What's the real deal with cover crops and the soybean cyst nematode?

Advanced Soil Health Training
February 18, 2020
Henry White Experimental Farm

Presented by Talon Becker

ILLINOIS Extension
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

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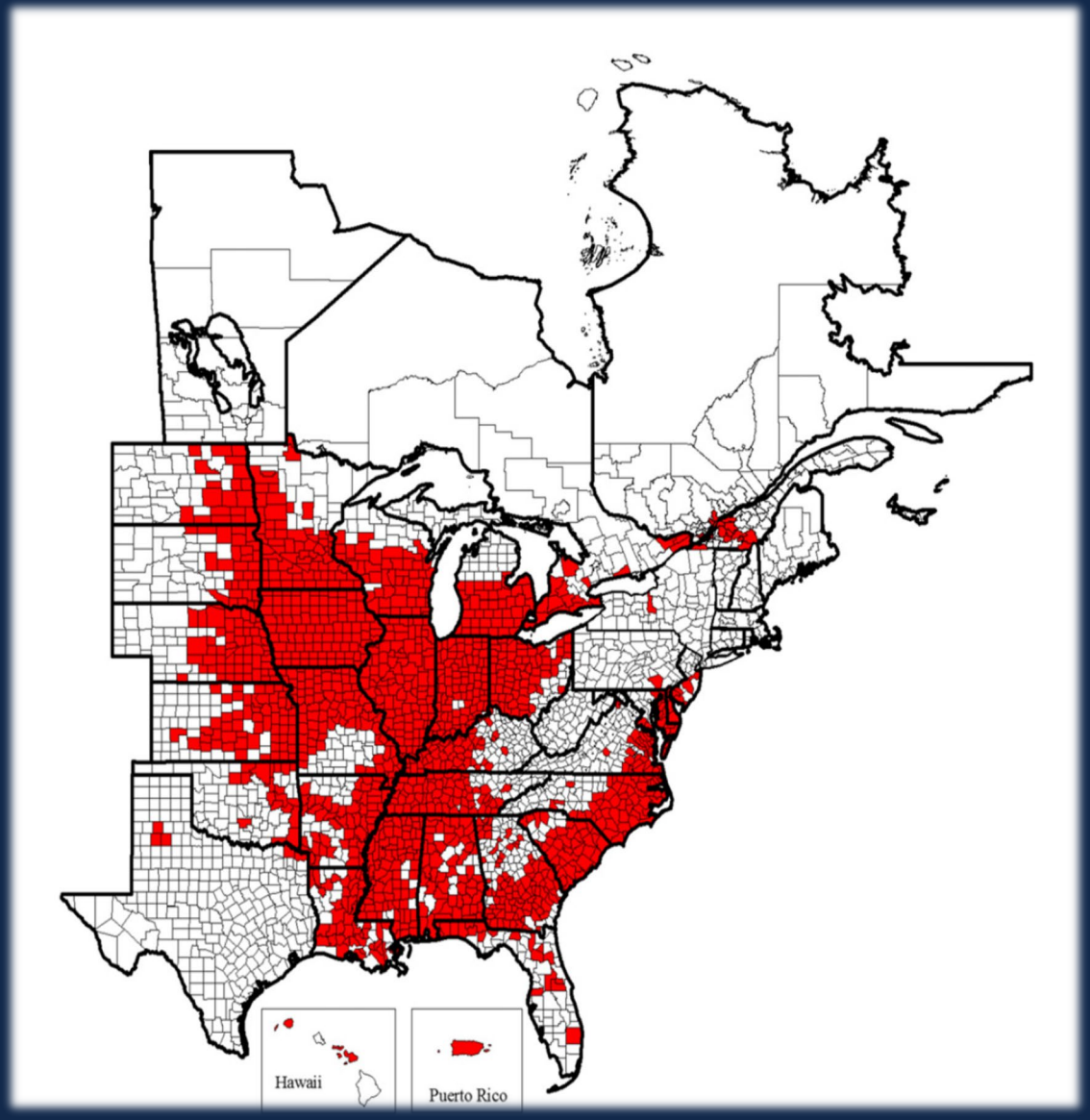
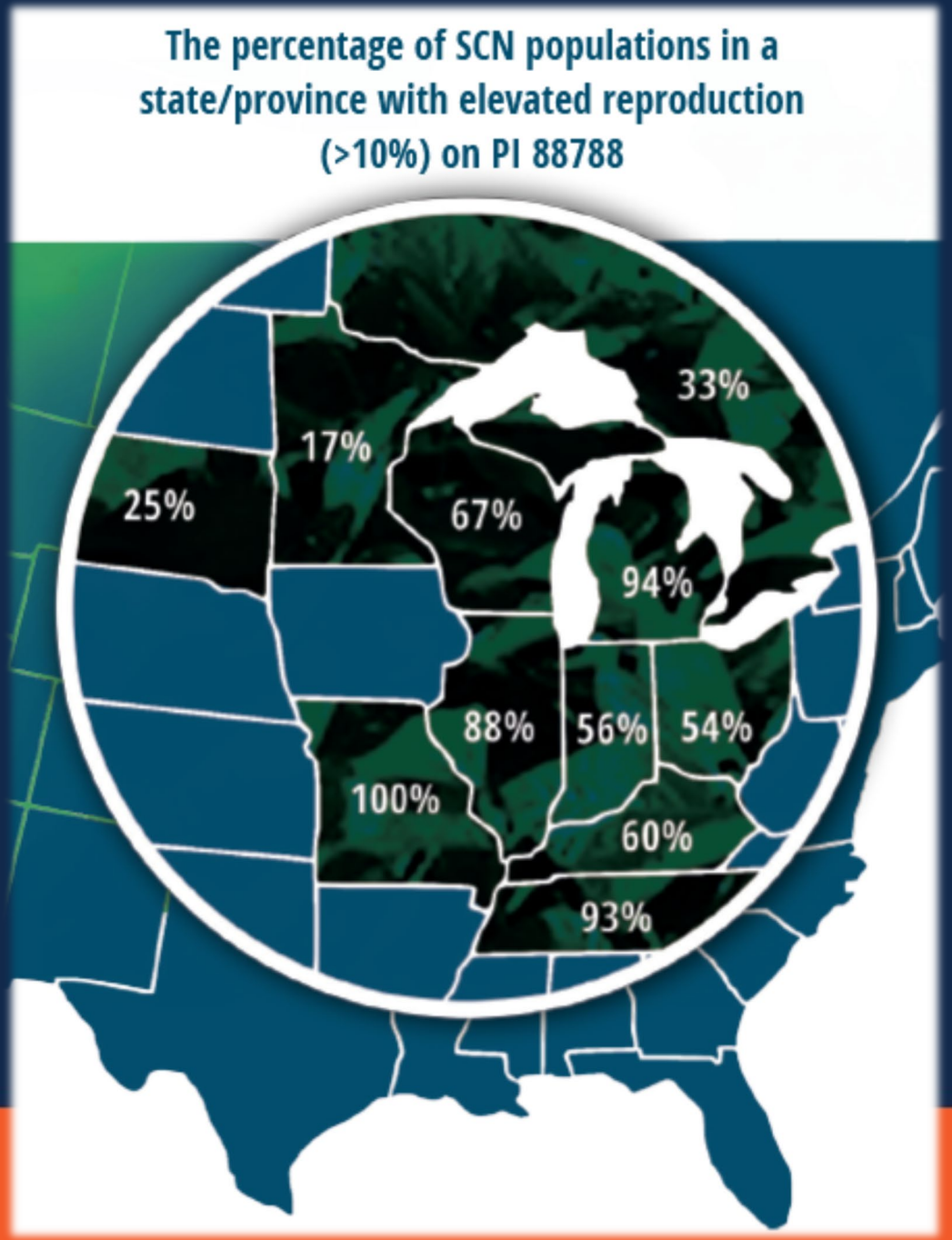


- Verified presence in every county in IL and most of the corn belt (Marett and Tylka, 2017)
- Average annual yield losses of approximately 11% (Hartman et al., 2015)
- Estimated economic effect of >$1B annually (Wang et al., 2017; Allen et al., 2017)

- Overcoming of PI 88788 resistance is also widespread
- Consecutive uses of same source of SCN resistance (PI 88788) and/or continuous soybean will increase rate of SCN adaptation/evolution

Number	Indicator Line
1	PI 548402 (Peking)
2	PI 88788
3	PI 90763
4	PI 437654
5	PI 209332
6	PI 89772
7	PI 548316 (Cloud)

Indicator lines for HG Type classification of genetically diverse populations of *Heterodera glycines*. Niblack et al., 2002



Trial at Ewing Demonstration Center

**Limited by single time point for soil sampling and SCN egg counts

Mean Separation of Yields (bu/A)

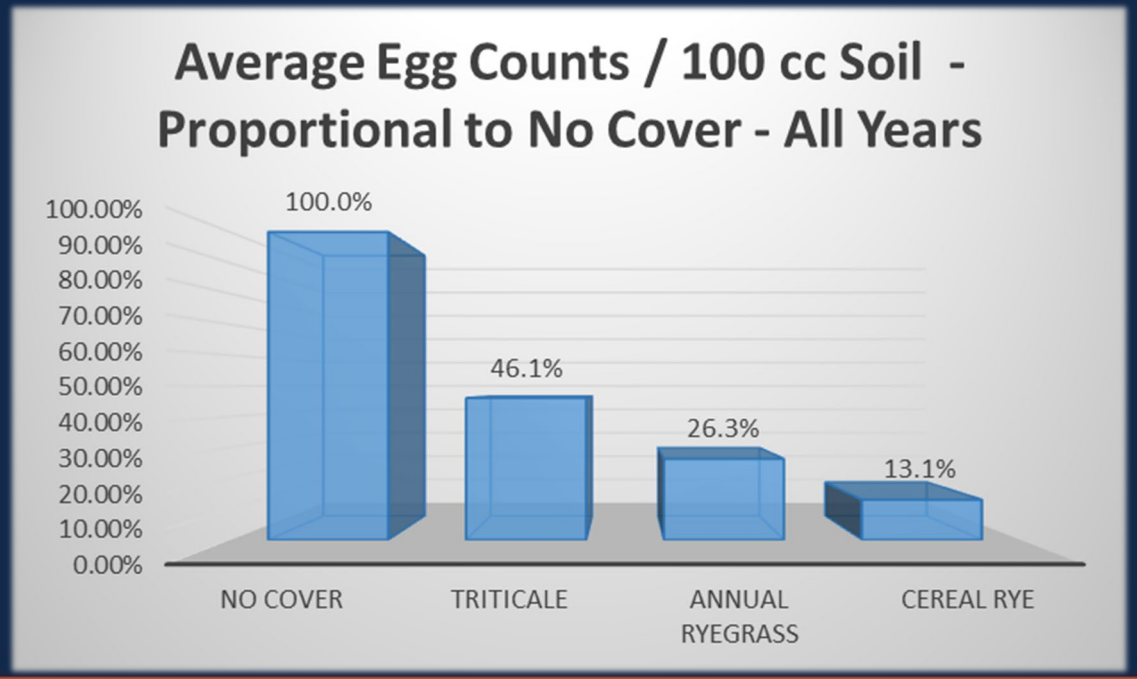
Treatment	2014	2015	2016	2017	All Years	2014-2016
No Cover	52.52 A	48.06 A	51.42 A	47.90 A	49.97 A	50.66 A
Triticale	51.76 A	46.06 A	51.43 A	49.26 A	49.63 A	49.75 A
Annual Ryegrass	50.18 A	42.91 A	44.20 A	29.88 B	41.79 B	45.76 B
Cereal Rye	53.17 A	48.85 A	49.90 A	49.39 A	50.33 A	50.64 A

