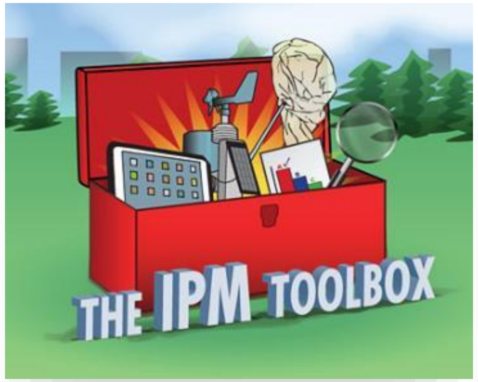
Exploring Alternatives to Neonicotinoid Seed Treatments: Case Studies in Vegetable Crops

Leo Salgado

Cornell University



Northeastern IPM Center

April 3, 2025

USDA United States Department of Agriculture National Institute of Food and Agriculture

Cornell AgriTech New York State Agricultural Experiment Station

Funding Acknowledgment

This presentation was funded by the Northeastern IPM Center through Grant #2022-70006-38004, Accession Number: 1017389 from the USDA National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

Webinar Details

Webinar will end at 12:00pm

Live Transcription

A recording of this webinar will be available within a week

http://www.neipmc.org/go/ipmtoolbox

Northeastern IPM Center

We Welcome Your Questions

Please submit a question **<u>at any time</u>** using the Q&A feature to your right at any time

If you'd like to ask a question anonymously, please indicate that at the beginning of your query.

Northeastern IPM Center

Webinar Presenter

Leo Salgado

PhD. Student, Brian Nault's Vegetable Entomology Lab

Cornell University

Cornell AgriTech New York State Agricultural Experiment Station

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Some Questions for You

Northeastern IPM Center

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Leonardo D. Salgado and Brian A. Nault

"The IPM Toolbox" Northeastern IPM Webinar Series

April 3, 2025

Cornell AgriTech
New York State Agricultural Experiment Station

Acknowledgements

Nault Lab 2024

Cooperators

New York Vegetable Growers

Kamterter Products, L.L.C.

bejo

IPM Integrated Pest Management

Northeastern IPM Center

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Funding

NEW YORK STATE OF OPPORTUNITY. | Agriculture and Markets

Dry Bean Endowment

New York Onion Research & Development Program

New York Vegetable Growers Association

University Cooperators

Cornell University

University of Guelph

University of Delaware

The University of California 1868

Oregon State University

Wisconsin University of Wisconsin–Madison

Washington State University

Outline

I. Neonicotinoid insecticides as seed treatments

II. Case studies in vegetable crops

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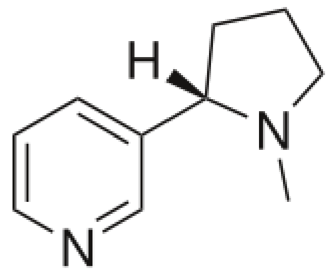
I. **Neonicotinoid insecticides as seed treatments**

