



1

## Take home messages

Slugs can build with long-term no-till, ample moisture

Slug control requires integrating several practices

Predators can help protect crops from slugs; IPM needed

Unnecessary insecticide use can worsen slug populations

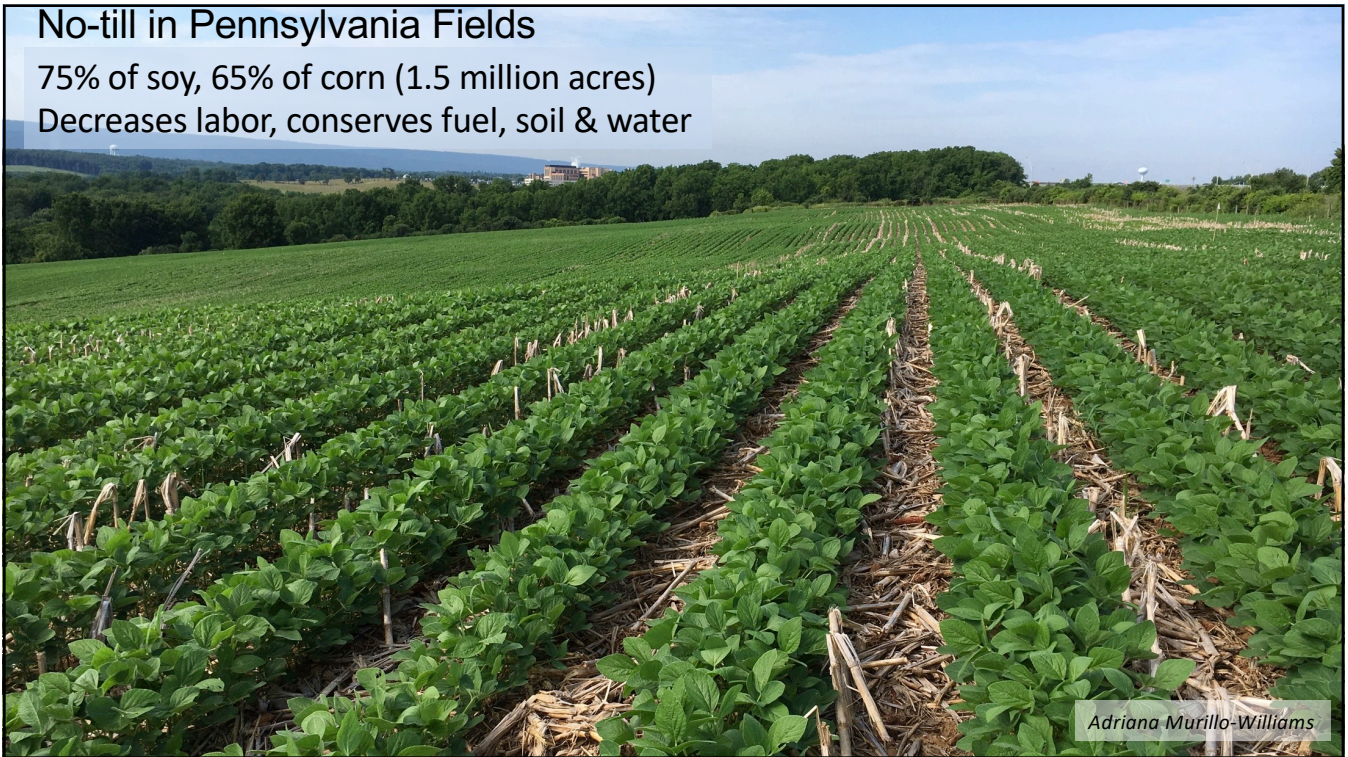
Cover crops can improve slug control

2



## No-till in Pennsylvania Fields

75% of soy, 65% of corn (1.5 million acres)  
Decreases labor, conserves fuel, soil & water



Adriana Murillo-Williams

3



4





5

### No-till in Pennsylvania Fields

75% of soy, 65% of corn (1.5 million acres)

Decreases labor, conserves fuel, soil & water, but promotes slugs!



Adriana Murillo-Williams

6





7

## Slugs can damage virtually all field crops

Canola



Corn



Soybean



Alfalfa &  
Sm. grains



8





9



10





11

## Grey garden slug - Most problematic species



Each individual can lay 500 eggs/year

Can feed on weeds and organic matter



12

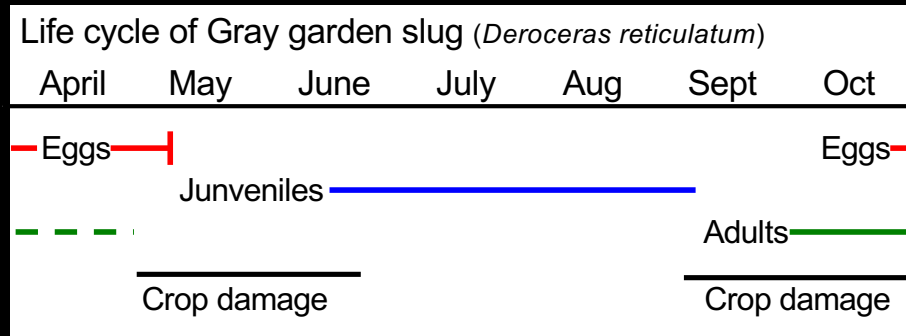


Life cycles can be out of synchrony (even within a species)

Different sized slugs can be found at any time (different species)