Conducted using SAS University Edition: PROC MIXED; Type 3 SS; Year, Year(Rep), and Year*Treatment = RANDOM; Treatment = FIXED. Main effects and interactions containing 'Year' were not included in individual year analyses. Different letters within a column indicate significant differences (α=0.1) based on a Tukey's multiple comparison test.

Mean Separation of SCN Harvest (SCN eggs/100 cc soil)

Treatment	2014	2015	2016	2017	All Years
No Cover	6150 A	50 A	160 A	1210 A	1892.5 A
Triticale	1410 B	40 A	280 A	1760 A	872.5 A
Annual Ryegrass	370 B	130 A	260 A	1230 A	497.5 A
Cereal Rye	720 B	60 A	10 A	200 A	247.5 A

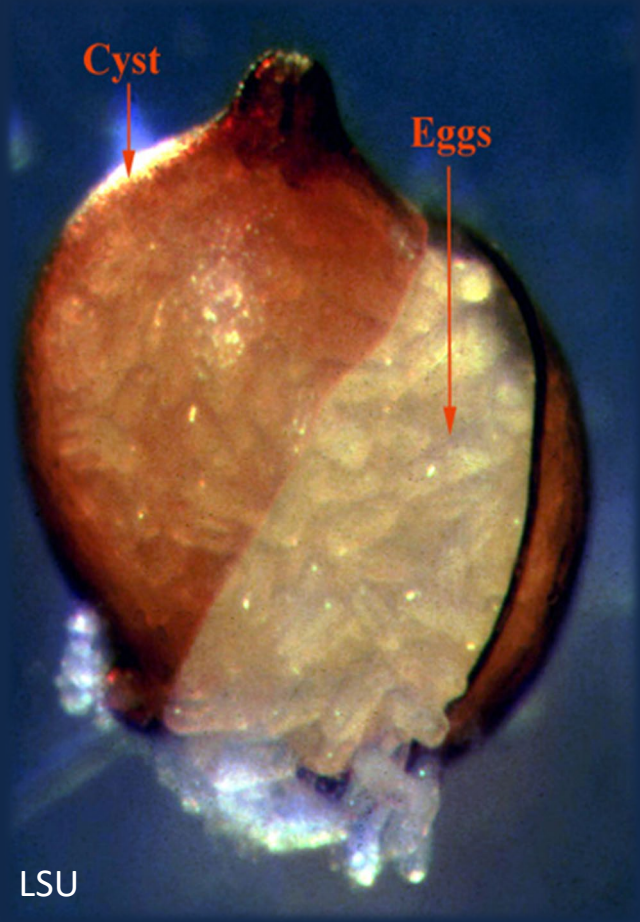
Conducted using SAS University Edition: PROC MIXED; Type 3 SS; Year, Year(Rep), and Year*Treatment = RANDOM; Treatment = FIXED. Main effects and interactions containing 'Year' were not included in individual year analyses. Different letters within a column indicate significant differences (α=0.1) based on a Tukey's multiple comparison test.



The soybean cyst nematode (*Heterodera glycines*, SCN)


USDA-ARS


Iowa State

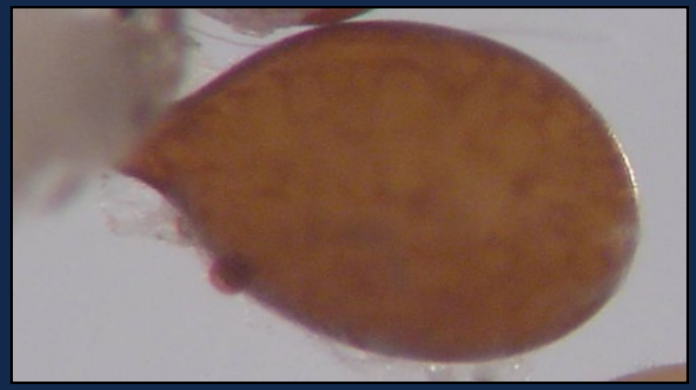


LSU

The soybean cyst nematode (*Heterodera glycines*, SCN)