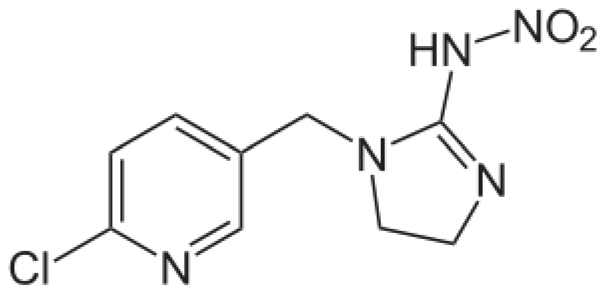
II. Case studies in vegetable crops

Neonicotinoid insecticides

- Chemical structure similar to nicotine



Nicotine



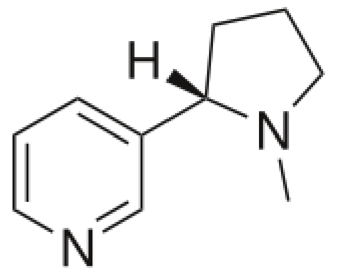
Imidacloprid

Shono & Scott 2002 and Pesticide Book Manual

Neonicotinoid insecticides

- Chemical structure similar to nicotine

- Greater toxicity to insects than to mammals



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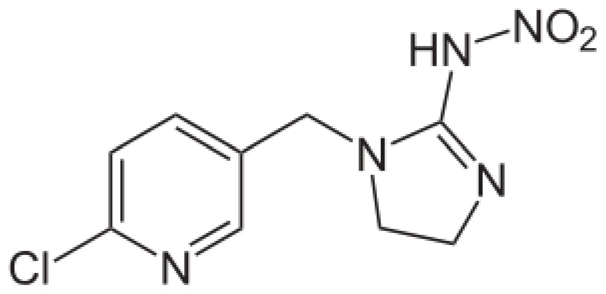

Imidacloprid

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Why are neonicotinoid insecticides so popular?

