

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



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Major Crises Facing the Planet



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

Wetland habitats

Wright and Wimberley. 2013. PNAS 110: 4134

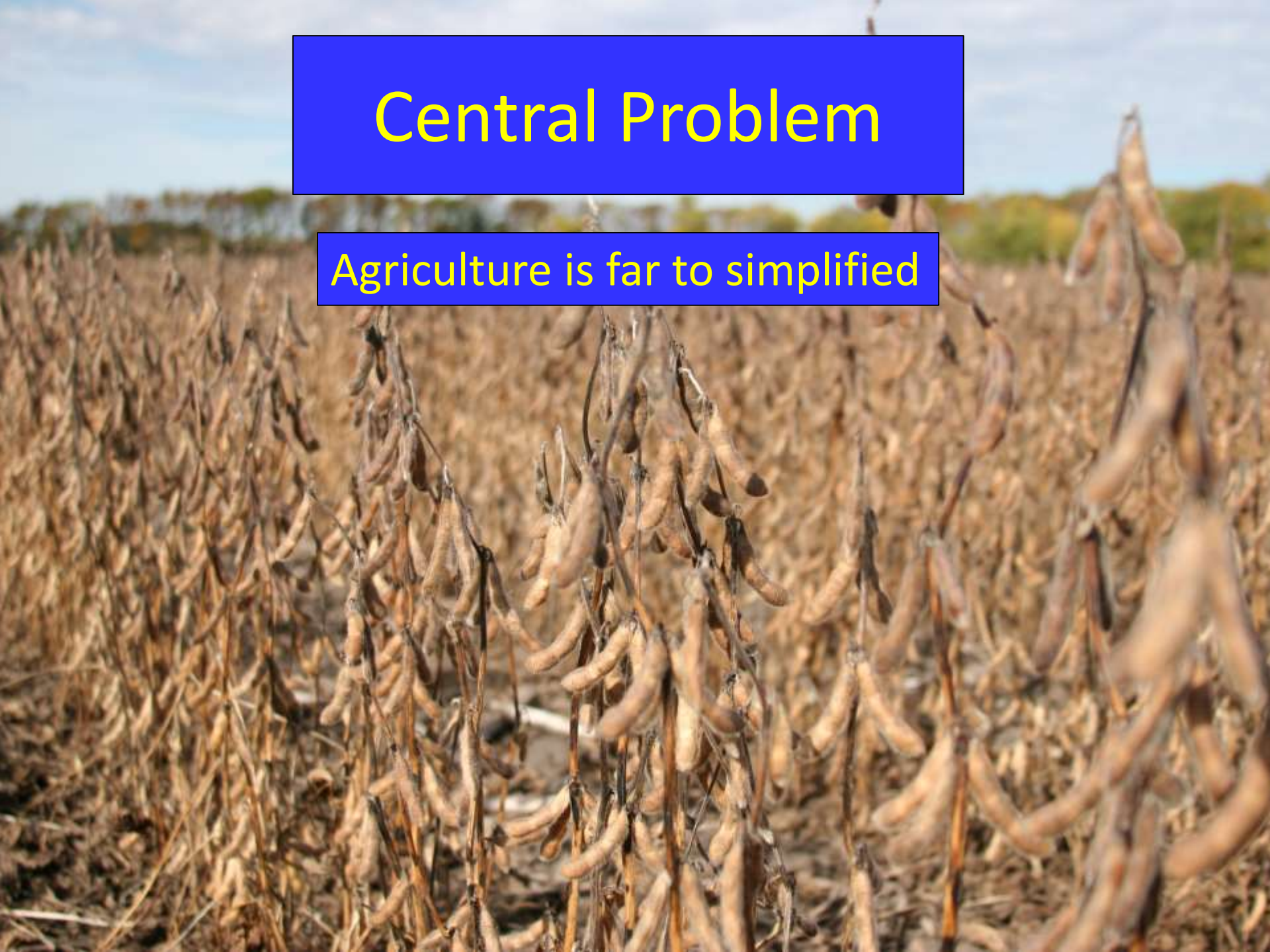
Insect communities

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

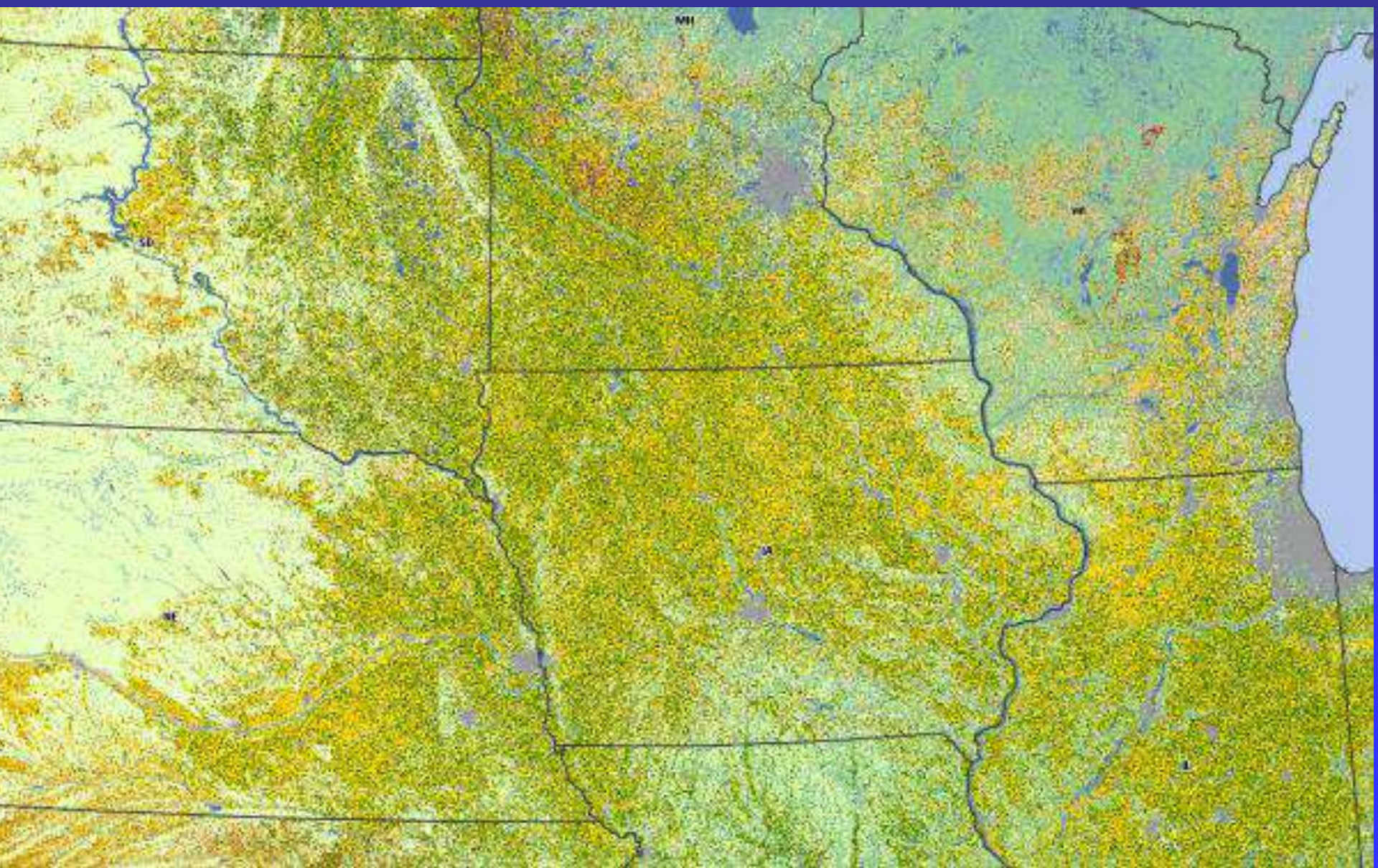
Butchart et al. 2011. Science 328: 1164
Potts et al. 2010. TREE 25: 345
Frick et al 2010. Science 329: 682
Newton 2004. Ibis 146: 579