Cover crops and the soybean cyst nematode

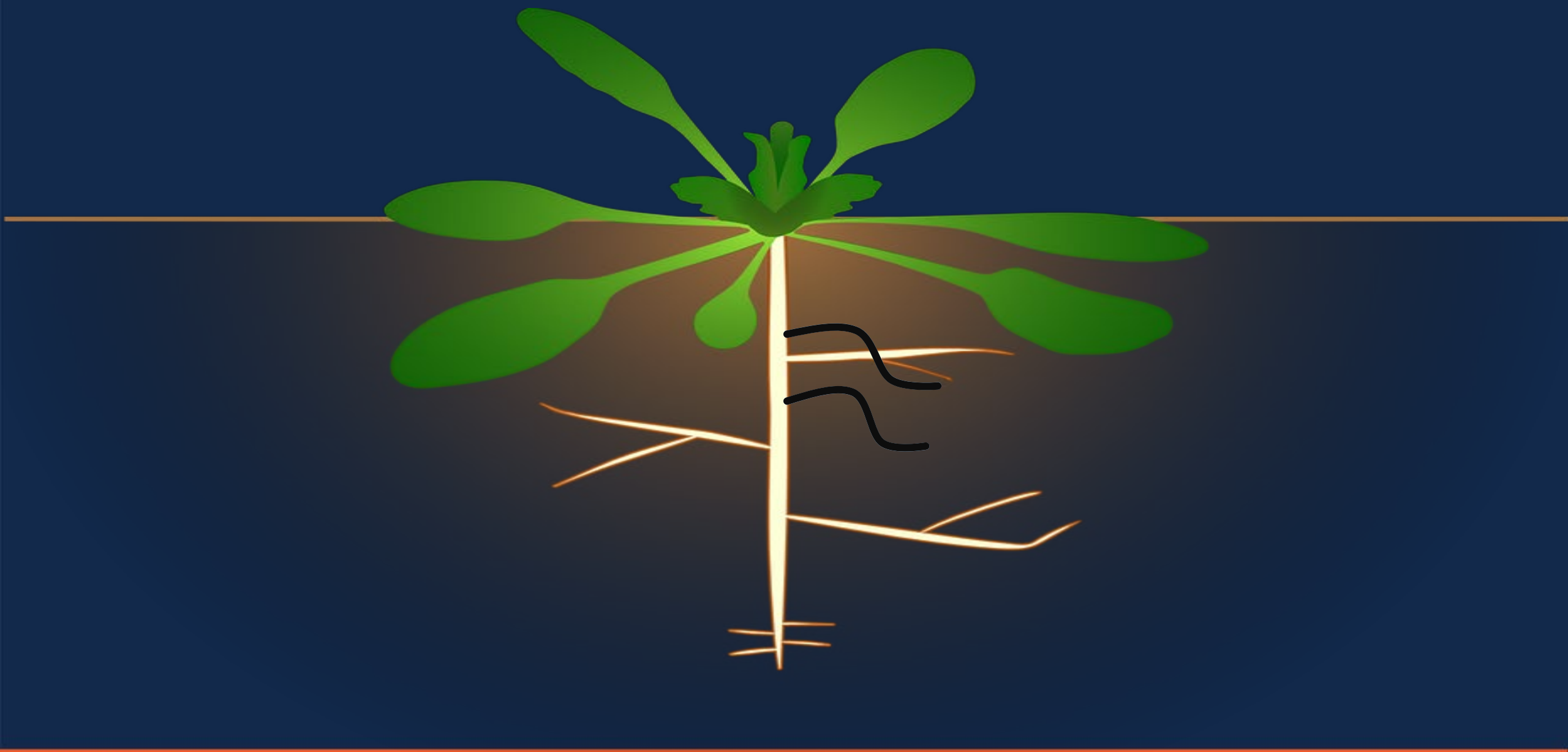
+



Increase SCN population density if cover crops are inadvertent hosts

No effect

Decrease SCN population density due to one or more mechanisms



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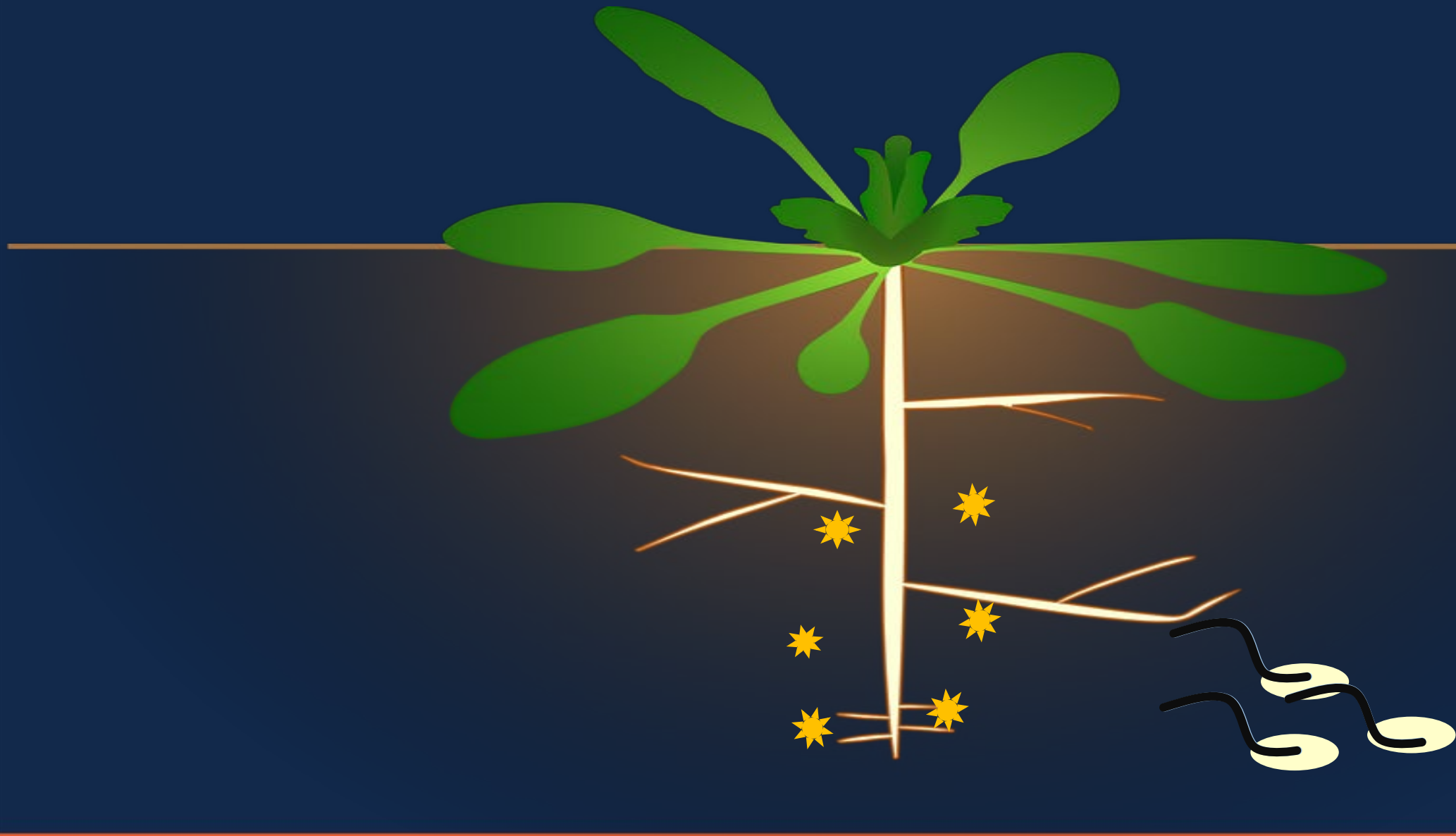
Trap crop



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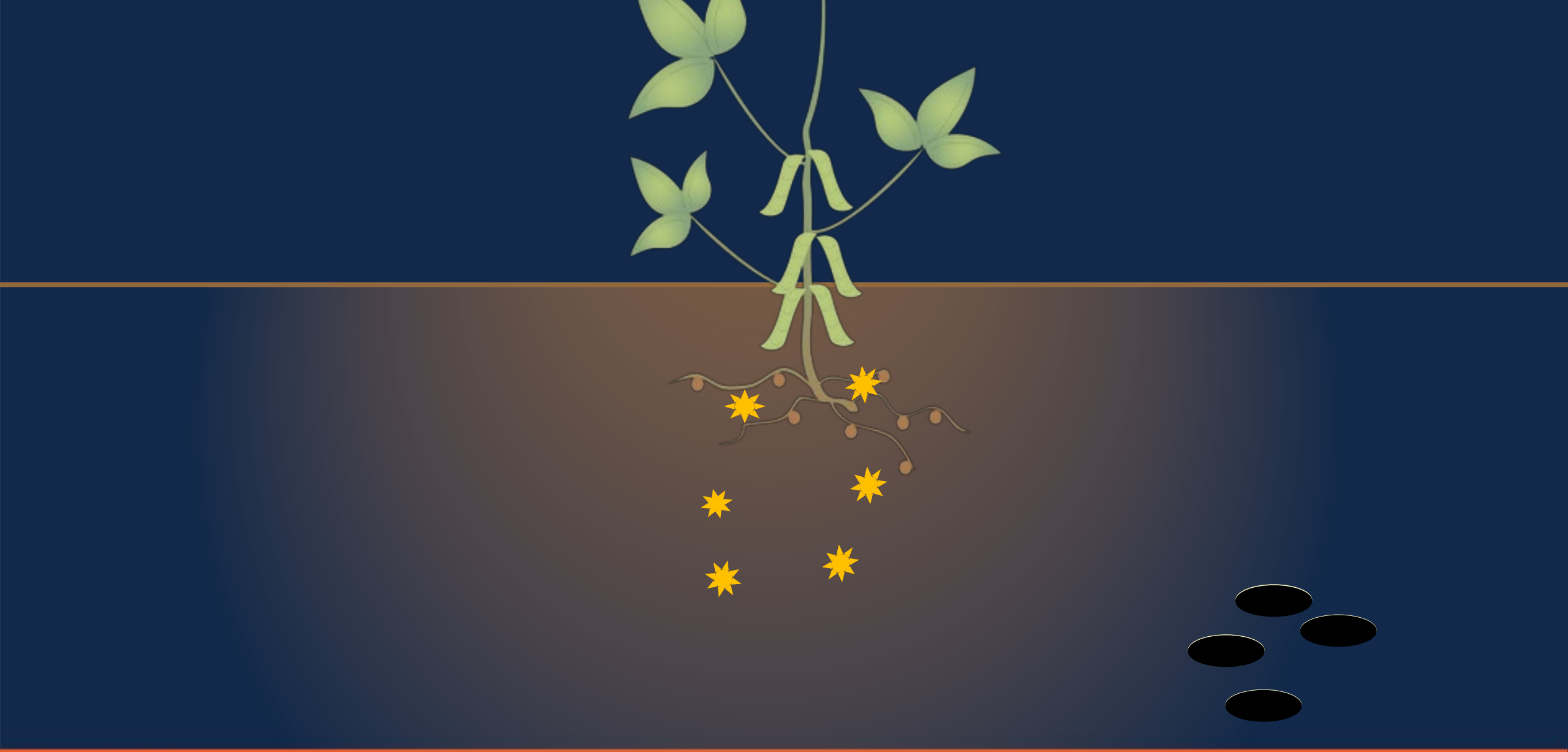
Hatch stimulant



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Inhibitory allelochemicals

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Toxic allelochemicals

What we know:

Host status of cover crops:

- Little reproduction on leguminous cover crops (5 or less)
- No reproduction observed on brassica or grass cover crops

(Kobayashi-Leonel et al. 2017, Acharya et al. 2016)

Field studies:

- Results inconsistent or not significant
- No differences between cover crops controls

(Wen et al. 2017, Miller et al. 2006, Chen et al. 2006)

Greenhouse/lab studies:

- Results inconsistent or not significant
- No difference between cover crops and controls
- Or lack sufficient controls

(Warnke et al. 2006, Riga et al. 2001, Warnke et al. 2008)

Cover crop seed company claims

Soil Buster Mix

80% Bounty Annual Ryegrass

20% Enricher Radish

- Deep rooting
- Increases organic matter
- Reduces compaction
- Captures free Nitrogen & Phosphorous
- Suppresses weeds
- Erosion control
- Reduces soy cyst nematode populations

Synergist Mix

88% Assist Annual Ryegrass

12% Dwarf Essex Rape

- Deep rooting
- Excellent combination for diversity
- Higher C:N ratios for being there next season when crop needs the N
- Weed suppression
- Erosion control
- Increase organic matter
- Good for reducing compaction
- Reduce soybean cyst nematode

Cover crop seed company claims

Tillage Radish®
The Original and Only

The Cover Crop That Pays

Visit Other Cover Crop Websites

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- Increased Yields
- Improved Soil Fertility
- Reduced Compaction
- Weed Control
- Enhanced Seed Bed
- Reduced Input
- Nematode Control

Call us today
1-800-767-9441

Home > Benefits > Nematode Control

Nematode Control

How it Pays: It's the Decrease in Pesticides!

A soil-enhancing benefit of Tillage Radish® (and another way to cut down on pesticide use) is nematode control. At peak growth, our cover crop radish's long taproot works hard to suppress pesky nematodes deep under the soil.

More good news: the loosening of soil creates micro pores, resulting in water and oxygen infiltration deep in the soil. As organic matter and microbial activity increases (a key sign of healthy, conditioned soil), the Tillage Radish cover crop radish becomes a virtual magnet for highly beneficial earthworms.

In short, Tillage Radish organically brings the good critters you want while keeping the bad guys at bay… it's a win-win!

Contact us today about our Tillage Radish® seed!