Mild winters or thick snowpack increase survival

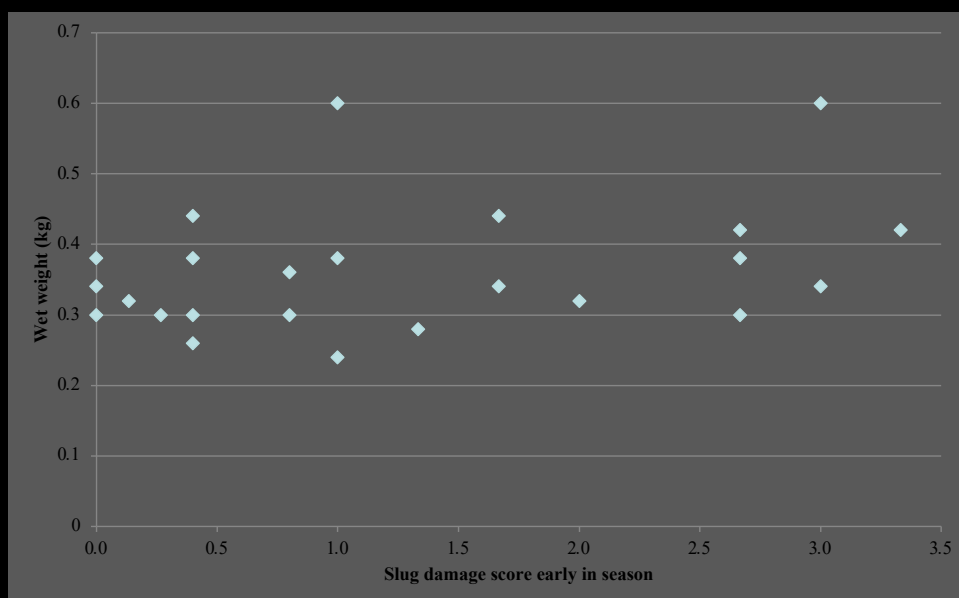
Juvenile slugs are most damaging



13

Slug damage to corn tends to look worse than it is

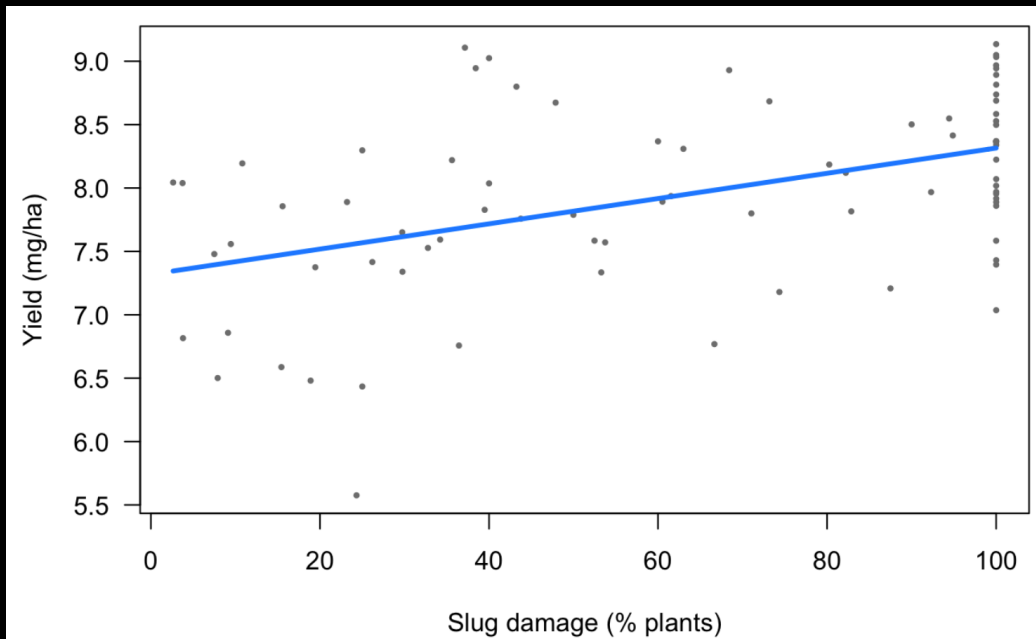
There is a weak relationship between damage and corn yield



14

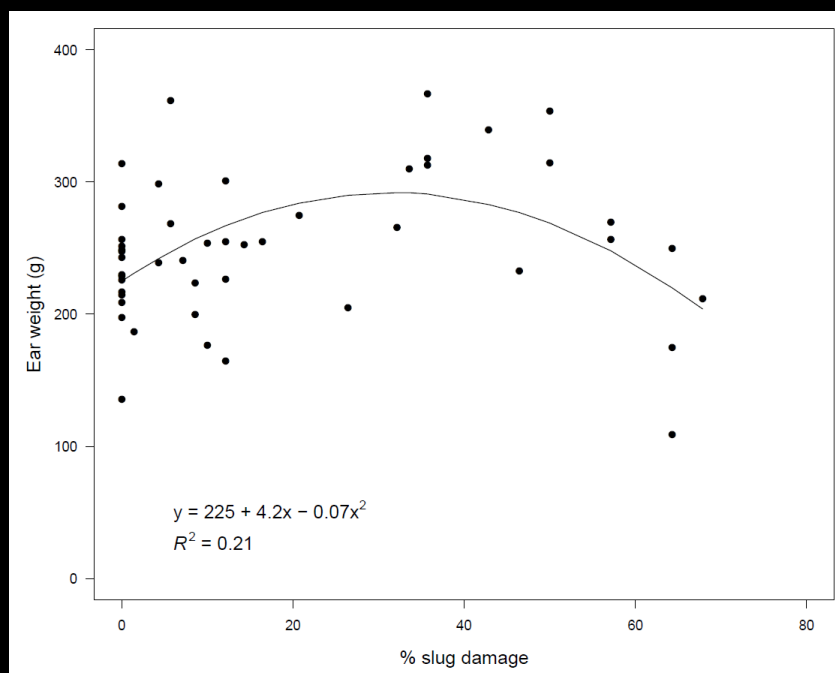


But some feeding by slugs might be ok?  
(data from multi-years field exp; damage at V2 and V5)



15

Amounts of damage matters: Little damage: **good?** ; lots of damage: **bad!**



16

## Slug management

Limited control options:

- Tillage

- Row cleaners + starter fertilizer

- Soil temperature

- Baits

- Nitrogen solutions

- Predators

17

## Slug management

Limited control options:

- Tillage: Not an option for many; is a little disturbance helpful?

18



## Vertical Tillage (A. Lefever, J. Wallace; Dept. Plant Sci; Penn State)

Soybeans: vertical tillage can mildly decreased slug damage

Two years, on-farm tests of vertical tillage tools (Lancaster Co)

Salford Independent

Great Plains Turbo-Till

Kuhn-Krause Excelerator

Vertical tillage reduced slug damage by about 24%

But no benefit to yield

Lefever et al. 2024 – Agronomy J.

