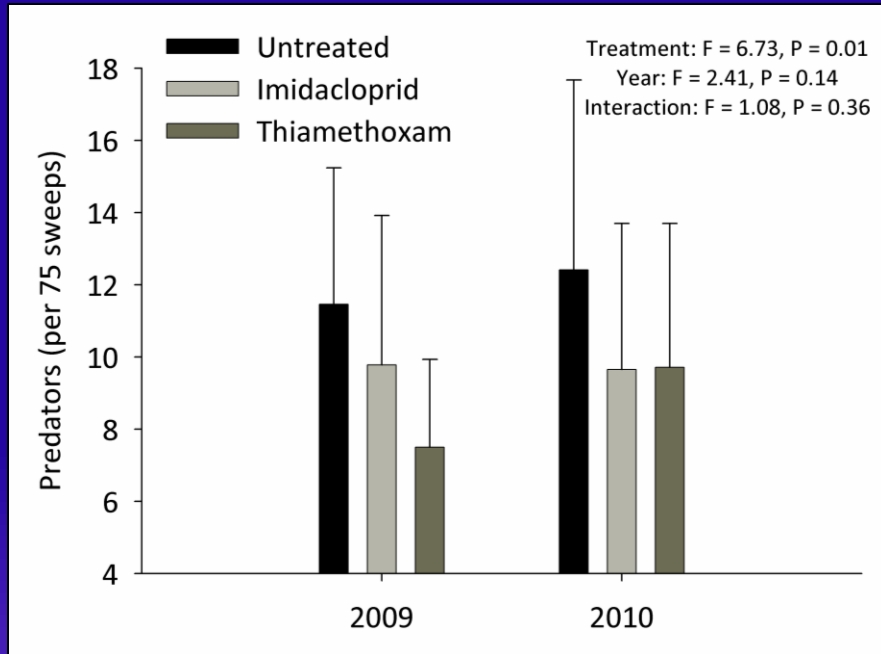


# The Insecticides are Gone by the Time that Aphids Arrive

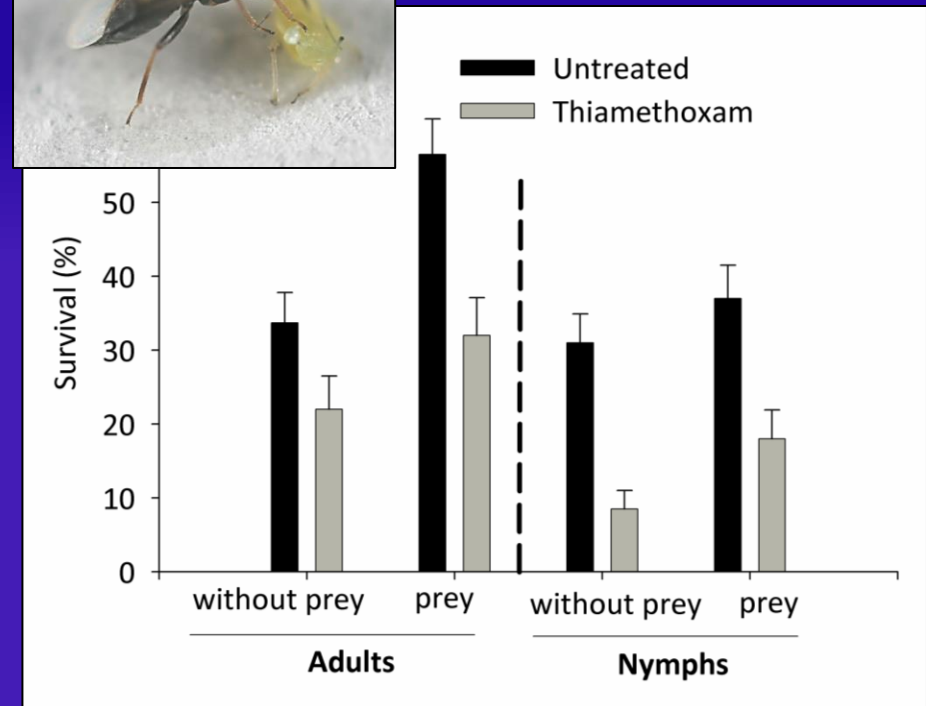




# Predator and Predator Populations



In the laboratory, *Orius* survival is reduced by thiamethoxam



There were significantly fewer predators in the thiamethoxam treatment



# Neonicotinoids: Are they Helping or Hurting?

Are they controlling pest insects?

Kill natural enemies

They cost \$10-15 per acre



Public Sector Research on Soybean Seed Treatments:  
McCornack and Ragsdale. 2006. Pest Management News (doi: 10.1094/CM-2006-0915-01-RS)  
Cox et al. 2008. Agronomy Journal 100: 1662-1665  
Ohnesburg et al. 2008. Journal of Economic Entomology 102: 1816-1826  
Johnson et al. 2009. Journal of Economic Entomology 102: 2101-2108  
Reisig et al. 2012. Journal of Economic Entomology 105: 884-889



# Over-arching Concerns Over Neonicotinoids

They are very toxic

How are they moving  
through the  
environment?