Greg Tylka

Experiments

small

Lab-based assays

Greenhouse experiments

Small-plot field studies

On-Farm strip trials

BIG

Treatments

Cereal rye (CR)
Secale cereale
Aroostook
Guardian

Annual ryegrass (ARG)
Lolium multiflorum
Bounty
RootMax

Mustard (M)
Brassica juncea
Kodiak
Pacific Gold

Daikon radish (DR)
Raphanus sativus subsp. *longipinnatus*
Tillage (CCS 779)
Enricher

Oilseed radish (OSR) *Raphanus sativus* subsp. *Oleiferus*
Image
Terranova

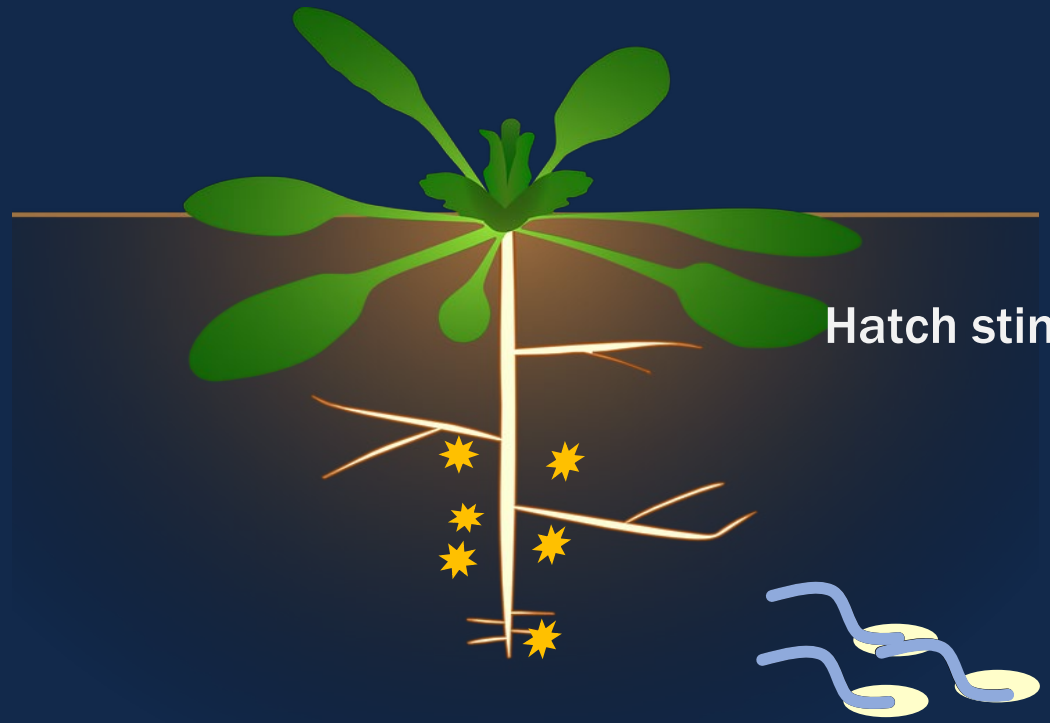
Mixes (Mix)
SF102- CR, DR, & crimson clover (CC), (VNS)
Soil Buster- Enricher DR & Bounty ARG
Synergist Mix- Dwarf Essex (rapeseed, R) & Bounty ARG

Control treatments

- Non-cover crop, nonhost control tomato cv. Rutgers
- SCN-Susceptible soybean cv. Williams 82
- Unplanted (fallow)