19

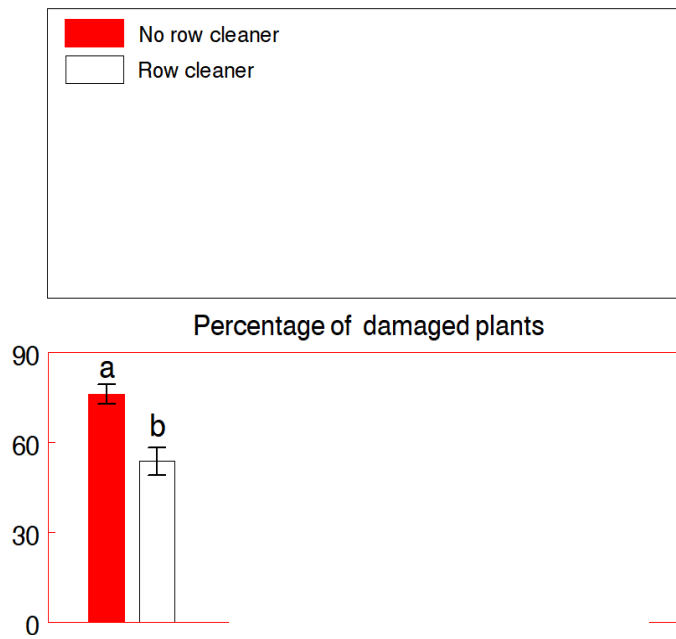
Limited control options:

Tillage: Not an option for most no-till farmers

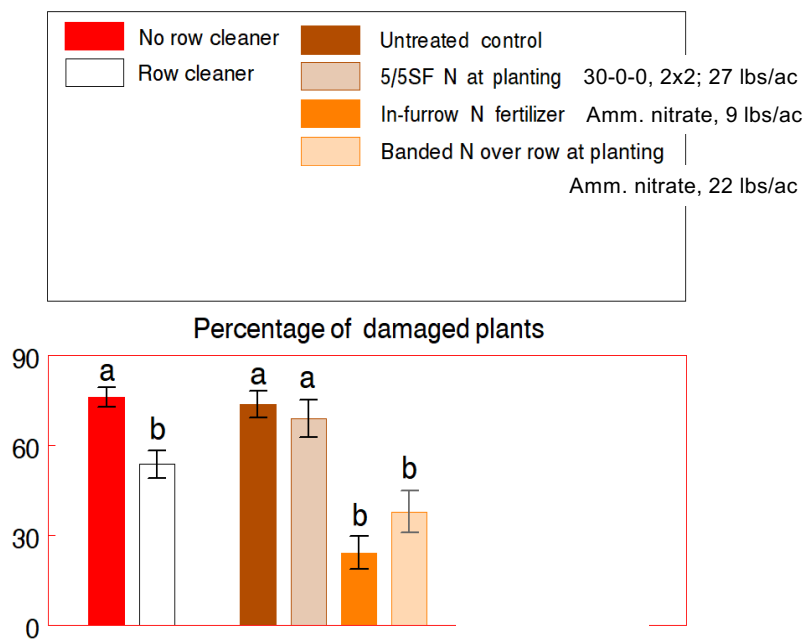
Row cleaners + starter fertilizer

Soil temperature

20



21



22



## Slug management

### Baits

Metaldehyde, Chelated iron

Best for targeted rescue treatments,  
not whole fields (expensive!)



Spreading pellets and potash



Deadline pellets mixed with potash

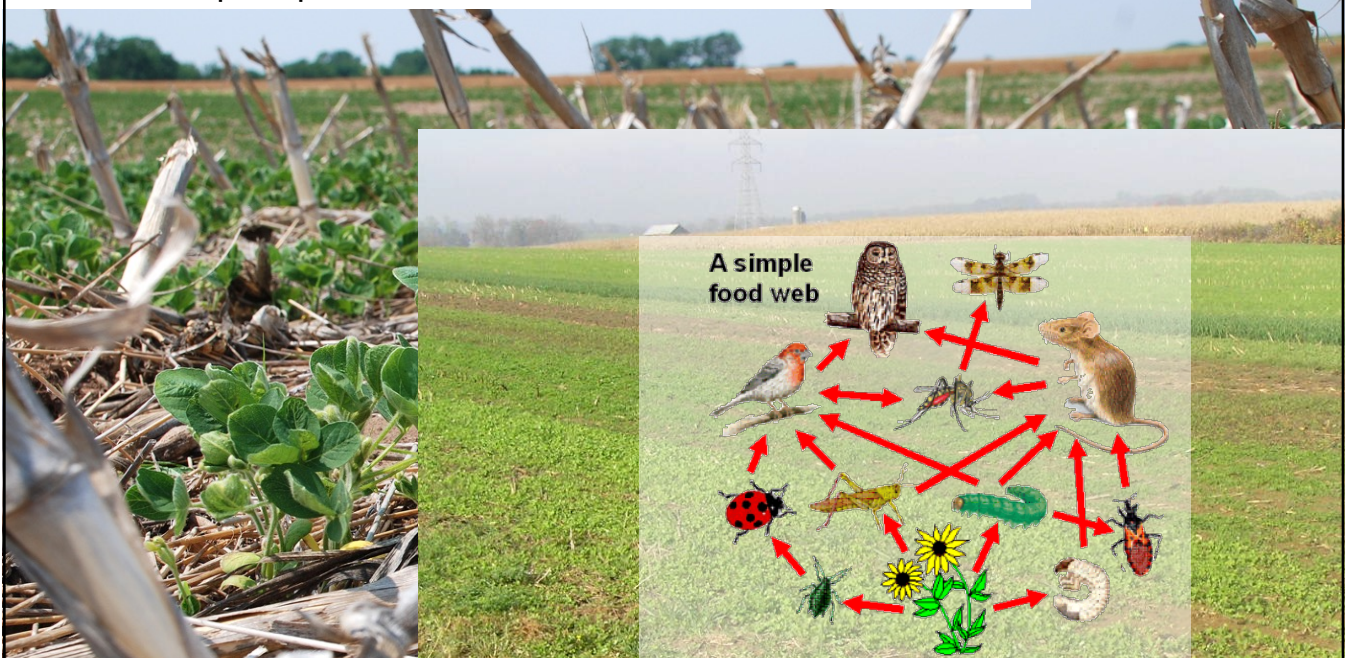


Aim for 10 lbs/acre; 4-6 pellets/sq foot

23

No-till makes conservation possible: great habitat for predators

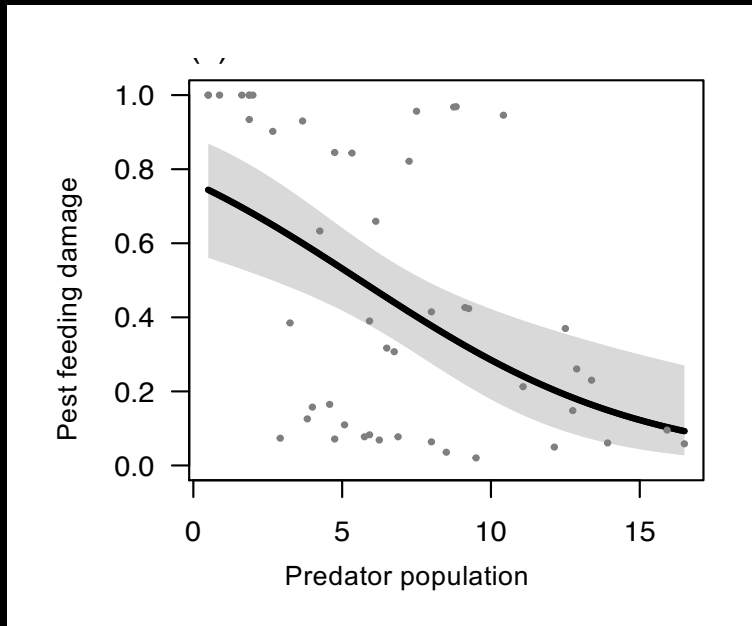
Cover crops improve habitats for natural enemies