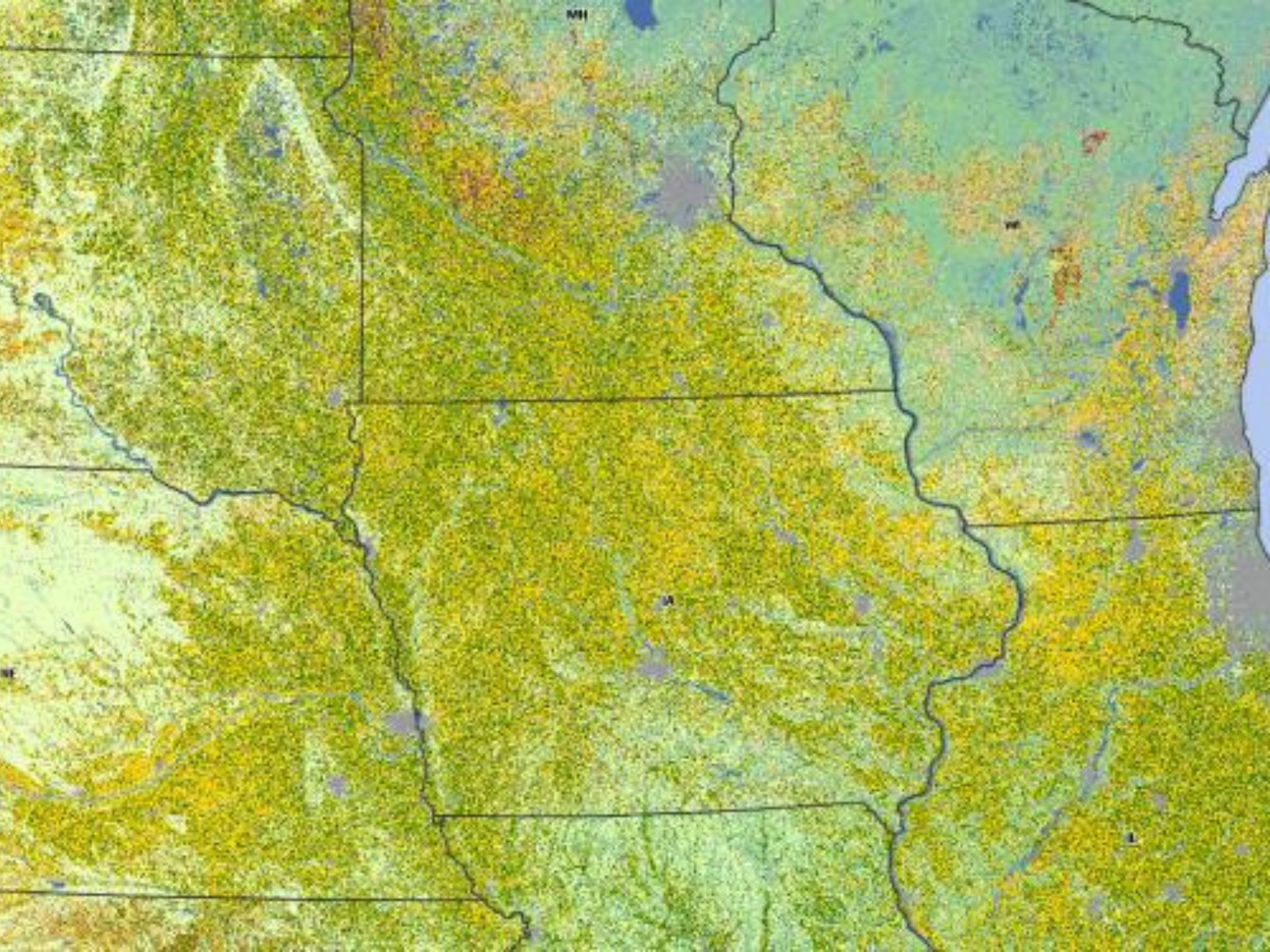
Scale of exposure

They affect organisms in  
unpredicted ways



Each corn seed can kill 164,000 bees









# Neonicotinoids are Not Staying Put

Conservation strips  
adjacent to neonic-  
treated cornfields  
or organic cornfields



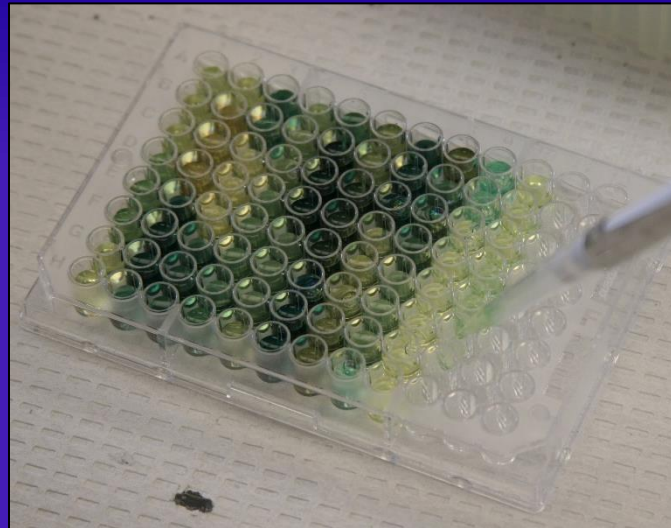
# Effects of Clothianidin on Hive Health