Central Problem

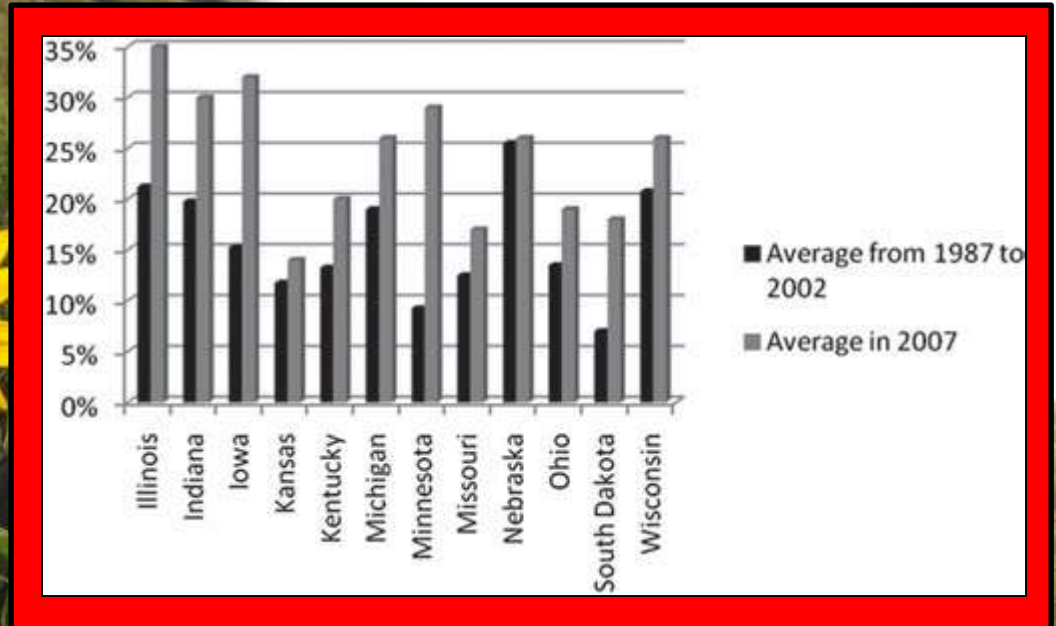
Agriculture is far too simplified



Agriculture



Rising Insecticide Use Rates



Insecticides: What pests are we shooting at?

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

2-year, replicated study

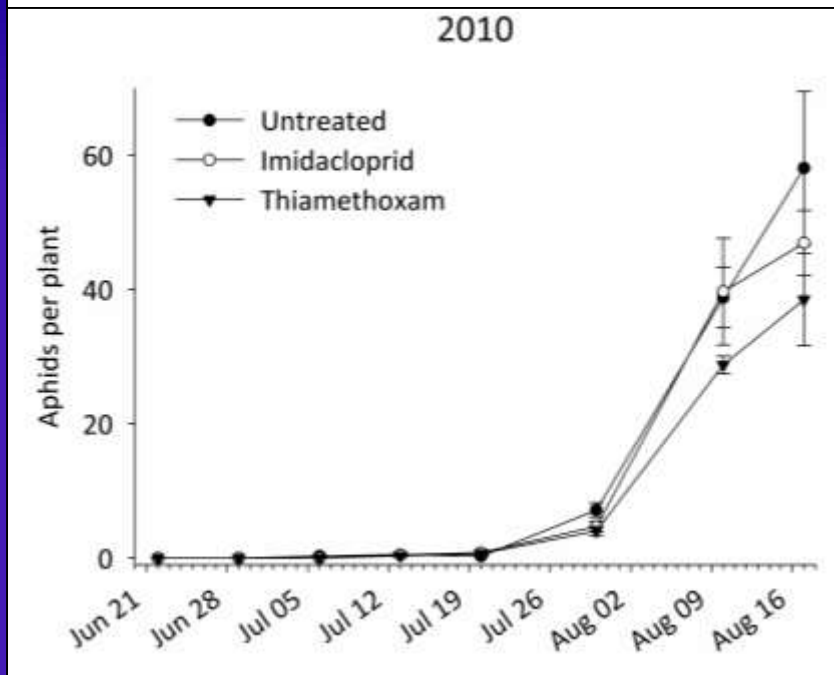
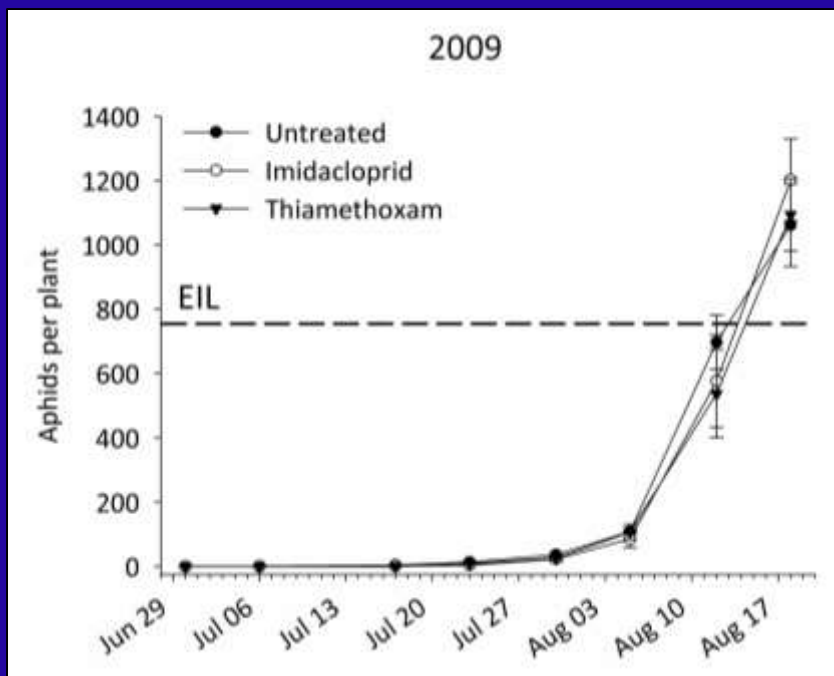
Three treatments
(thiamethoxam, imidacloprid,
untreated)