24



Strong predator populations can protect plants from pests



25

Ground beetles = Allies in pest control



Black cutworm  
True armyworm  
Wireworm  
Slugs

Some farms: Thousands/acre



26

## Integrated Pest Management (IPM) protects predators

Maintains natural-enemy populations

Requires scouting to check pest populations

If pests exceed economic thresholds, use an insecticide



27

## Insecticides are overused, always have been

U.S. insecticide use is increasing

Most use is insurance-based, not need-based

Decrease good insects (predators, decomposers)

Fields with fewer predators are more vulnerable to pests



28



## Insecticides are valuable tools

**"DDT is good for me-e-e!"**

The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and is now one of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products . . . and DDT is only one of Pennsalt's many chemical products which benefit industry, farm and home.

**GOOD FOR STEERS**—Red grows meeter rowdays . . . for it's a wonderful fact that—compared to untreated cattle—Red-sters gain up to 20 pounds extra when protected from flies and many other pests with DDT insecticides.

**GOOD FOR THE HOME**—helps keep the home healthy, more comfortable home . . . prevents your family from dangerous insect pests. Use Pennsalt DDT Powder and Spray as directed . . . then watch the bugs "bite the dust!"

**GOOD FOR FRUITS**—Bigger apples, juicier fruit that are free from unsightly worms and blemishes resulting from DDT dusts and sprays.

**GOOD FOR ROW CROPS**—25 more barrels of produce per acre . . . normal DDT results have shown crop increases that DDT dusts and sprays help risk farmers gain these gains along to you.

**GOOD FOR INDUSTRY**—Food, drugs, dry cleaning fluids, paints, . . . almost all industries gain effective bug control with Pennsalt DDT products.

**PENNSALT CHEMICALS**  
87 Years' Service to Industry • Farm • Home  
PENNSYLVANIA SALT MANUFACTURING COMPANY  
WIDENER BUILDING, PHILADELPHIA 7, PA.

**THE seed treatment that little monsters fear.**

Even the smallest pests can create big problems for your crops. But there is one way to scare the life out of these little monsters — Poncho Plus. This innovative seed treatment protects eight crops above and below ground. Ask a member of staff about Poncho Plus today and protect your crops from being eaten away.