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Dr. Chrissy Mogren

Collected honey bees,  
nectar, pollen, and honey  
from each site



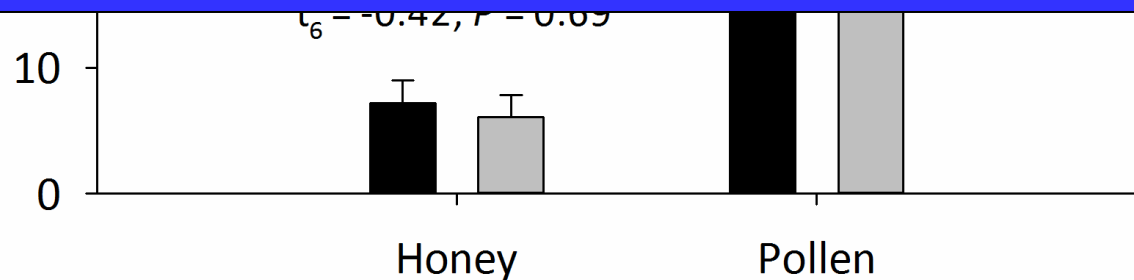
Used ELISA to quantify clothianidin

# Clothianidin in Honey and Pollen



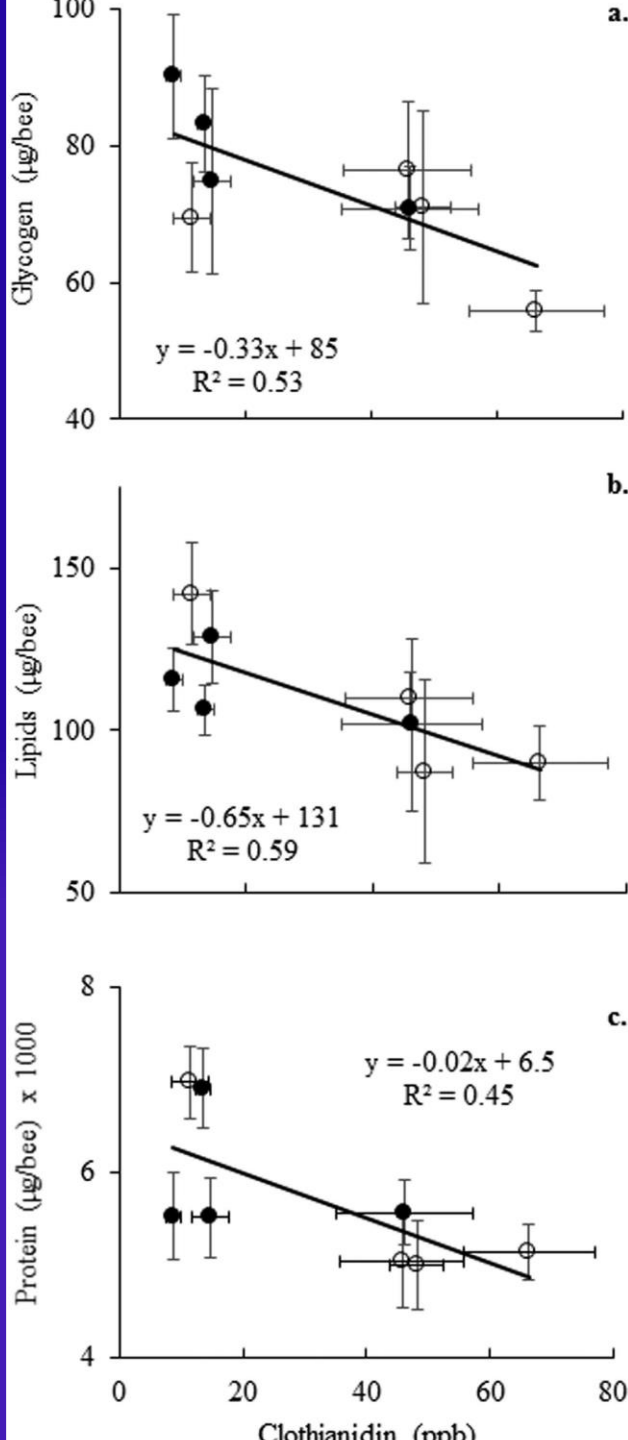
Organic

In all metrics, organic farms and conventional farms had equal contamination levels





# Conservation Strips and Bee Health



Are conservation strips helping or hurting?