- Zinc sulfate (SCN hatch stimulant)
- DI water

SCN hatching studies

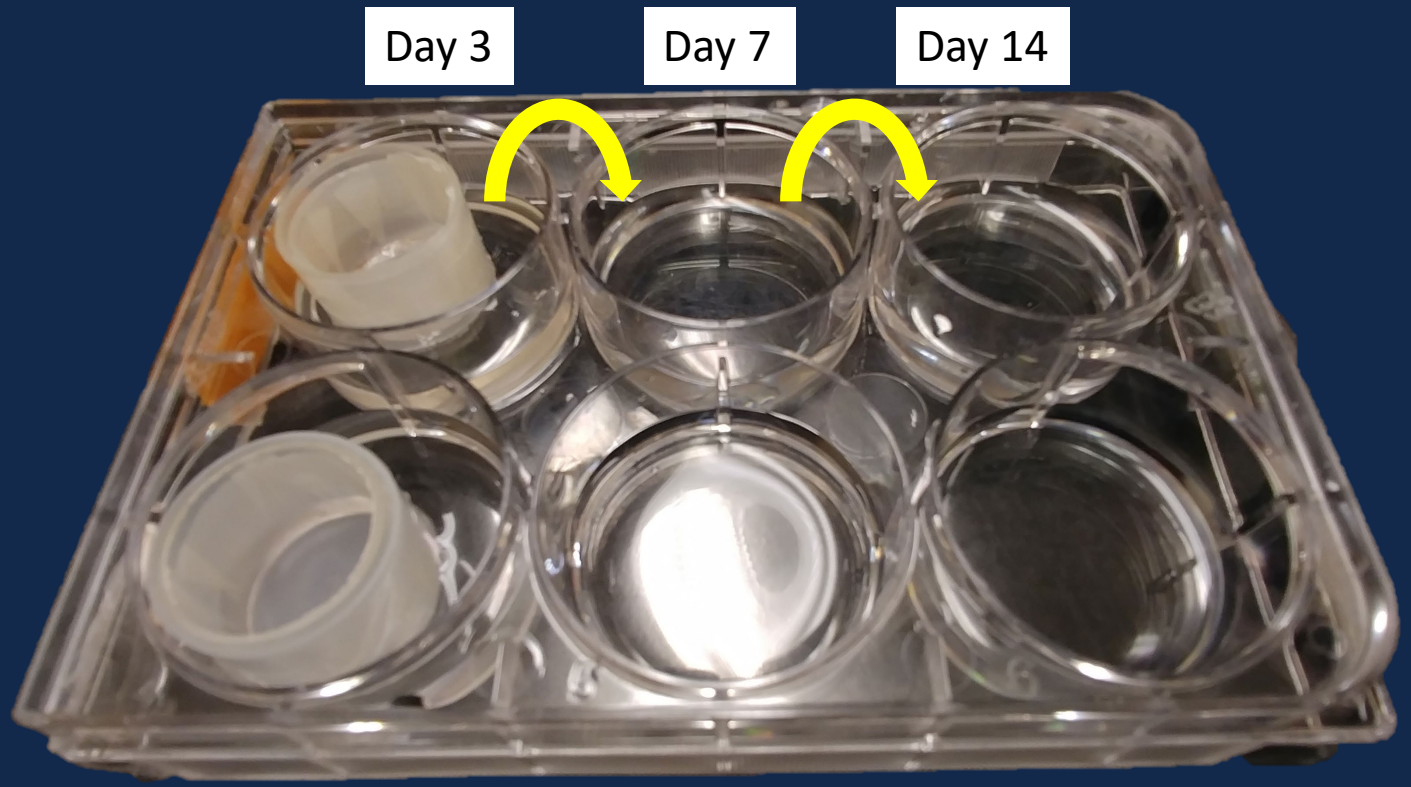


SCN hatching studies

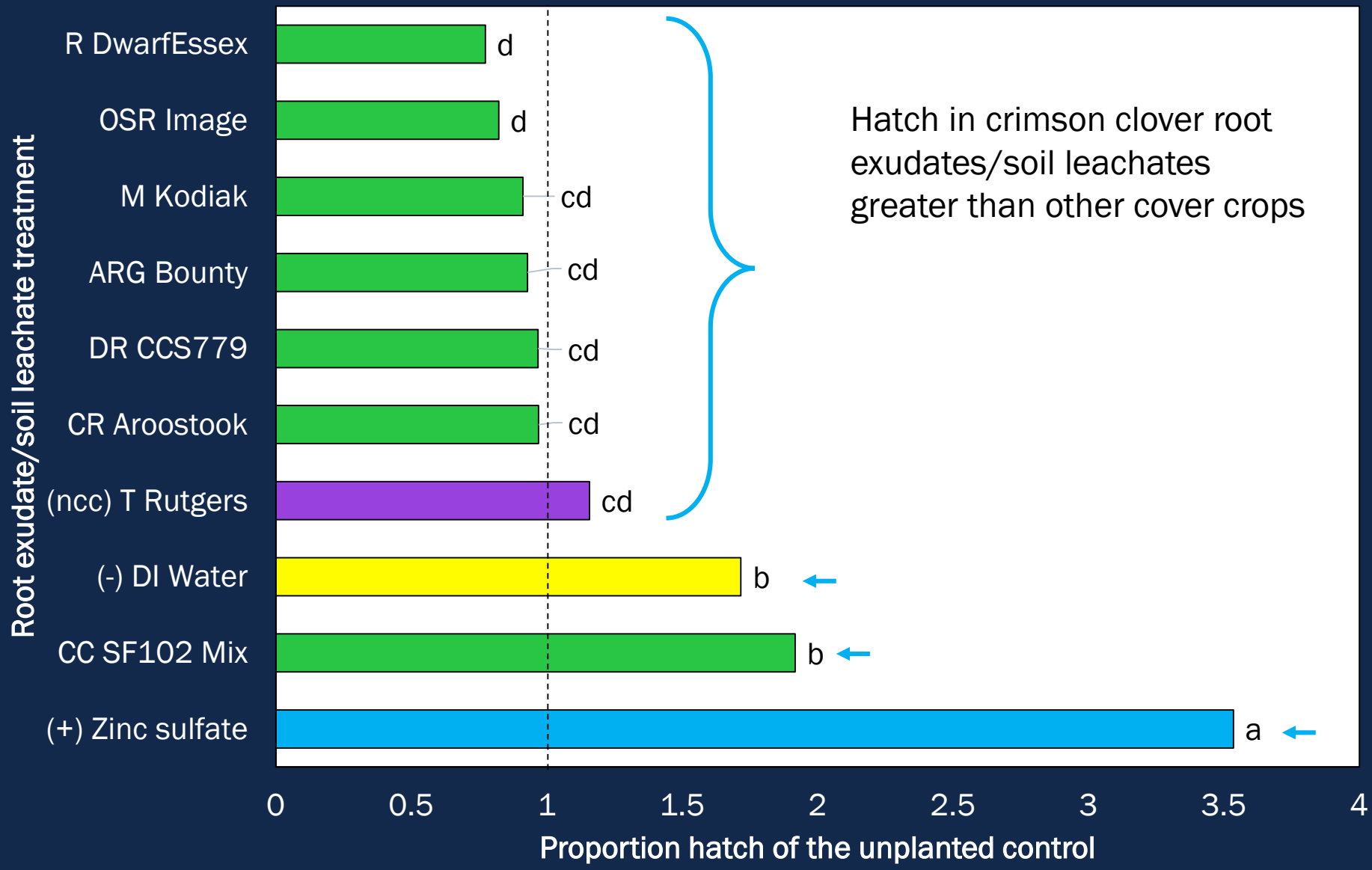
Noel and Sikora, 1996

SCN hatching studies

Noel and Sikora, 1996

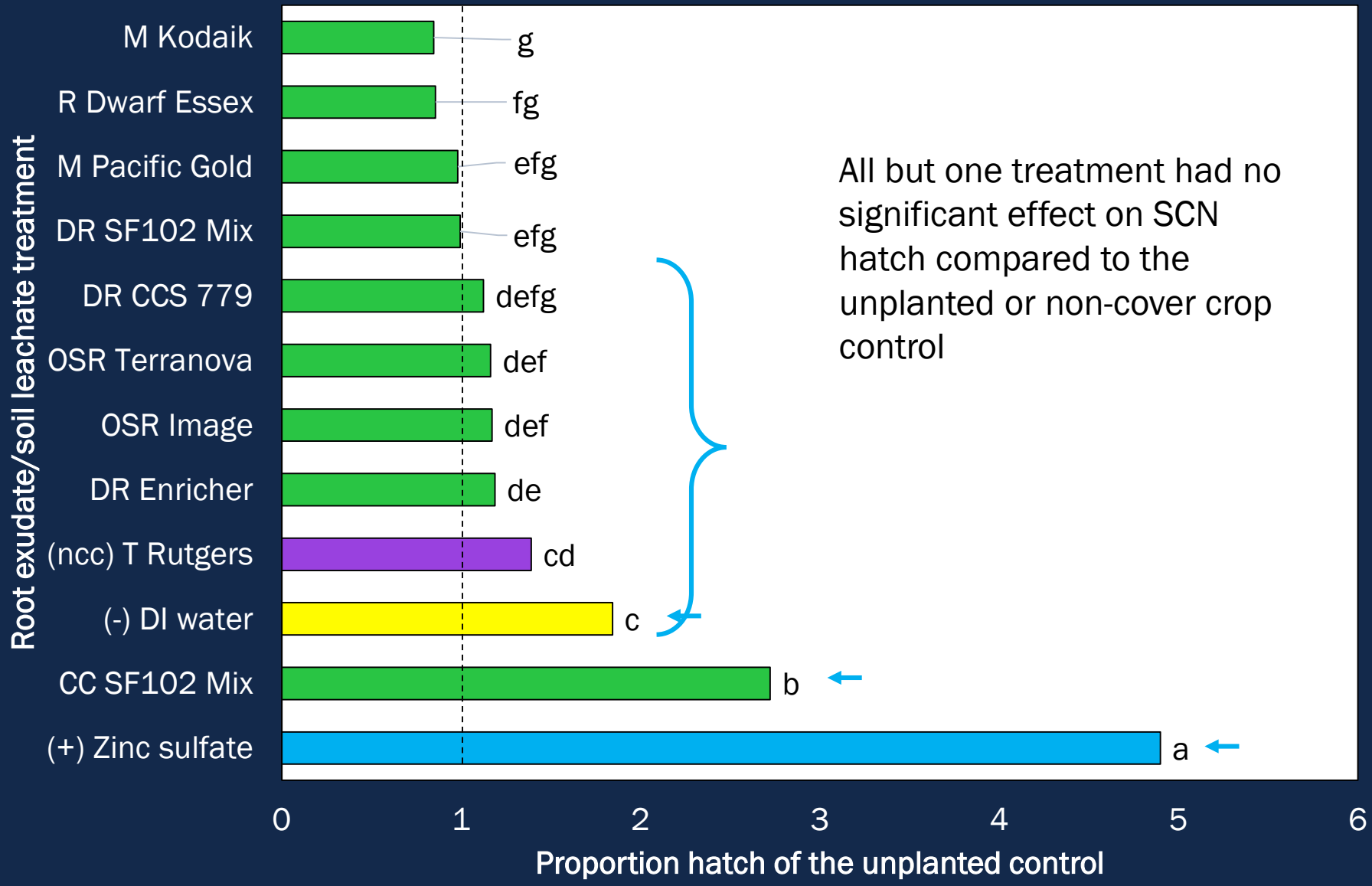


SCN hatching results (group A)



Two runs
Four reps/run
$\alpha = 0.05$

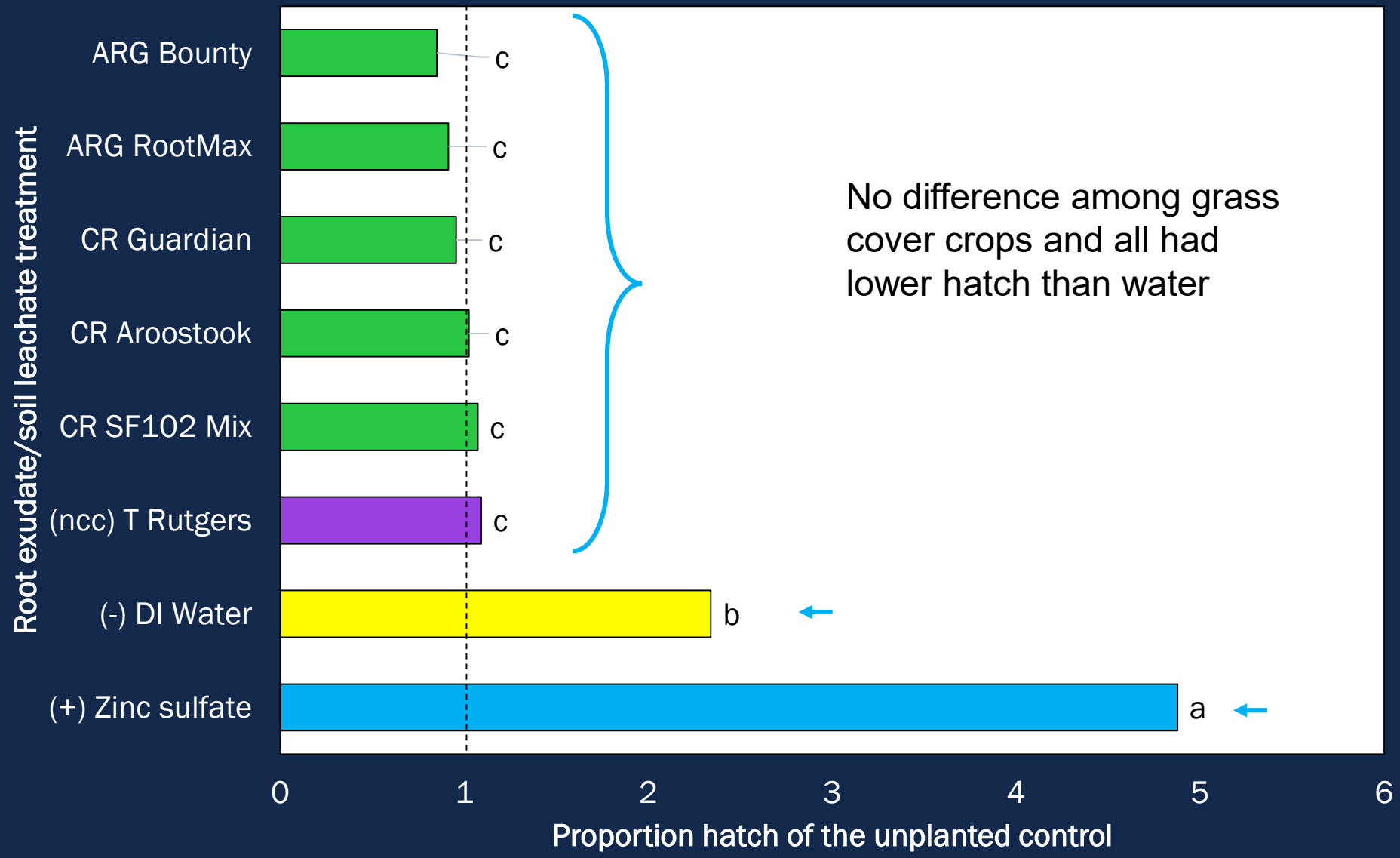
SCN hatching results (group B)



All but one treatment had no significant effect on SCN hatch compared to the unplanted or non-cover crop control

Two runs
Four reps/run
$\alpha = 0.05$

SCN hatching results (group C)



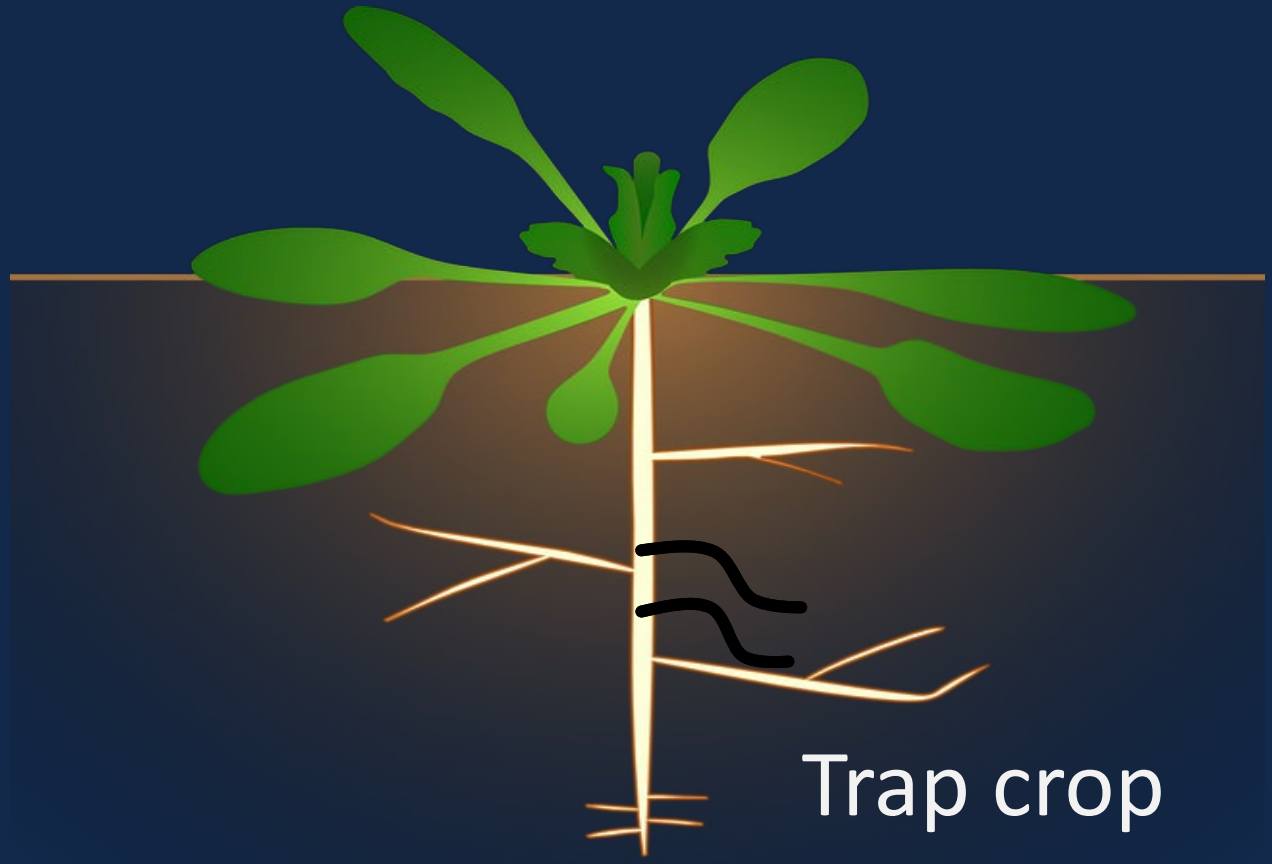
No difference among grass cover crops and all had lower hatch than water