Bayer CropScience

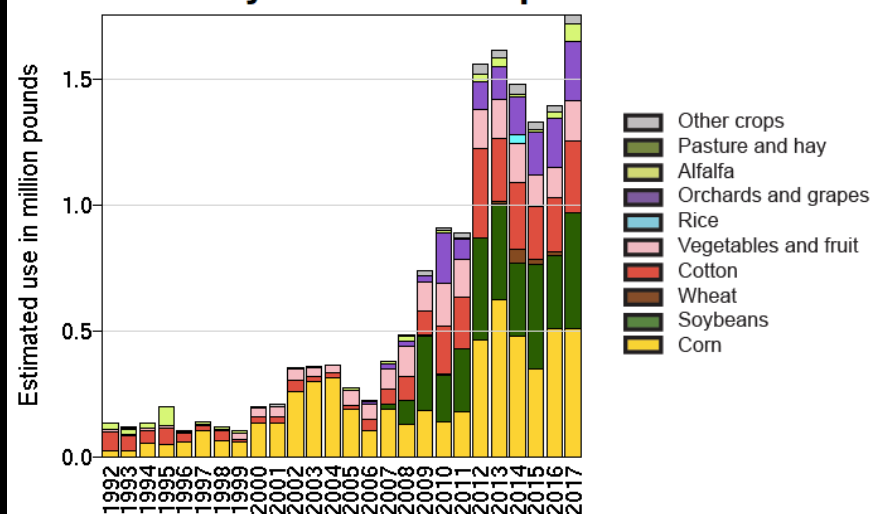
29

## Insecticide use appears to be increasing:

Unfortunately, much of the use is unnecessary

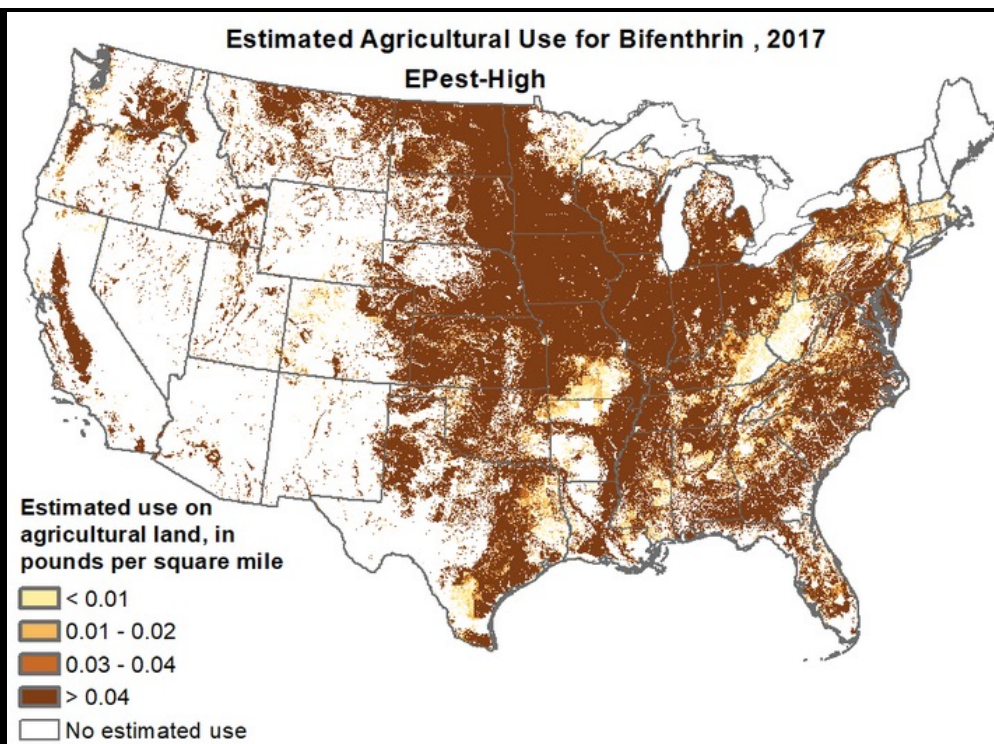
### Bifenthrin – national usage

#### Use by Year and Crop

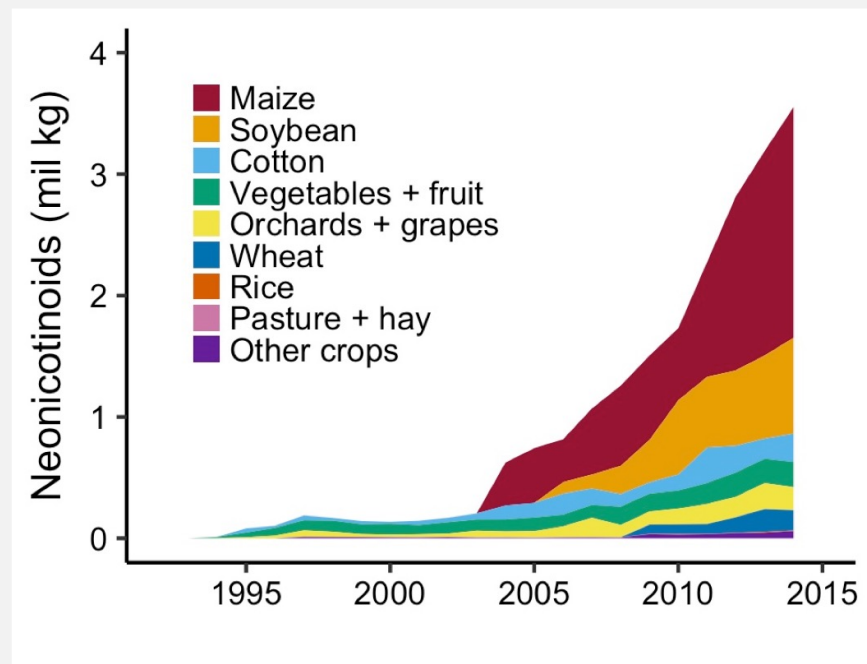


USGS Pesticide National Synthesis Project

30



31



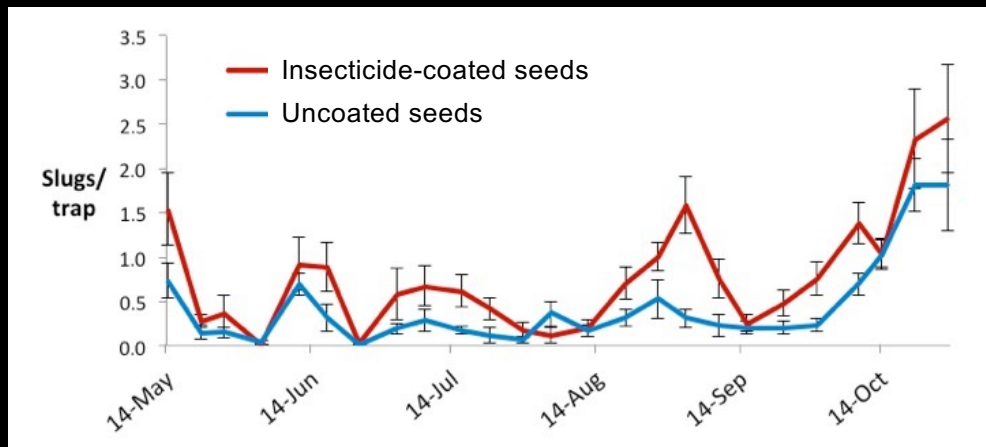
Douglas and Tooker 2015, Tooker et al. 2017

32



## Insecticides exacerbate slug problems by killing predators (insecticides coated on seeds, broadcast applications)

Without predators, slugs are free to feed, do more damage



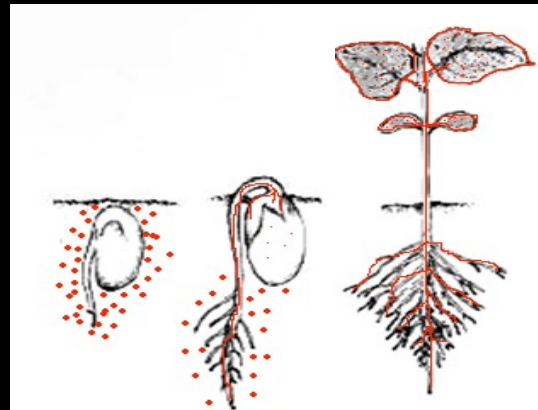
33

## Neonicotinoid seed treatments

Can protect yield

Systemic activity

Very toxic to insects



34

## Neonicotinoid seed treatments target 2° pests:

### Corn

(Aphids)

(Black cutworm)

Corn flea

Seed corn

White grub

Wireworm

(Rootworm)

### Soybeans

(Aphids)

Bean leaf beetle

ers

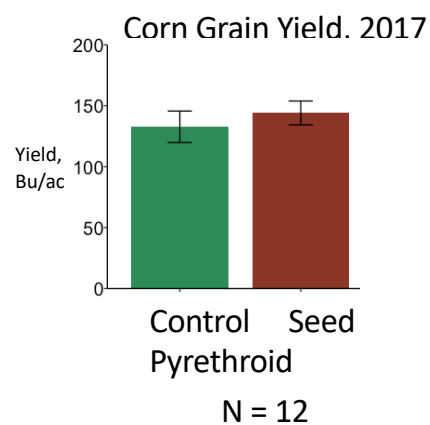
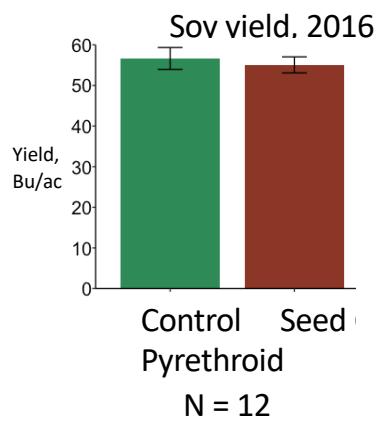
maggot