# Neonicotinoids Affect Organisms in Ways We Don't Understand



70% of deer in MT  
had genital  
deformities and jaw  
deformities



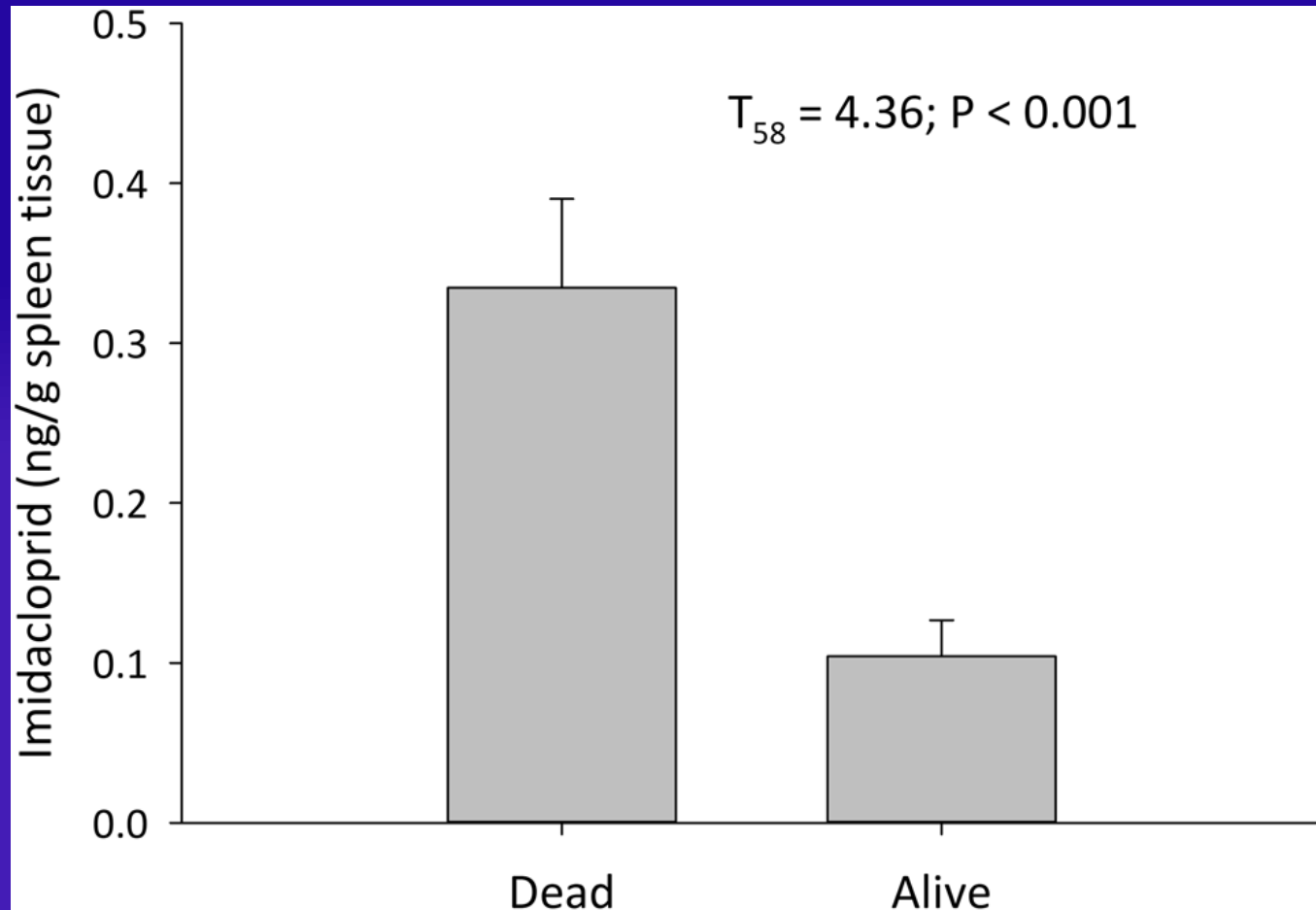
# Does Imidacloprid Harm Deer?

A 2-year captive  
deer study

3 doses  
administered  
weekly in their  
water



# Imidacloprid and fawn mortality





# More Imidacloprid in Spleens were Associated With Reduced:

fawn body weight

fawn thyroid hormone levels

fawn organ weights

fawn jawbone length

activity levels in adult deer



# What are Spleen Imidacloprid Levels in Wild Deer?

Captive deer spleens  
0.18 ng imidacloprid/g  
of spleen

ND wild deer spleens  
0.60 ng imidacloprid/g  
of spleen





# Pest Management in Bare and Covered Soils

Compared no-till cornfields planted with cover crops (slender wheatgrass) to those with bare soil

## Pest Populations



## Root ratings



Lundgren and Fergen 2010. Environmental Entomology 39(6): 1816-1828  
Lundgren and Fergen 2011. Applied Soil Ecology 51: 9-16