Two runs
Four reps/run
$\alpha = 0.05$

Thoughts on hatching results:

- Crimson clover a hatch stimulant?
- No significant hatch stimulation by all other cover crops
- Some cover crops inhibited hatch

SCN root penetration assay



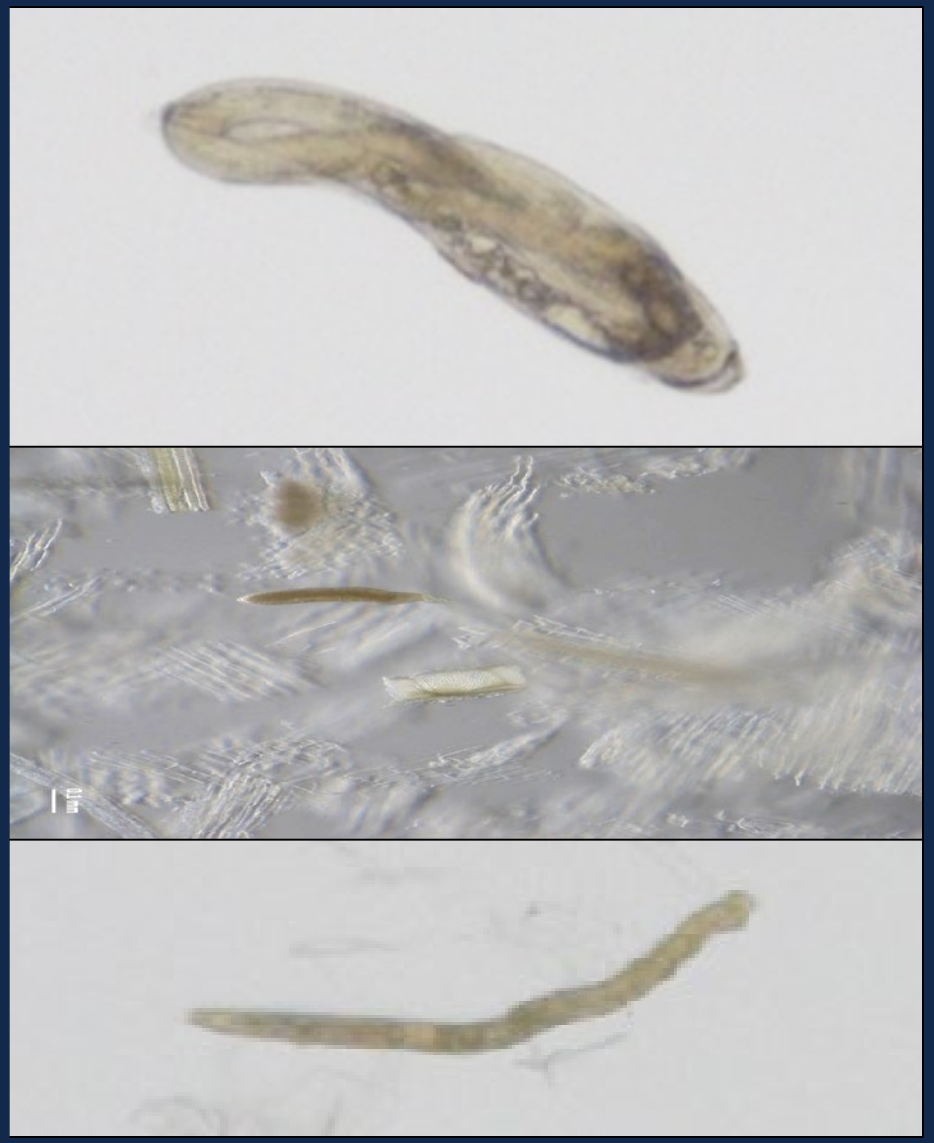
SCN root penetration assay

Data collected:

- total number of nematodes
- fresh root weight

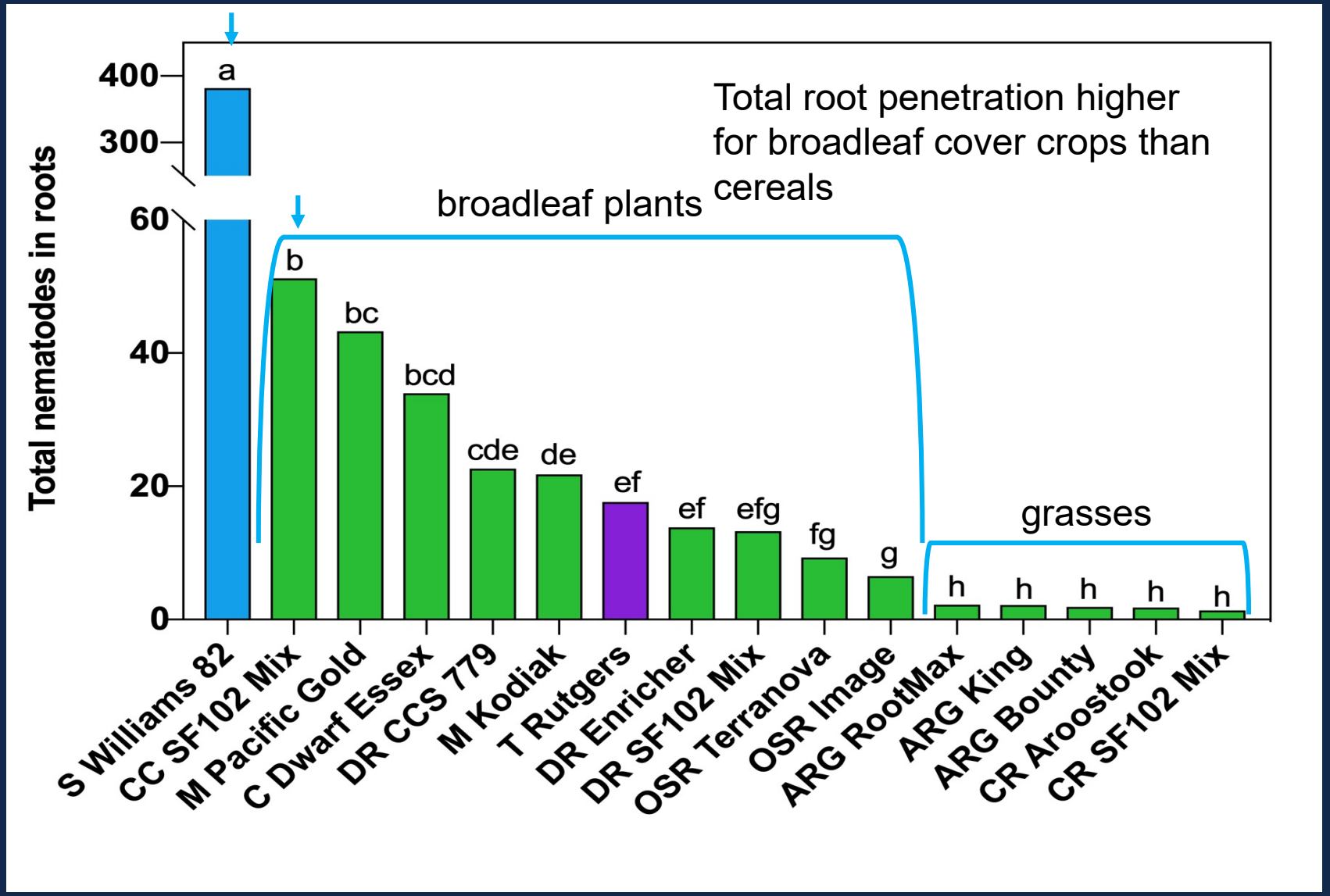
Analyses conducted on:

- total number of nematodes per root
- number of nematodes per g root



Root penetration results

Three runs
Runs 1 and 3:
Six reps each
Run 2:
Three reps
$\alpha = 0.05$



Thoughts on SCN root penetration results

- Crimson clover: possible trap crop?
- Brassica plants: little potential
- Cereal rye and annual ryegrass: NOT trap crops

De-production experiment

Reproduction (as defined by dictionary.com): The natural process among organisms by which new individuals are generated and the species perpetuated

“De-production” (as defined by C. Harbach): The natural process by which the number of organisms is decreased

De-production experiment

Data collected:

- $P_{(initial)}$: SCN population density at the beginning of the experiment
- $P_{(final)}$: SCN population density at the end of the experiment