bs

n



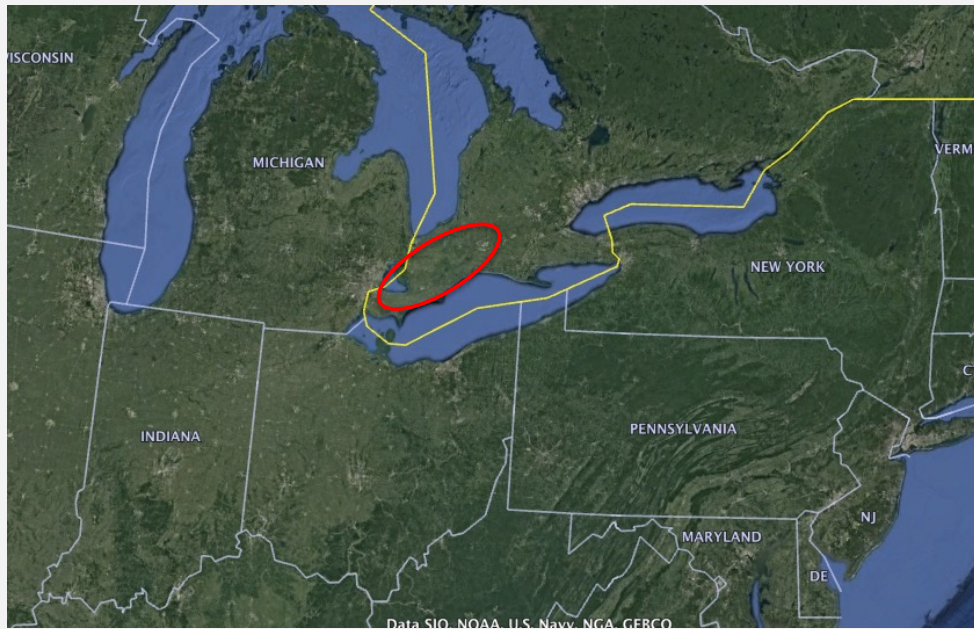
35



36



University of Guelph – 4 yr exp.; corn and soy; Fungicide ST vs. Neonic ST



Smith et al. 2020, J. Econ. Entomol.

37

Results from Ontario:

Seeds with fungicides (FST) vs fungicide + neonics (NST)

Dependent variable	<i>n</i>	FST	NST
Corn FST vs NST			
Stand (plants m <sup>-2</sup> ) (VE-V1)	145	6.7 ± 0.03	7.0 ± 0.03
Below-ground injury <sup>c</sup> (VE-V1)	145	0.24 ± 0.012	0.22 ± 0.012
Above-ground injury <sup>d</sup> (VE-V1)	145	0.45 ± 0.016	0.42 ± 0.016
Yield (Mg ha <sup>-1</sup> )	129	11.1 ± 0.02	11.2 ± 0.02
Corn FST vs NST			
Wireworms (no. m <sup>-2</sup> ) (VE-V1)	145	1.4 ± 0.16	1.6 ± 0.16
White grubs (no. 900 cm <sup>-2</sup> ) (VE-V1)	145	0.02 ± 0.005	0.03 ± 0.005

(Paper includes similar results for V3-V4 stage corn & for soybeans)

Smith et al. 2020, J. Econ. Entomol.

38

Bottom line:

Manage for the pests that you have

Insecticide can make slug populations worse

Any insecticide can cause problems: broadcast or seed coatings



39

Bottom line:

Manage your insect pests with Integrated Pest Management

Scout regularly, compare populations to economic thresholds

Use insecticides only if pest populations exceed thresholds

Protect predator populations!



40



## Penn State Diversified Dairy Cropping Systems project

One two-year corn-soy rotation

Bt, seed treatments, broadcast pyrethroid

Pests have  
been worse

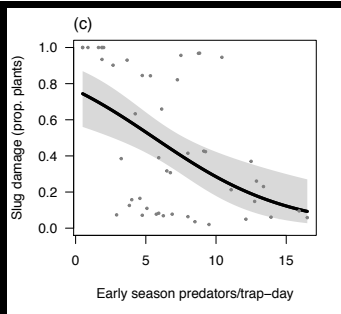
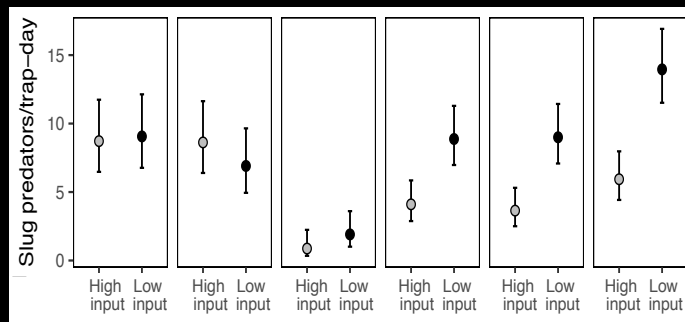
Two six-year rotations (cover crops, alfalfa, corn, small grains)

IPM (no Bt or seed treatments, insecticides as necessary)