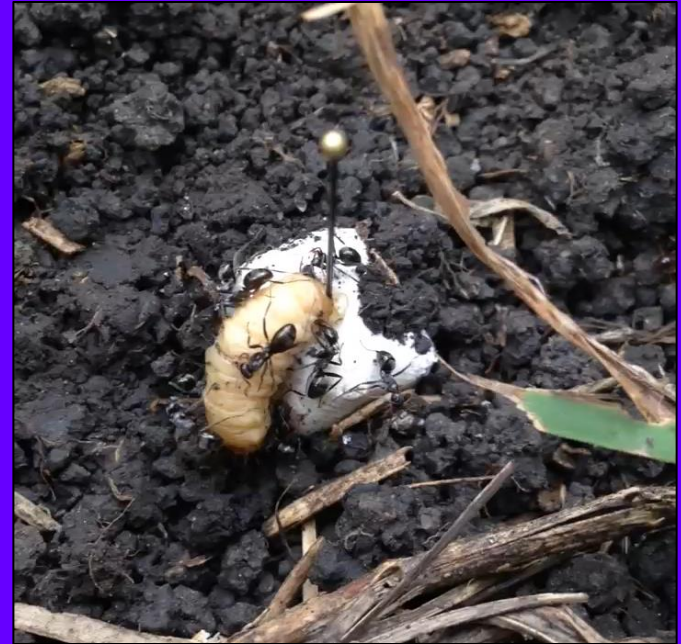


# Sampling

Quadrats



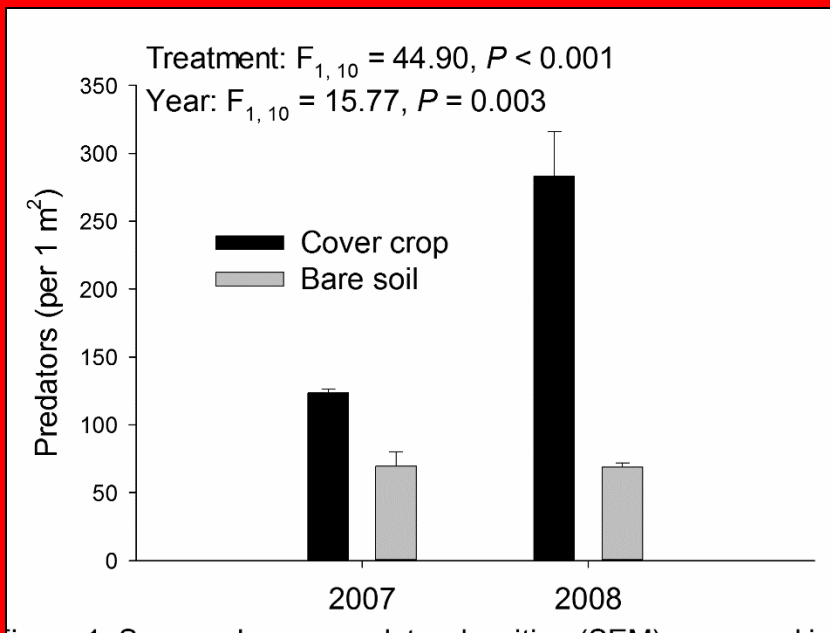
Sentinel larvae





# Effects on Predators

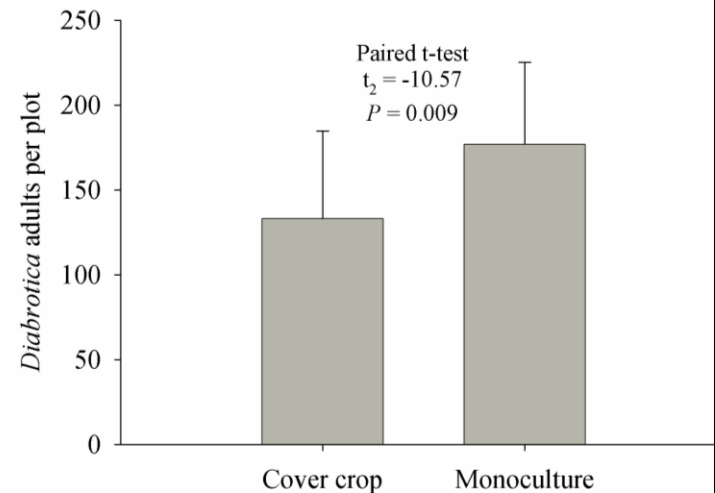
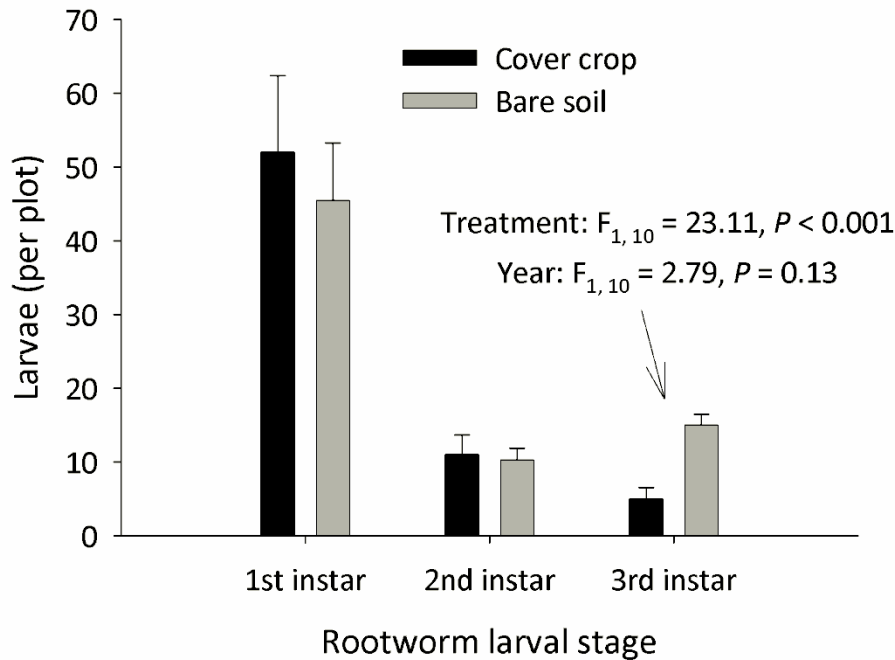
Significantly more predators in cover-cropped cornfields