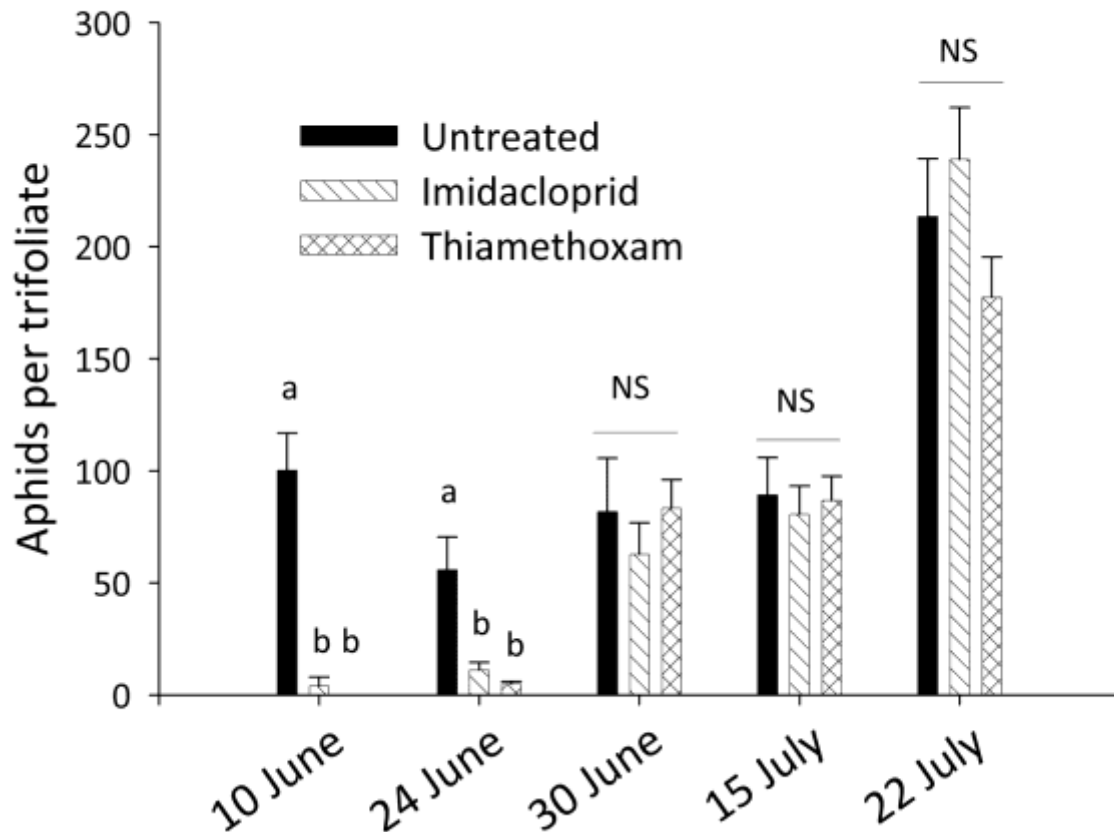
Aphid populations (other pests too)
Populations of predators
Soybean performance

Pest Populations and Crop Performance

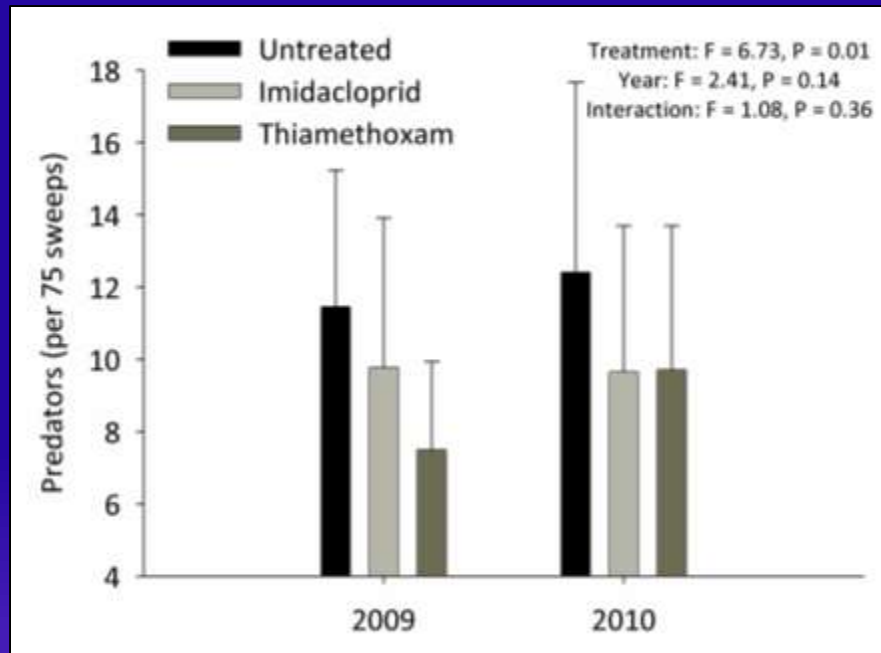
Soybean yields were equivalent in all treatments in 2009 and 2010