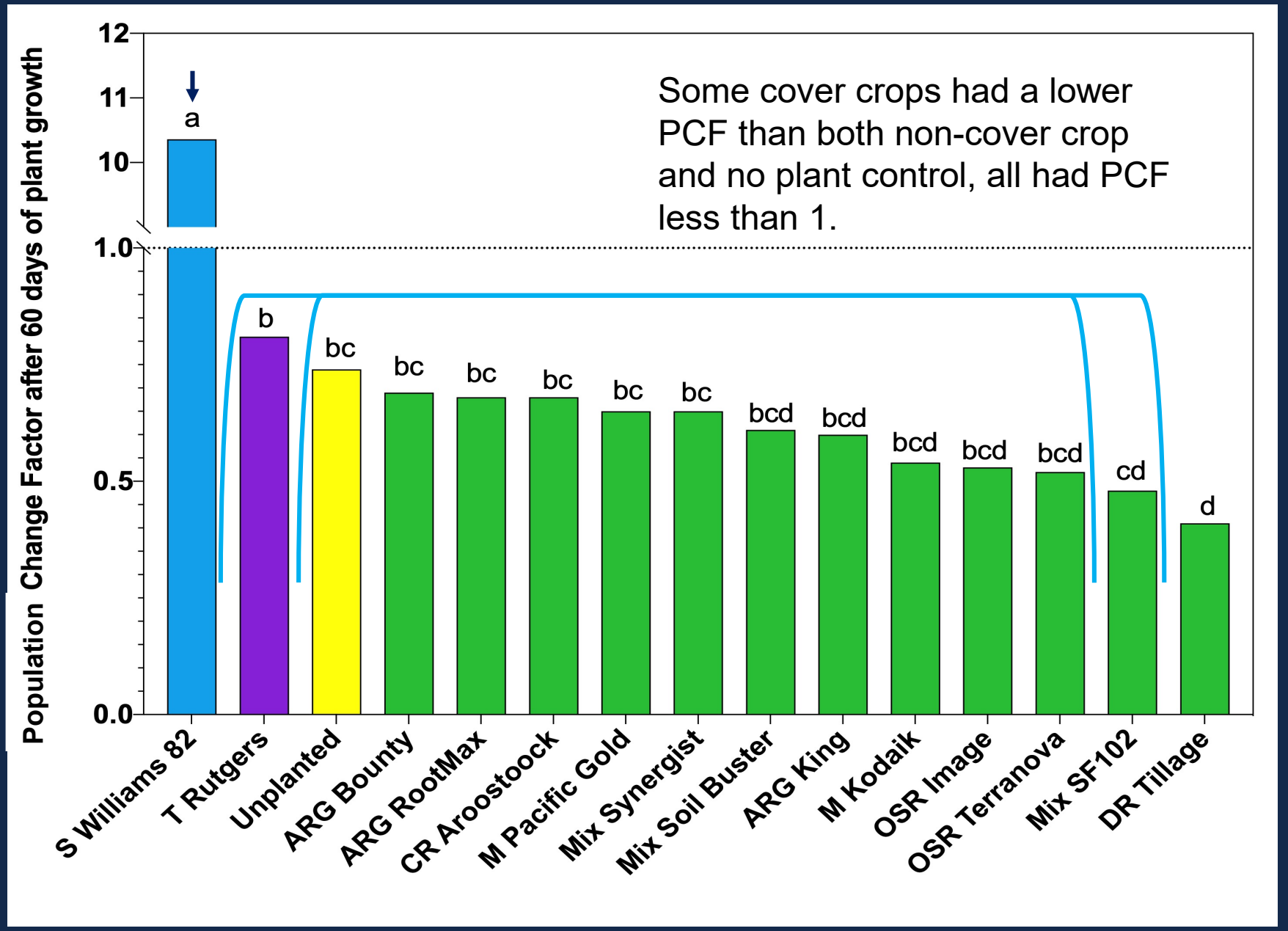
Analyses conducted on:

- $P_{(final)} \div P_{(initial)}$ = Population Change Factor (PCF)*, to assess the change in population density from beginning to end of cover crop growth

*Warnke et al. 2008

De-production results

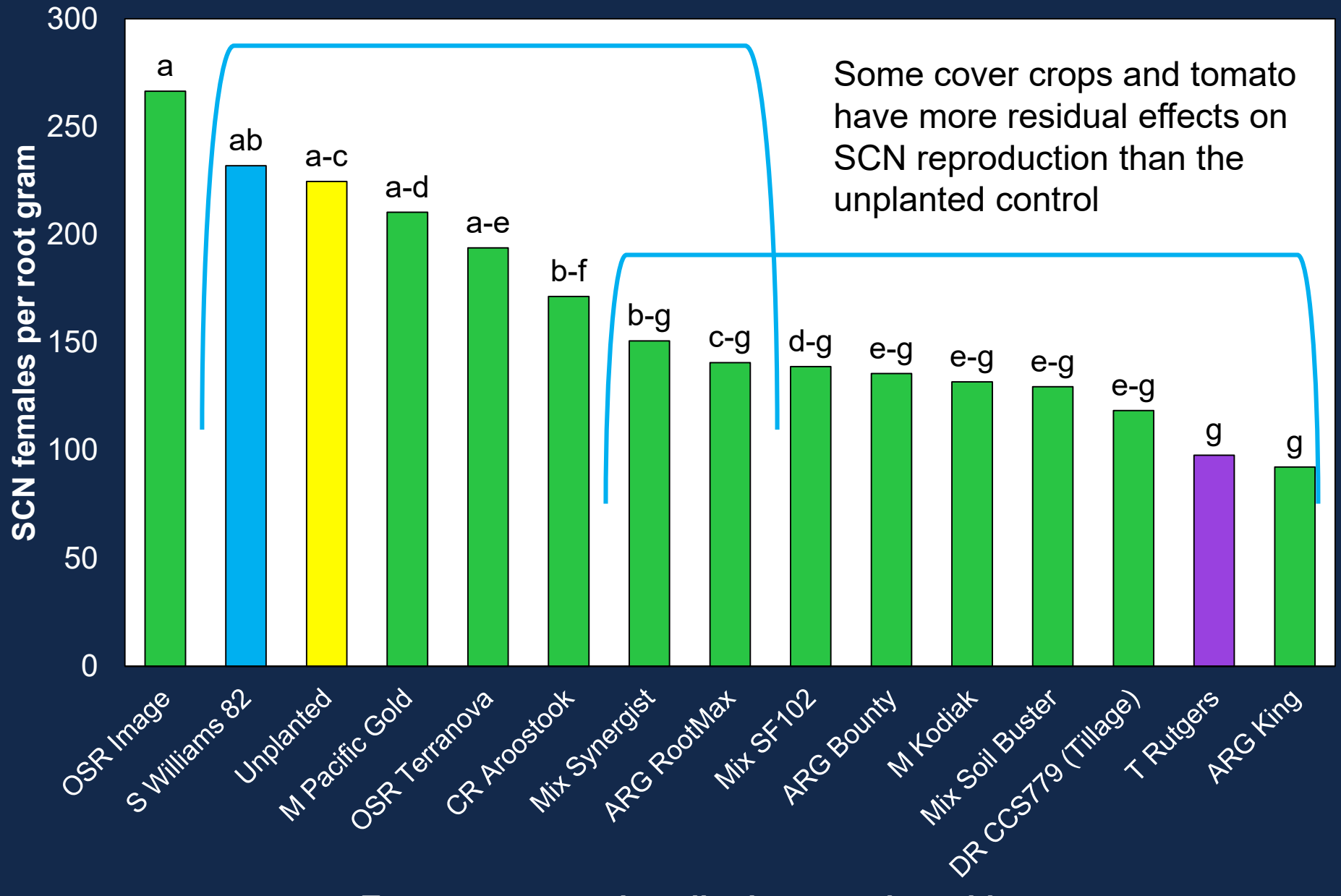
Two runs
Six reps/run
$\alpha = 0.05$



But wait! There's more...

Residual effects of cover crops on SCN reproduction

Two runs
Six reps/run
$\alpha = 0.05$



Thoughts on de-production and residual effects

- No significant reduction in PCF in cover crop treatments compared to the
  - Unplanted control
  - Tomato control

- Some residual effects on SCN reproduction

Small-plot studies

Two locations

Fruitland, IA (Muscatine Island Research Farm [MIRF])

Kanawha, IA (Northern Research Farm [NRF])