# Effects on Rootworms

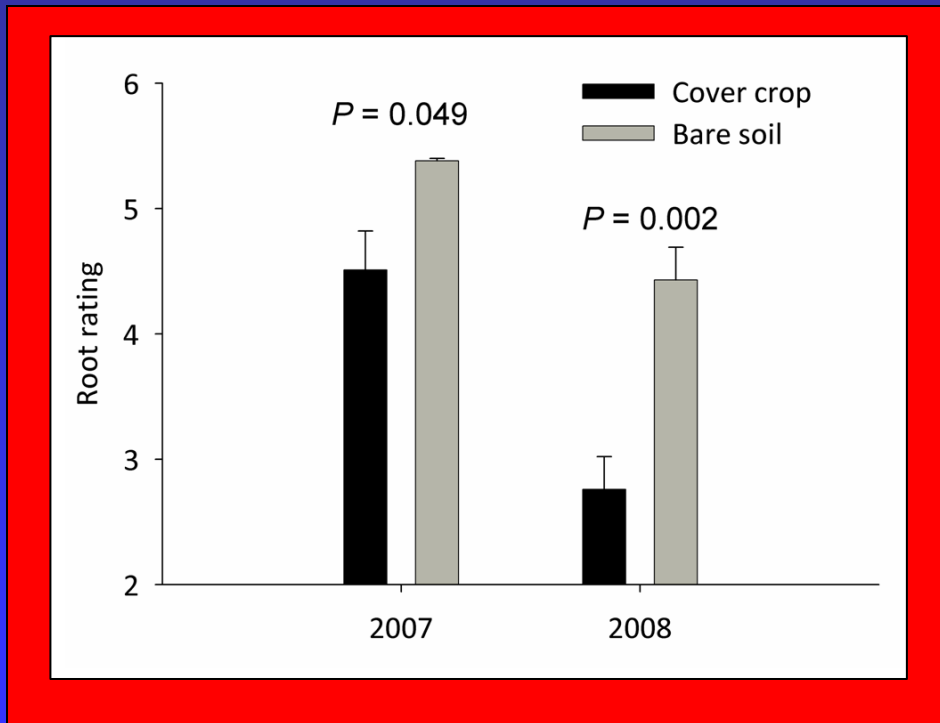
Cover-cropped cornfields  
had lower 3<sup>rd</sup> instar  
rootworm survival