The Insecticides are Gone by the Time that Aphids Arrive

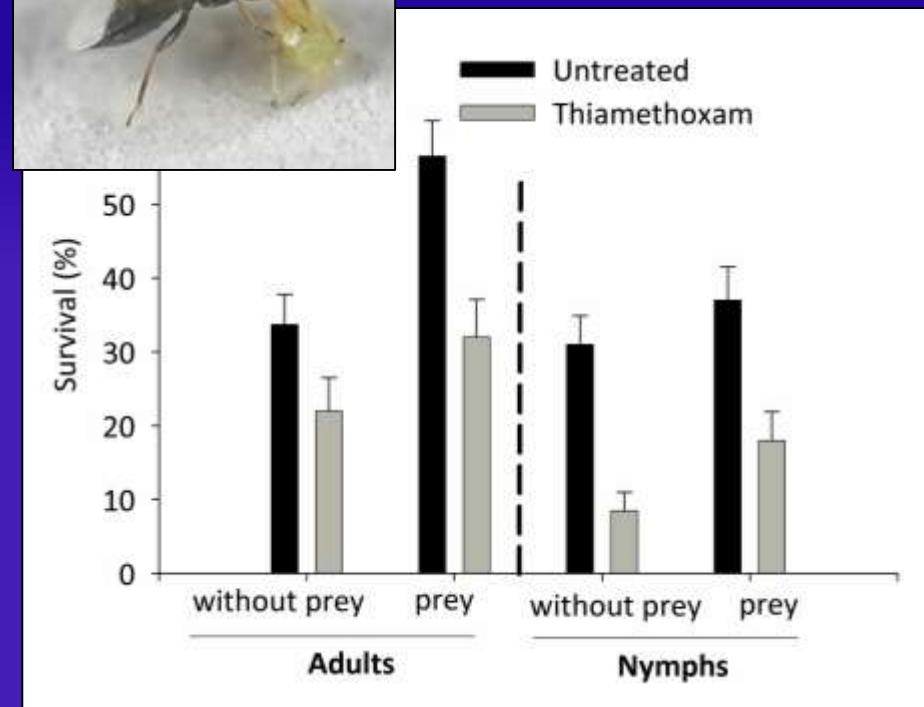


Predator and Predator Populations



There were significantly fewer predators in the thiamethoxam treatment

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



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

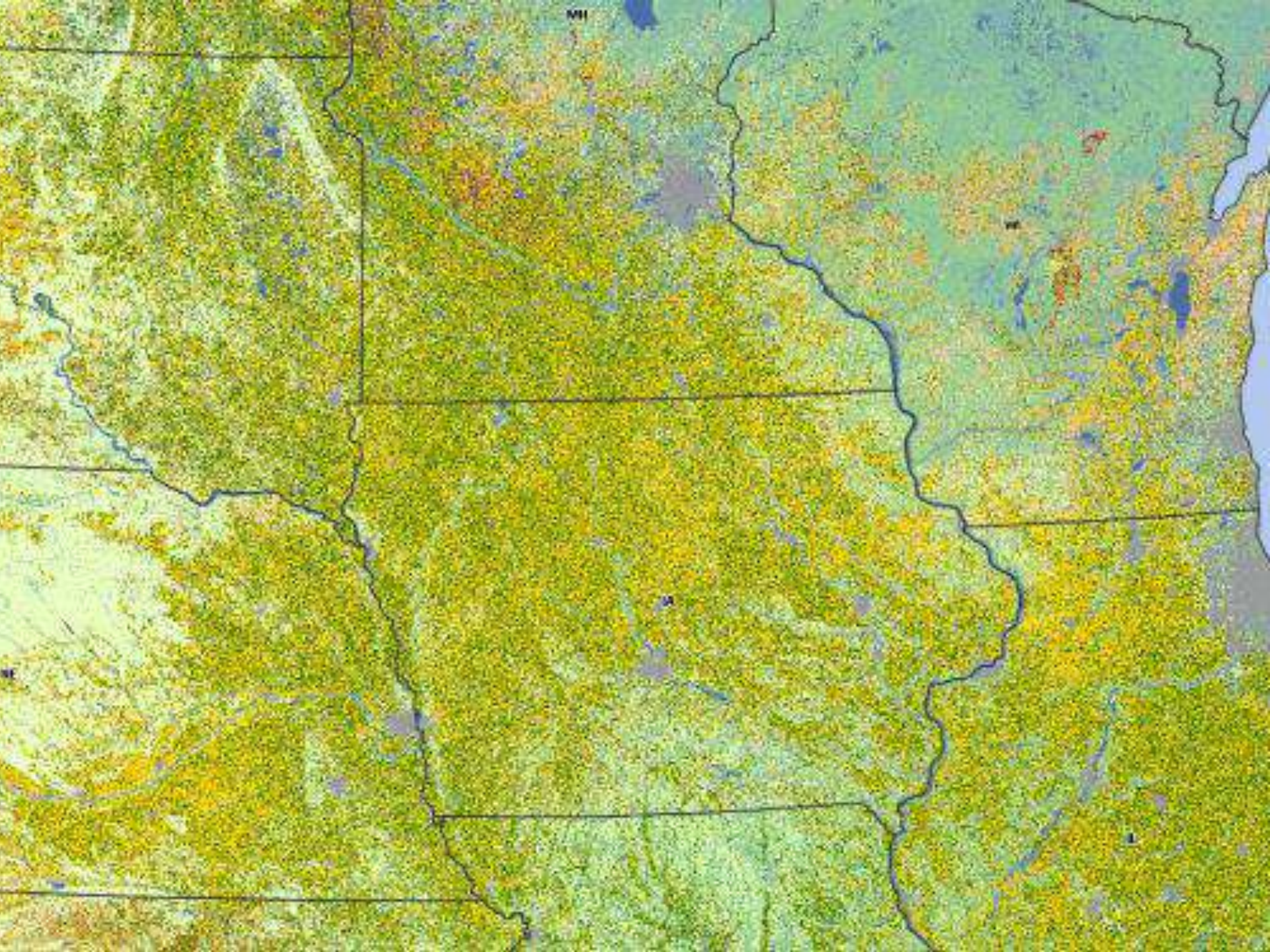
How are they moving
through the
environment?