41

No-till, diversity (crop rotation + cover crops) builds predator pops



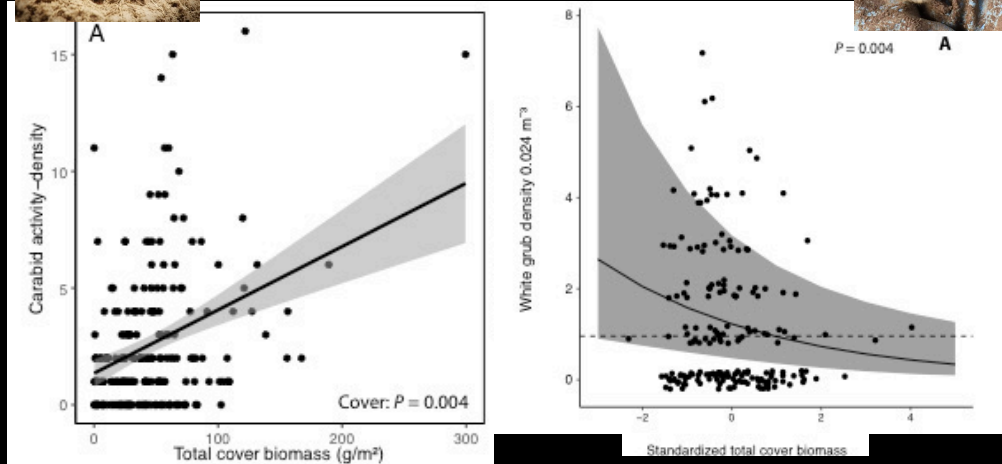
Busch et al. 2020

42

Cover crop harbored NEs, which suppressed white grubs in corn



Three-year experiment



Rowen et al. 2022

43

No-till makes conservation possible, cover crops add to it

Cover crops foster natural-enemy populations; protect them with IPM



44





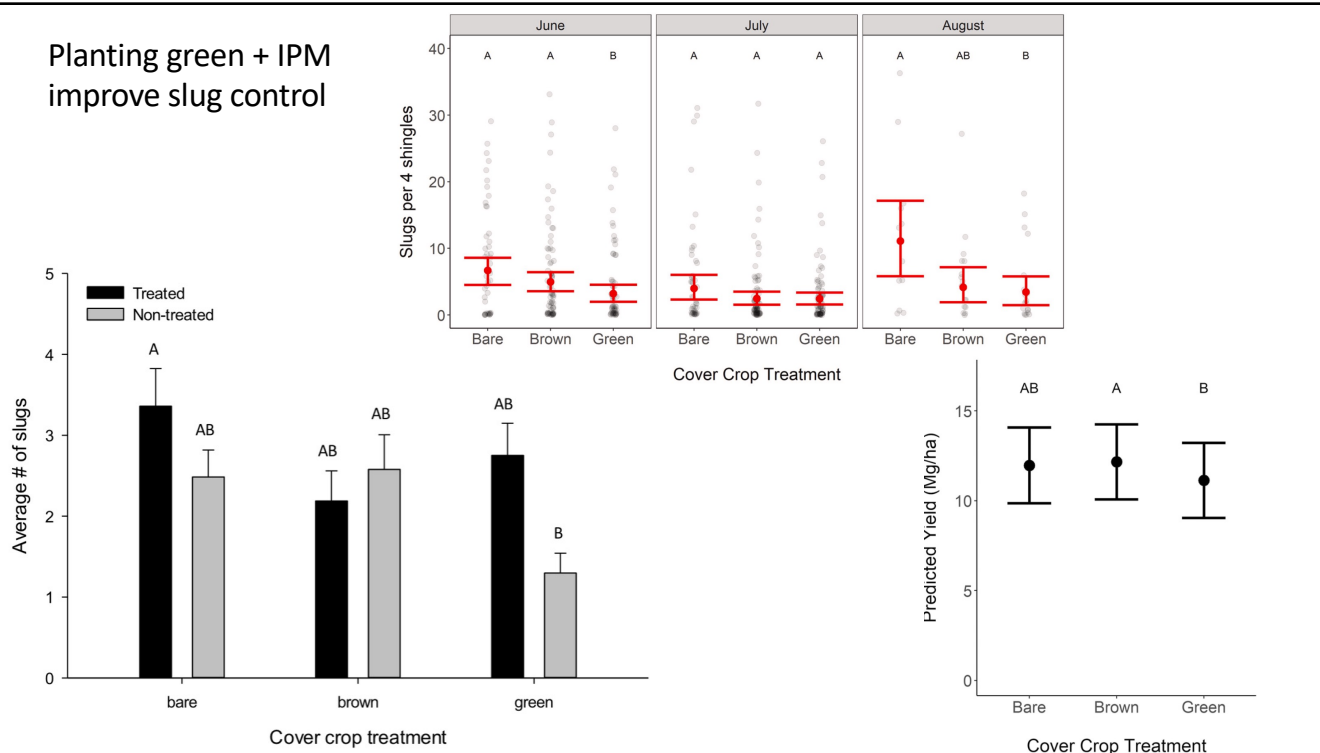
45



46



# Planting green + IPM improve slug control



47



48



## Take home messages



**PennState**  
College of  
Agricultural Sciences

Slugs can build with long-term no-till, ample moisture

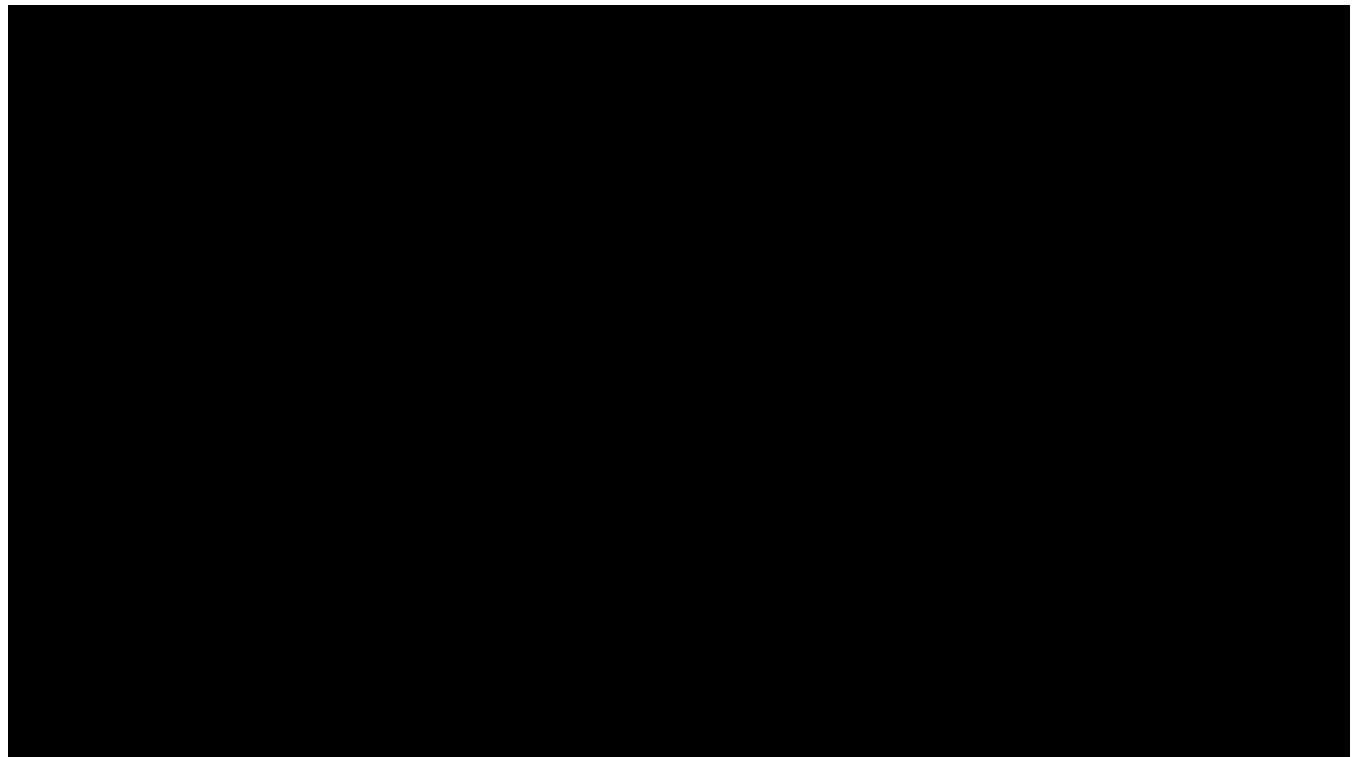
Slug control requires integrating several practices

Predators can help protect crops from slugs; IPM needed

Unnecessary insecticide use can worsen slug populations

Cover crops can improve slug control

49



50

## Damage from slugs was in terrible in 2024

Many farmers in PA had to replant 1-3 times



Lots of slugs!