...and lower adult  
emergence





# Effects on Crop Damage



Cover-cropped fields experienced less damage



FARMERS  
**Lead**  
THE WAY





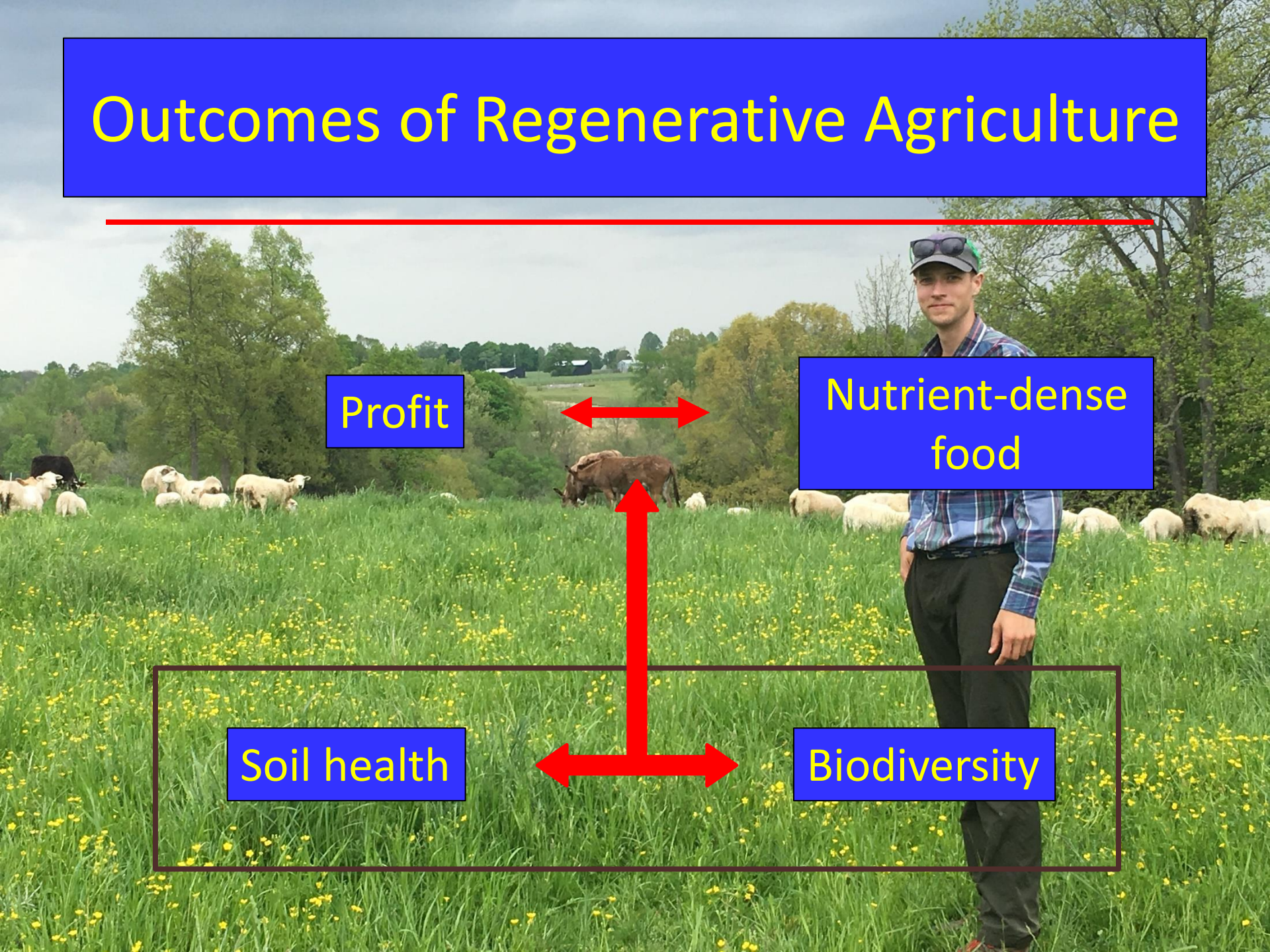
# Outcomes of Regenerative Agriculture

Profit

Nutrient-dense  
food

Soil health

Biodiversity





# A Better Way to Farm

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Best management  
practices  
Regional focus  
Systems level

Claire LaCanne, MSc

Regenerative

No insecticides

Conventional

Insecticides



# Approach

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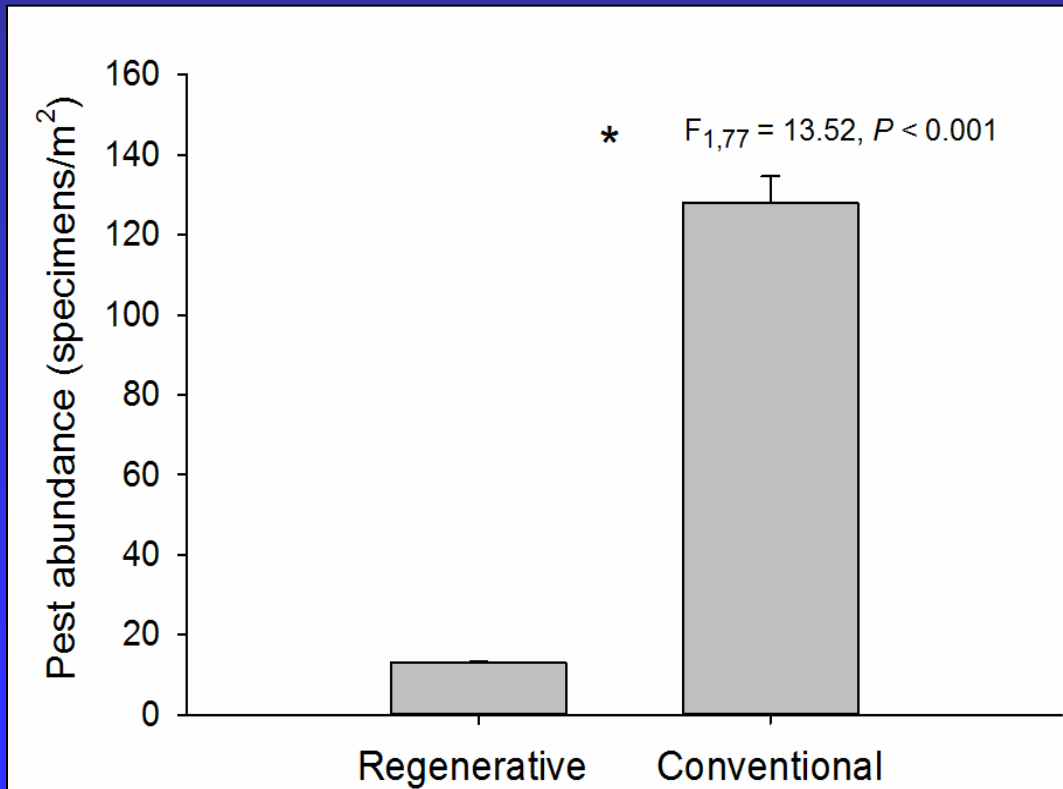
Full bioinventory  
of corn community