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



Dr. Chrissy Mogren

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

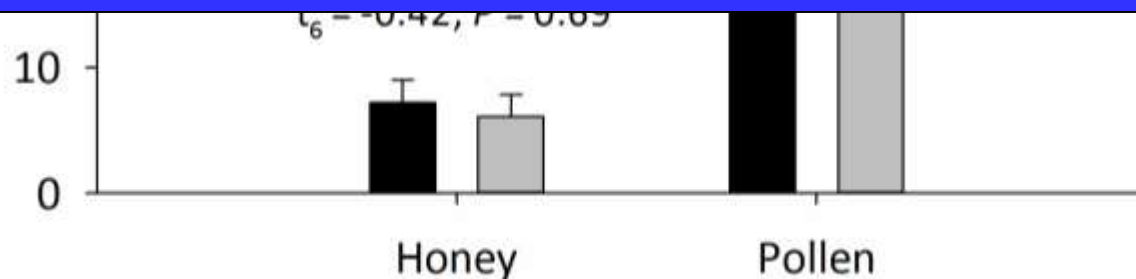


Used ELISA to quantify clothianidin

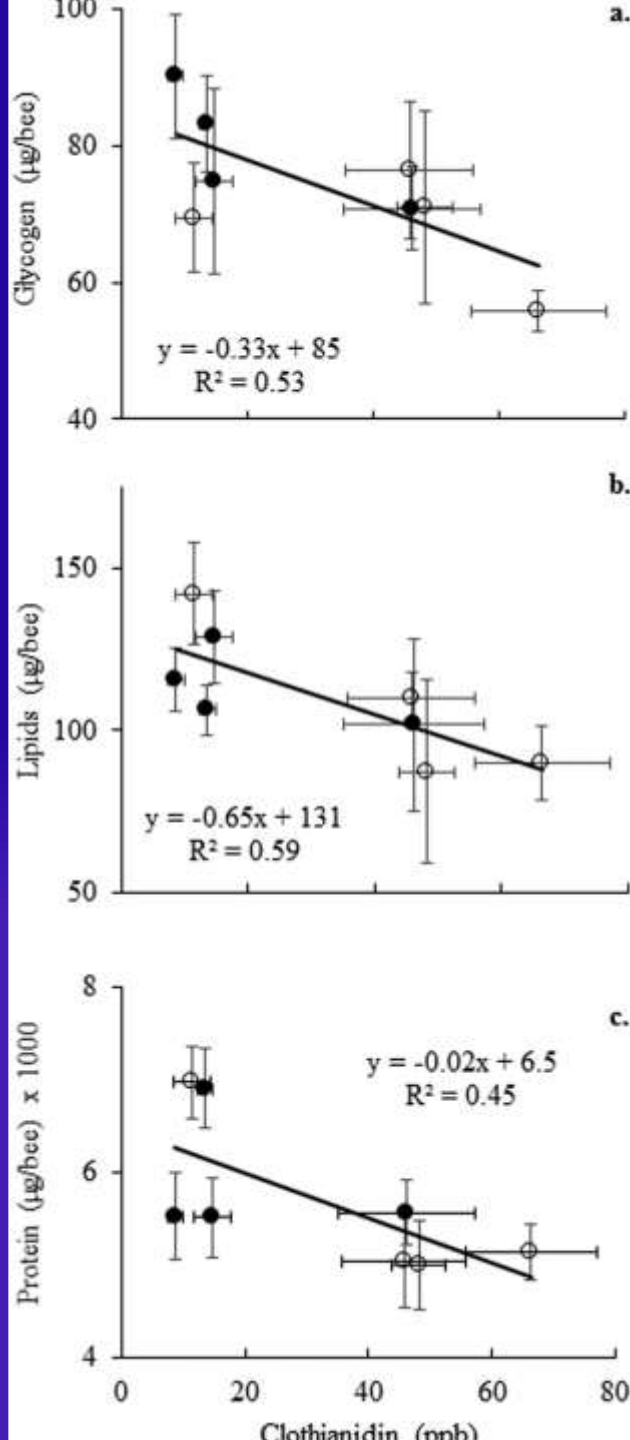
Clothianidin in Honey and Pollen



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?