Slugs ate soybeans as they emerged



Slugs benefited  
from open  
seed slots

51

Two reasons for heavy slug damage in 2024:

1. High slug populations resulted from a mild winter

Warm winters: more slugs survive winter, lay more eggs

In spring 2024, more juveniles were active longer

52



## Two reasons for heavy slug damage in 2024:

1. High slug populations resulted from a mild winter

2. Many farmers are planting soybeans early

Research from Midwest has demonstrated benefits of early planting

But this research did not include slugs

April-June: conditions were wet/cool, soybeans did not grow

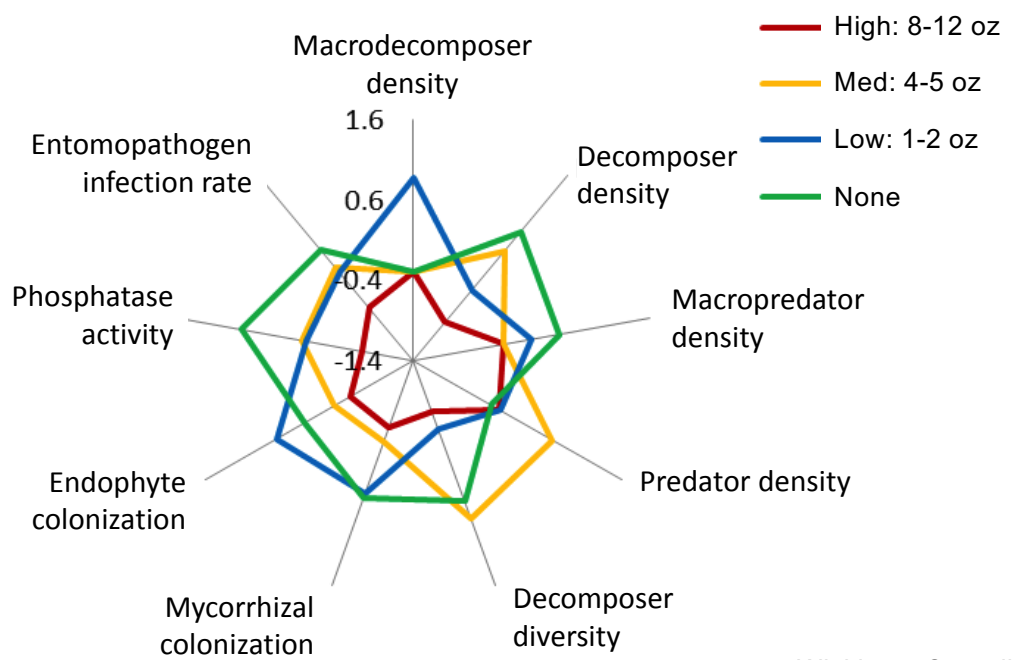
Slugs were happy and ate a lot

If slugs are a problem, planting decisions need to be dynamic, based on conditions

Mild winter, wet conditions: plant later.

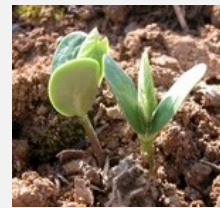
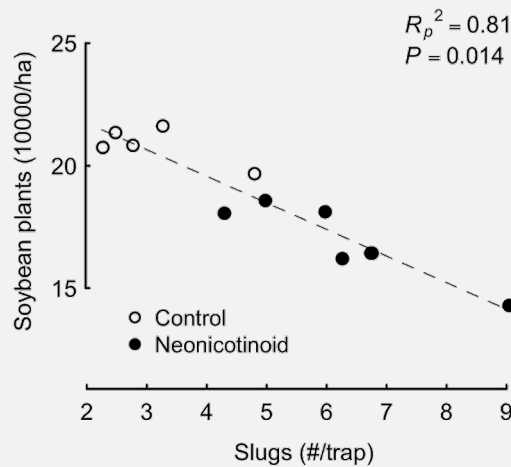
53

## Soil function is highest with no insecticides



54

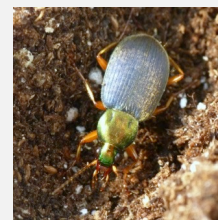
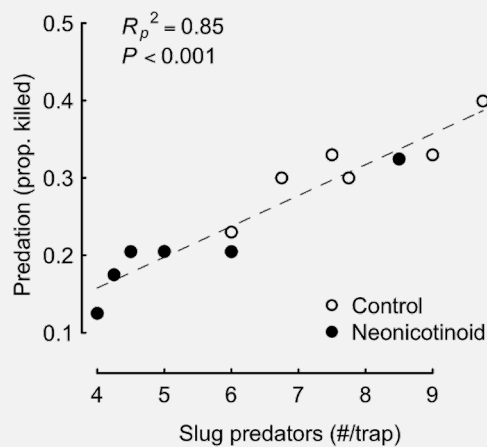
## More slugs → fewer soybean plants



Douglas, Rohr, & Tooker 2015 *Journal of Applied Ecology*

55

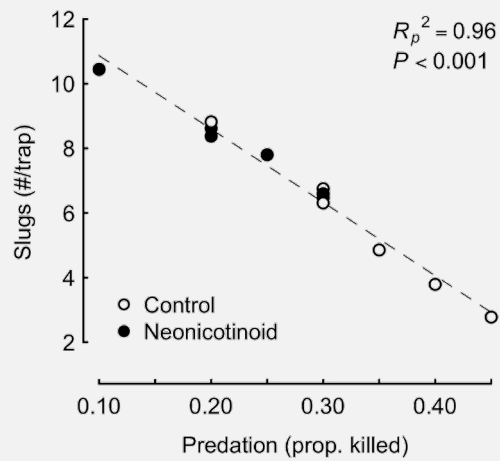
## More slug predators → more predation



Douglas, Rohr, & Tooker 2015 *Journal of Applied Ecology*

56

More predator activity → fewer slugs



Douglas, Rohr, & Tooker 2015 *Journal of Applied Ecology*