Yields and profit

# Pest Populations

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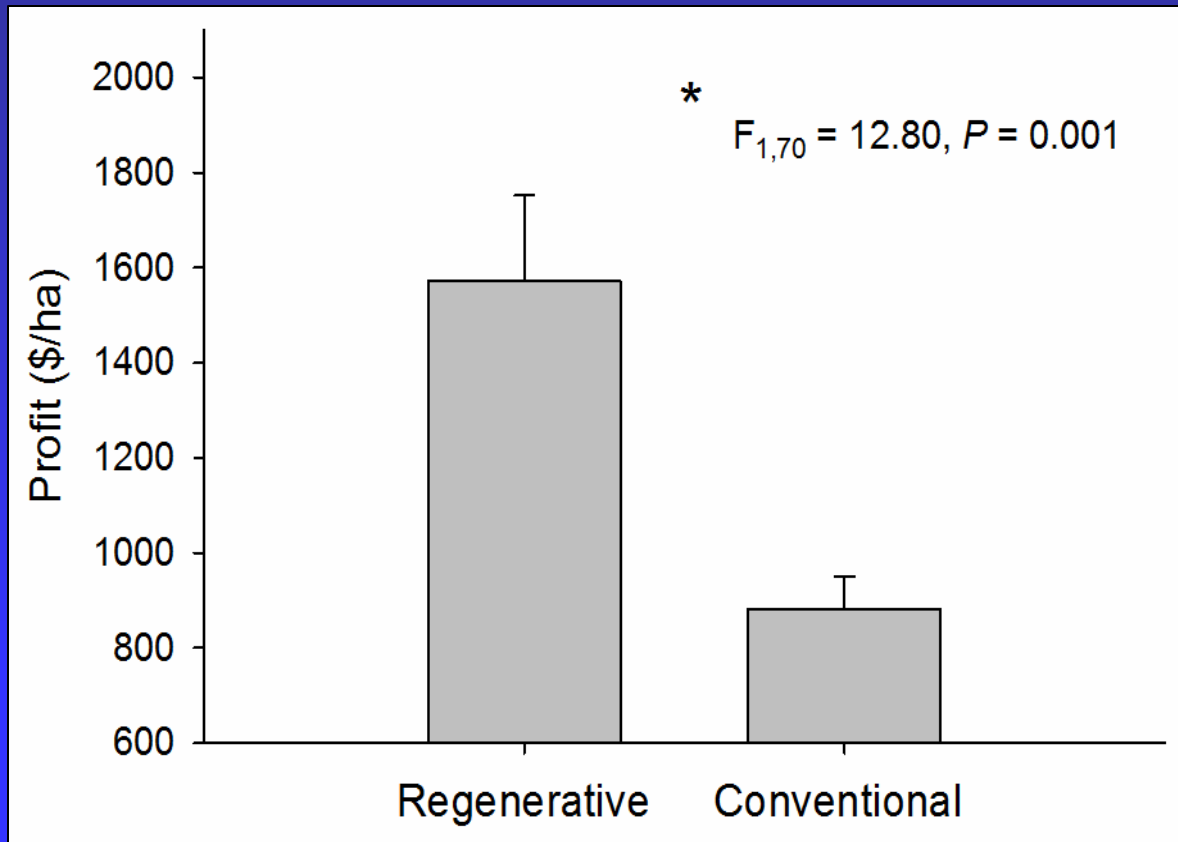


Regenerative systems  
had 10-fold fewer pests  
than insecticide-treated  
systems



# Profits

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Regenerative  
systems were twice  
as profitable



Solution to the Problem

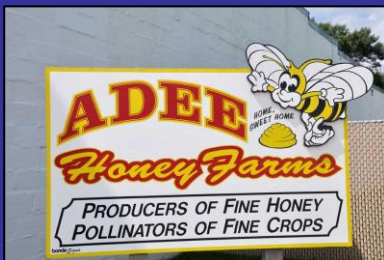
Change agriculture

Anything less, and the planet will continue to decline



# Thanks!

## Hundreds of donors



# A New Way for Science to Help Bee Keepers and Farmers



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