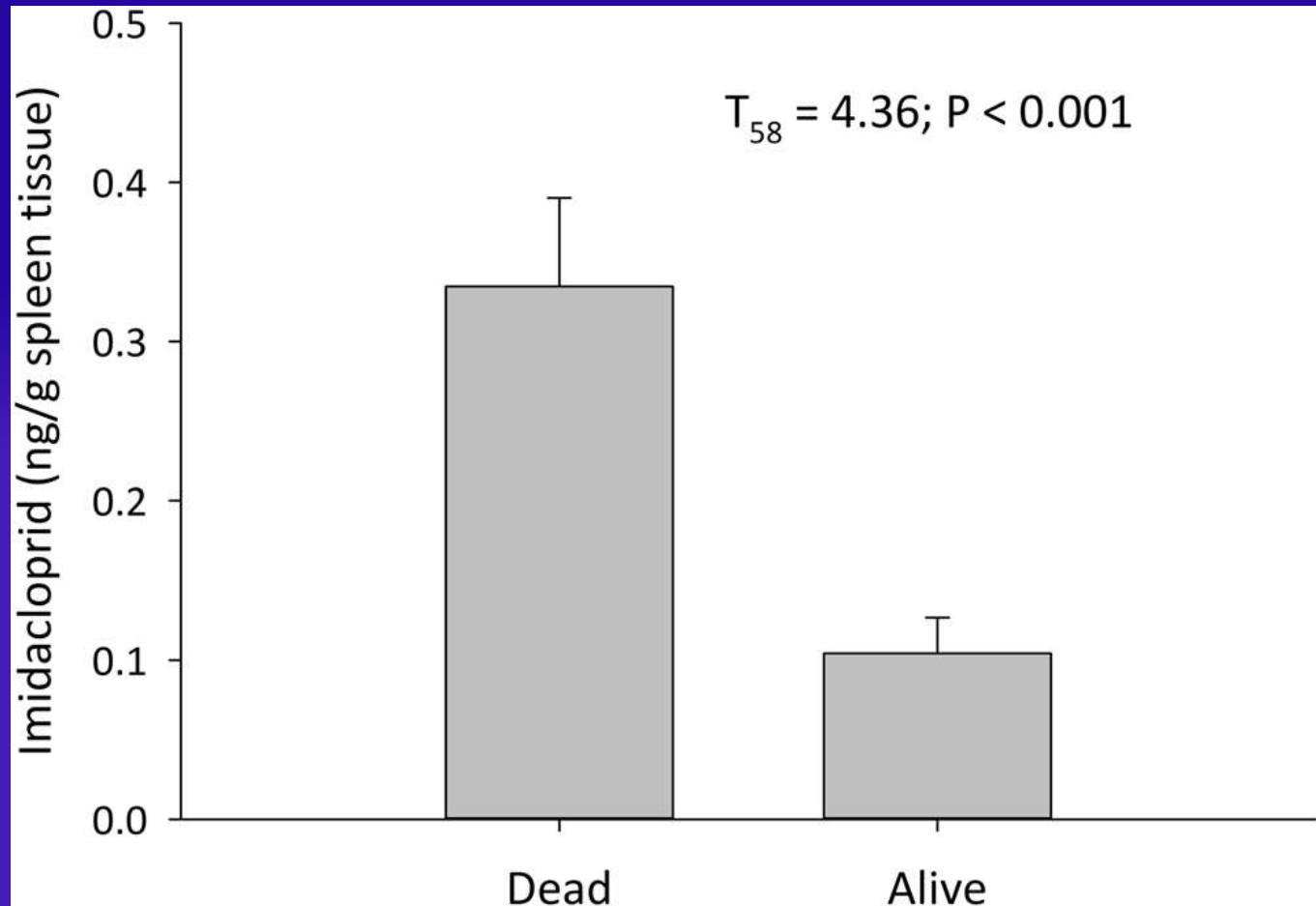
A 2-year captive
deer study

3 doses
administered
weekly in their
water



Elise Hughes Berheim et al. 2019. Sci Reports 9: 4534

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

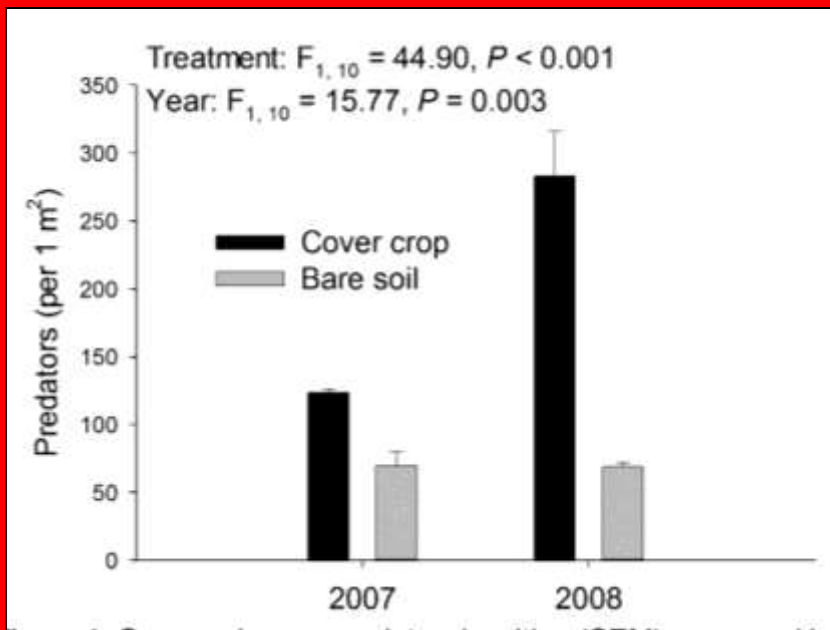


Sentinel larvae



Effects on Predators

Significantly more predators in cover-cropped cornfields



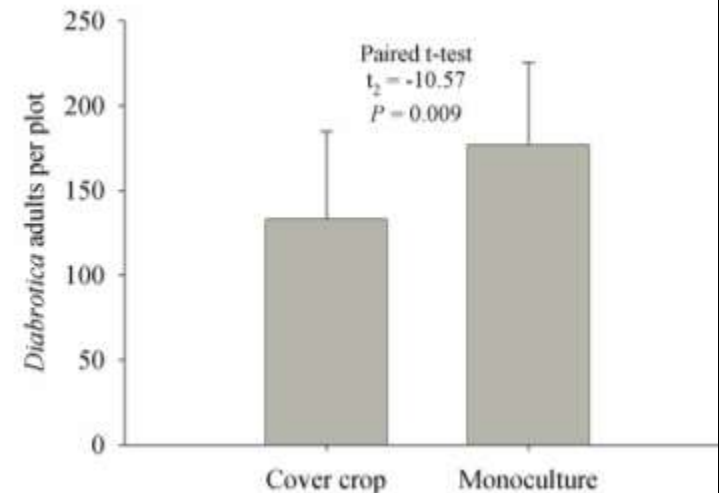
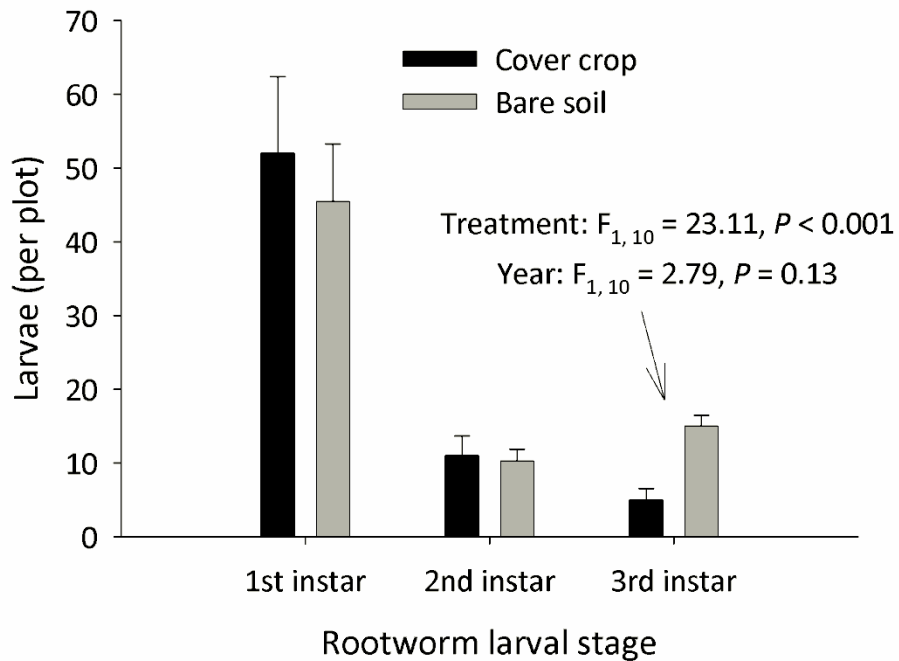
Lundgren and Fergen 2010. Environmental Entomology 39(6): 1816-1828