Two rotations (fields) per location

2016 Soy
2017 Corn
2018 Soy

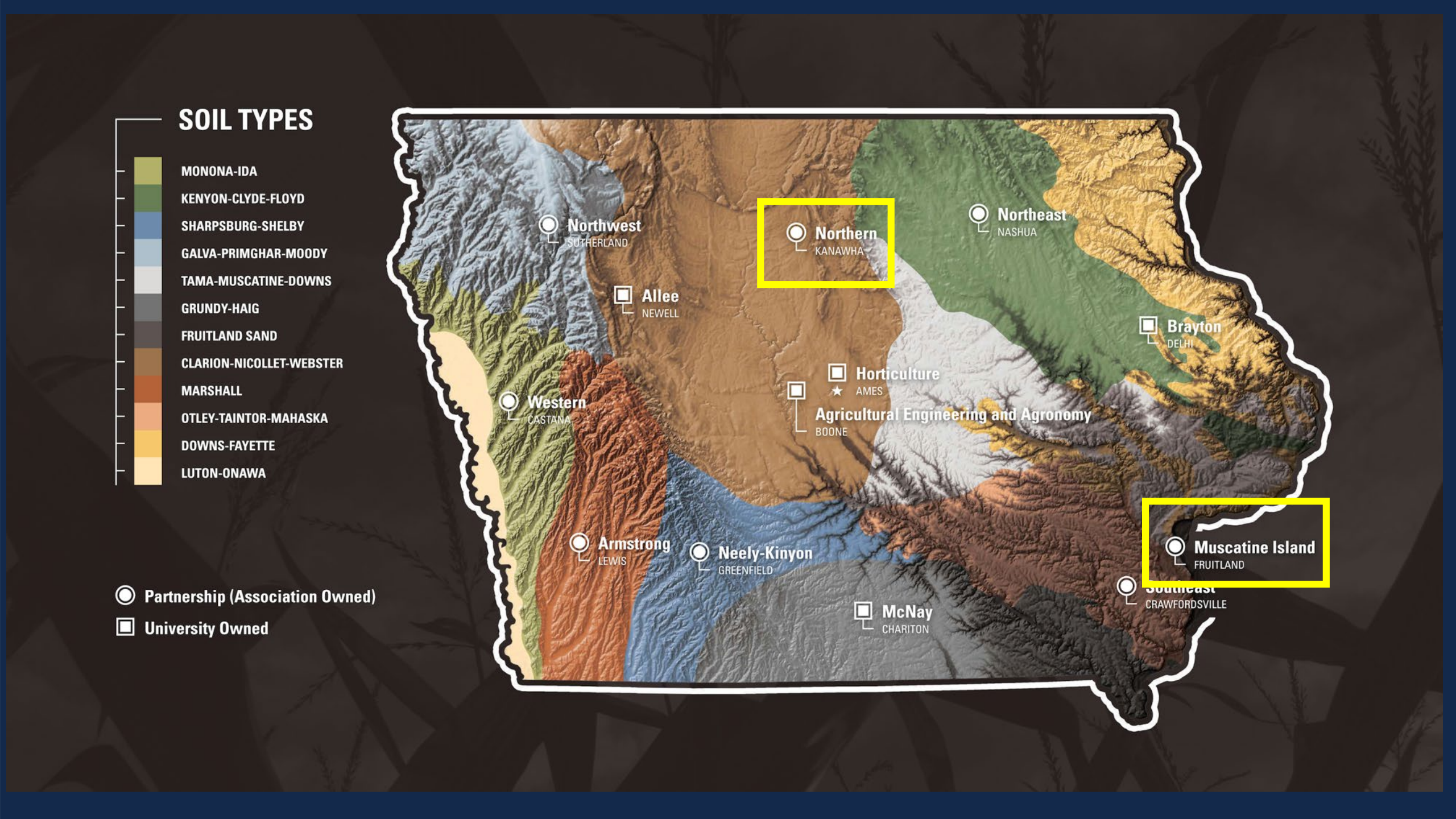
2016 Corn
2017 Soy
2018 Corn

Ten treatments

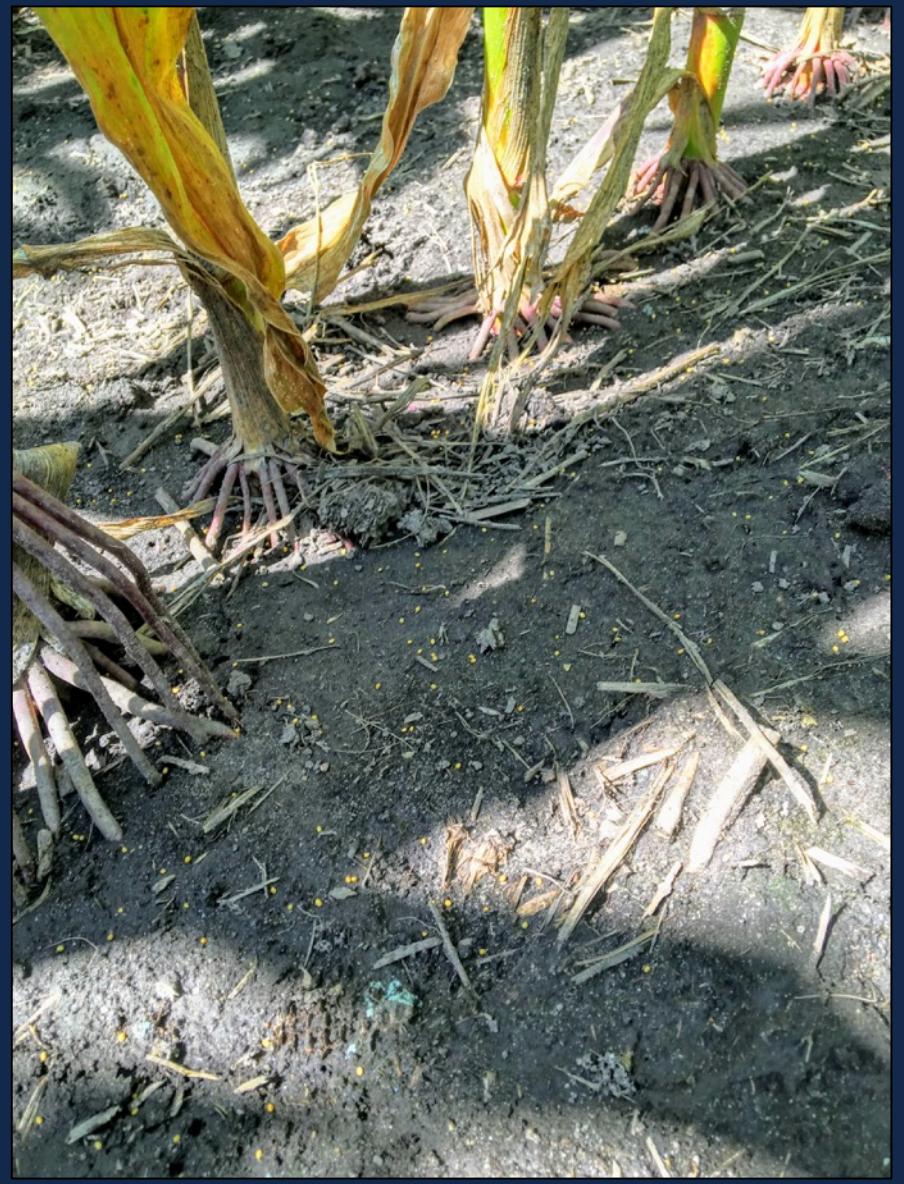
ARG Bounty
ARG Rootmax
CR Aroostook
CR Guardian
M Kodiak
M Pacific Gold
DR Tillage (CCS779)
OSR Image
Mix SF102
Unplanted (fallow)

Three soil sampling dates/year

1. Seeding
2. Pre-winter
3. Spring


SOIL TYPES
MONONA-IDA
KENYON-CLYDE-FLOYD
SHARPSBURG-SHELBY
GALVA-PRIMGHAR-MOODY
TAMA-MUSCATINE-DOWNS
GRUNDY-HAIG
FRUITLAND SAND
CLARION-NICOLLET-WEBSTER
MARSHALL
OTLEY-TAINTOR-MAHASKA
DOWNS-FAYETTE
LUTON-ONAWA
Partnership (Association Owned)
University Owned
Northwest
SUTHERLAND
Northern
KANAWHA
Northeast
NASHUA
Allee
NEWELL
Brayton
DELHI
Horticulture
AMES
Agricultural Engineering and Agronomy
BOONE
Western
CASTANA
Armstrong
LEWIS
Neely-Kinyon
GREENFIELD
McNay
CHARITON
Muscatine Island
FRUITLAND
CRAWFORDSVILLE

Small plot setup



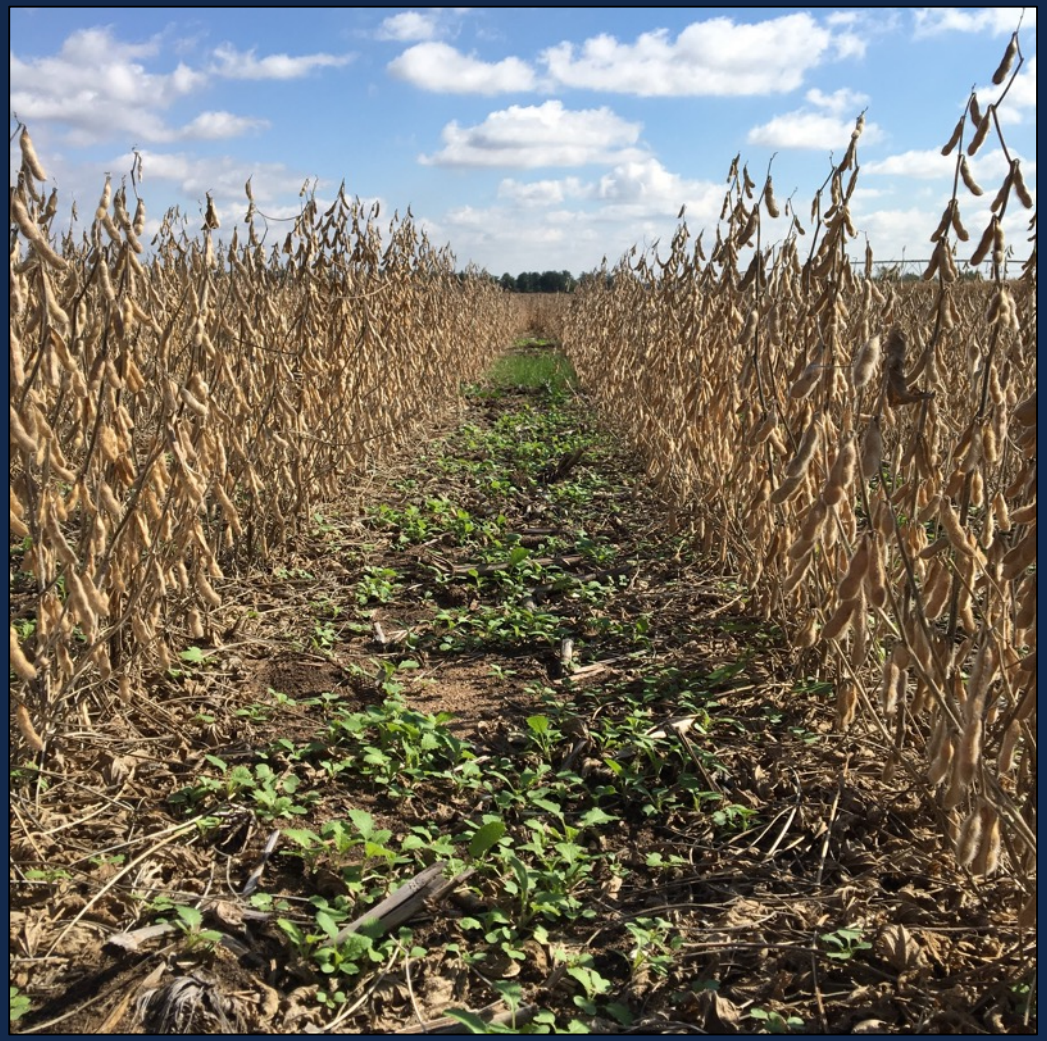


Photo credit: X. Phillips

Data collection and analyses:

Calculate two PCF (population change factor) values per year:

(1) pre-winter ÷ seeding (2) spring ÷ pre-winter

Conduct analysis of variance for each PCF value and field

Location	Rotation	Year	PCF	P value
MIRF	S-C-S	1	1	0.97
			2	0.26
		2	1	0.51
			2	0.75
	C-S-C	1	1	0.80
			2	0.78
		2	1	0.64
			2	0.25
NRF	S-C-S	1	1	0.49
			2	0.47
		2	1	0.93
			2	0.86
	C-S-C	1	1	0.09
			2	0.70
		2	1	0.38
			2	0.29

Thoughts on small plot results

- No significant reduction in SCN numbers*
  - Years
  - Locations
  - Treatments
  - Sampling dates

*Under these experimental conditions

Thank you!

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