Lundgren and Fergen 2011. Applied Soil Ecology 51: 9-16

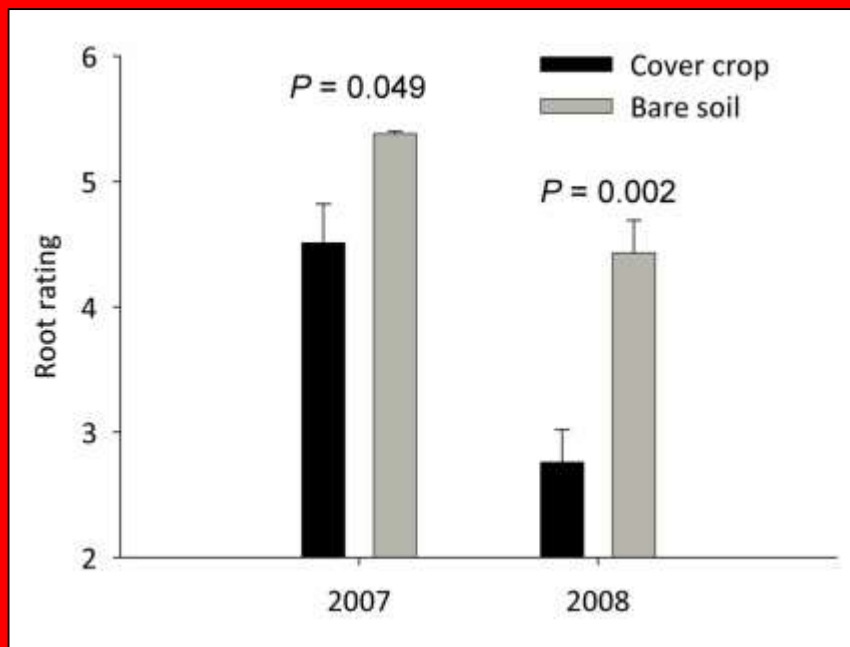
Effects on Rootworms

Cover-cropped cornfields
had lower 3rd instar
rootworm survival

...and lower adult
emergence



Effects on Crop Damage



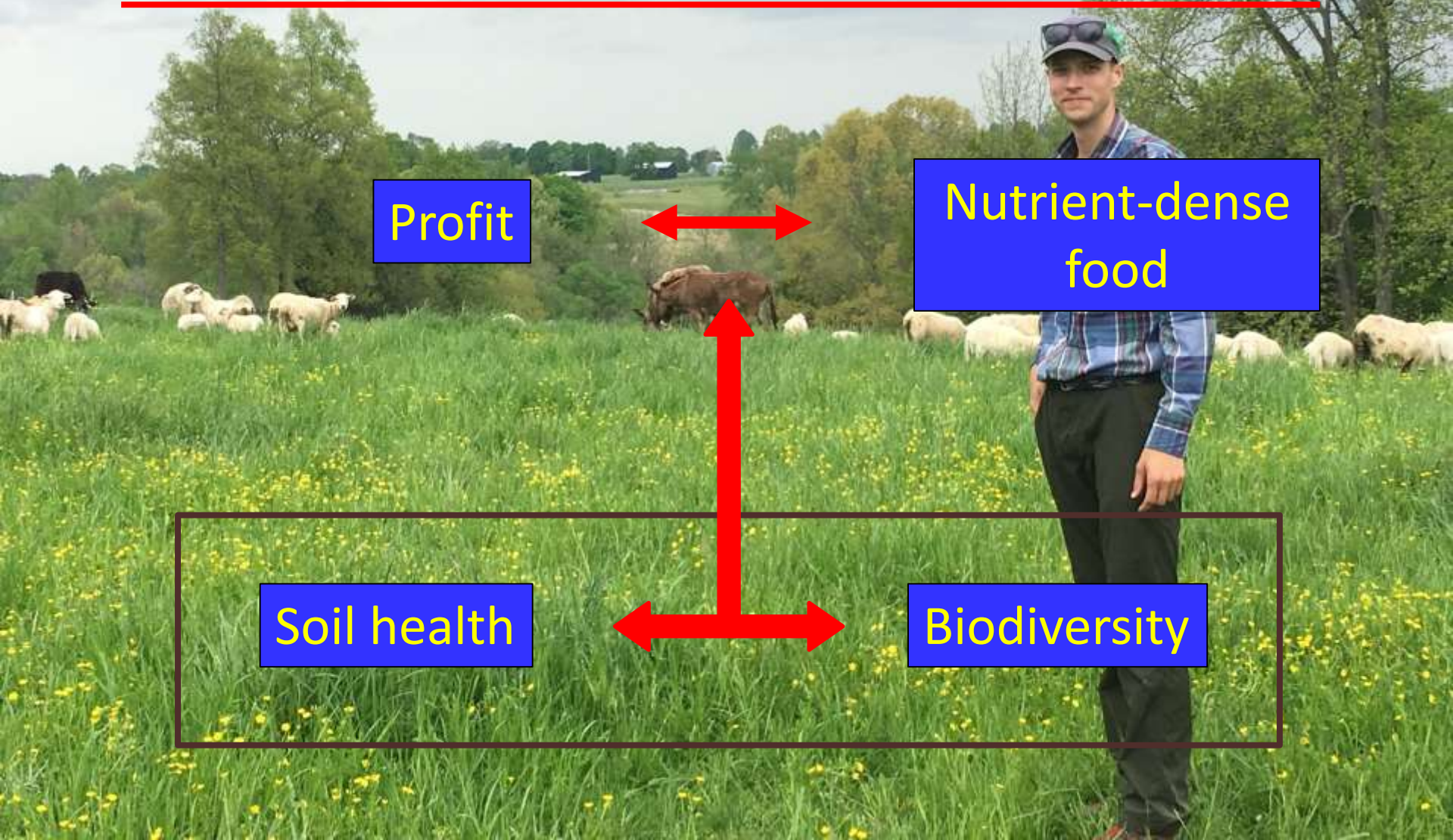
Cover-cropped fields experienced less damage



FARMERS
Lead
THE WAY



Outcomes of Regenerative Agriculture



A Better Way to Farm



Best management
practices
Regional focus
Systems level

Claire LaCanne, MSc

Regenerative
No insecticides

Conventional
Insecticides

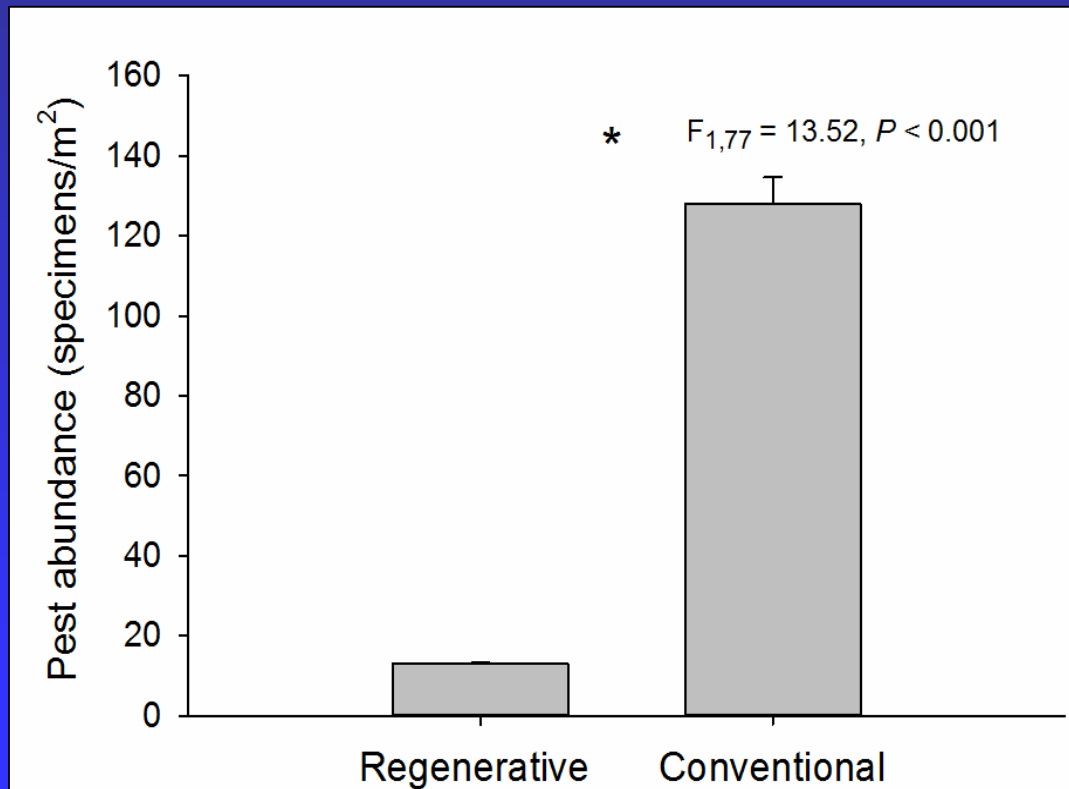
Approach

Full bioinventory
of corn community



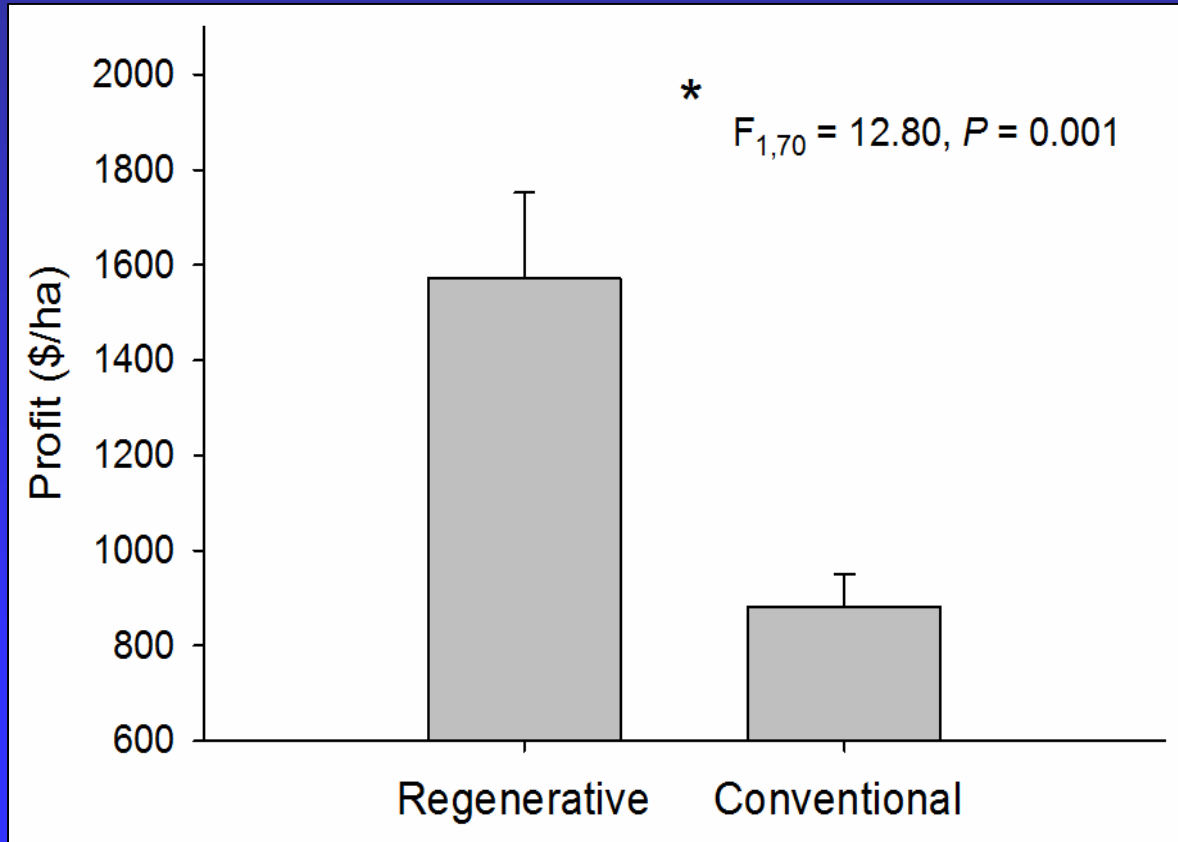
Yields and profit

Pest Populations



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

Profits



Regenerative
systems were twice
as profitable



Solution to the Problem

Change agriculture

Anything less, and the planet will continue to decline

Thanks!

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www.bluedasher.farm



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