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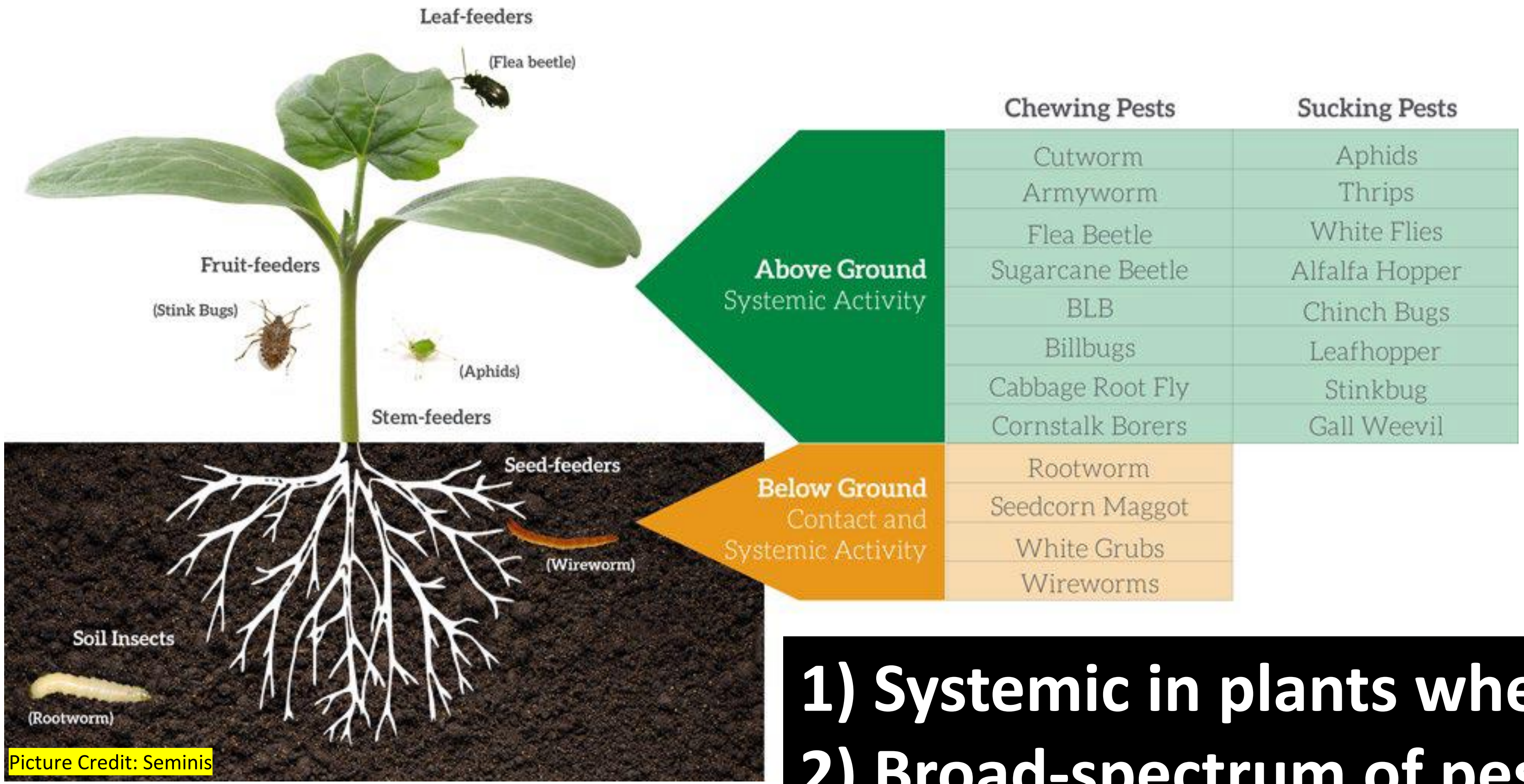
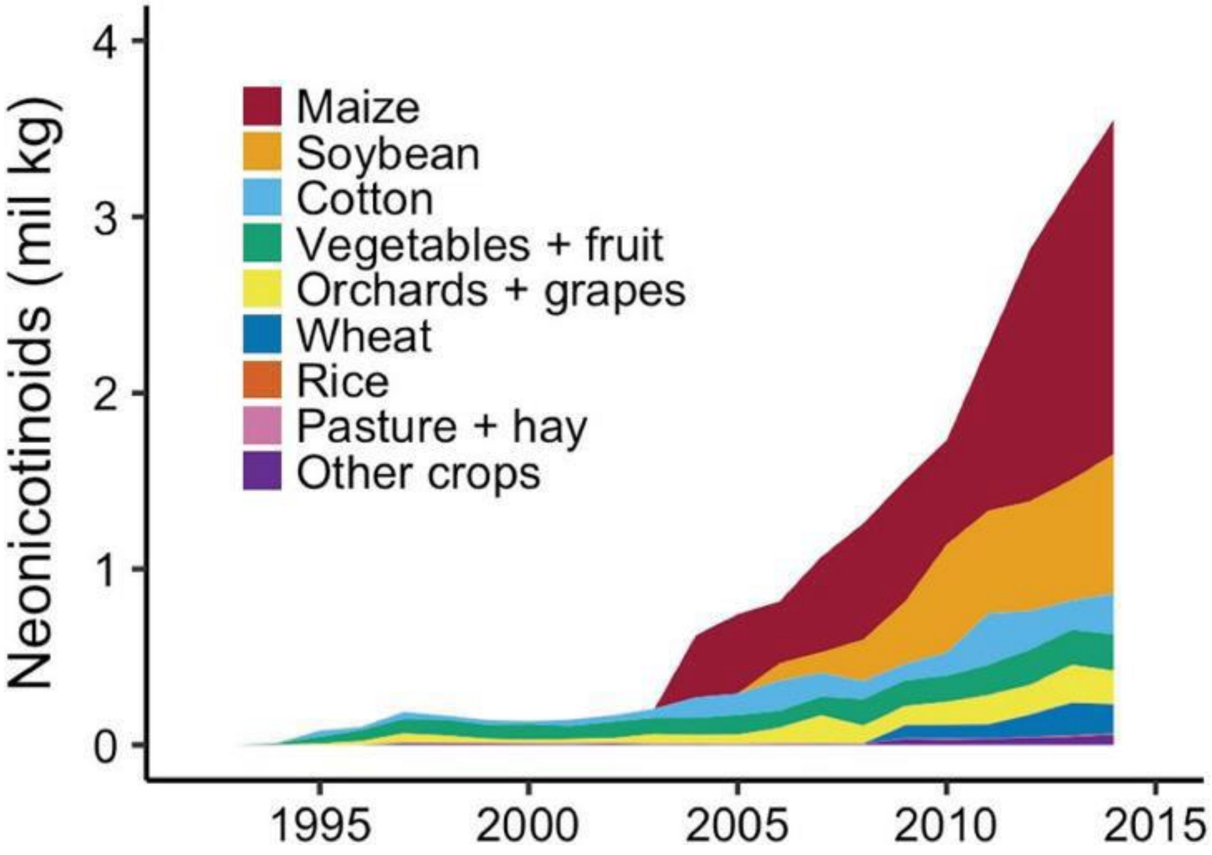


1) Systemic in plants when applied to soil
2) Broad-spectrum of pest activity

Annu. Rev. Pharmacol. Toxicol., 2005, vol. 45, p. 247-268.

Why are neonicotinoid insecticides so popular?



Douglas & Tooker (2015): *Environ. Sci. Technol*. 49, 8, 5088–5097

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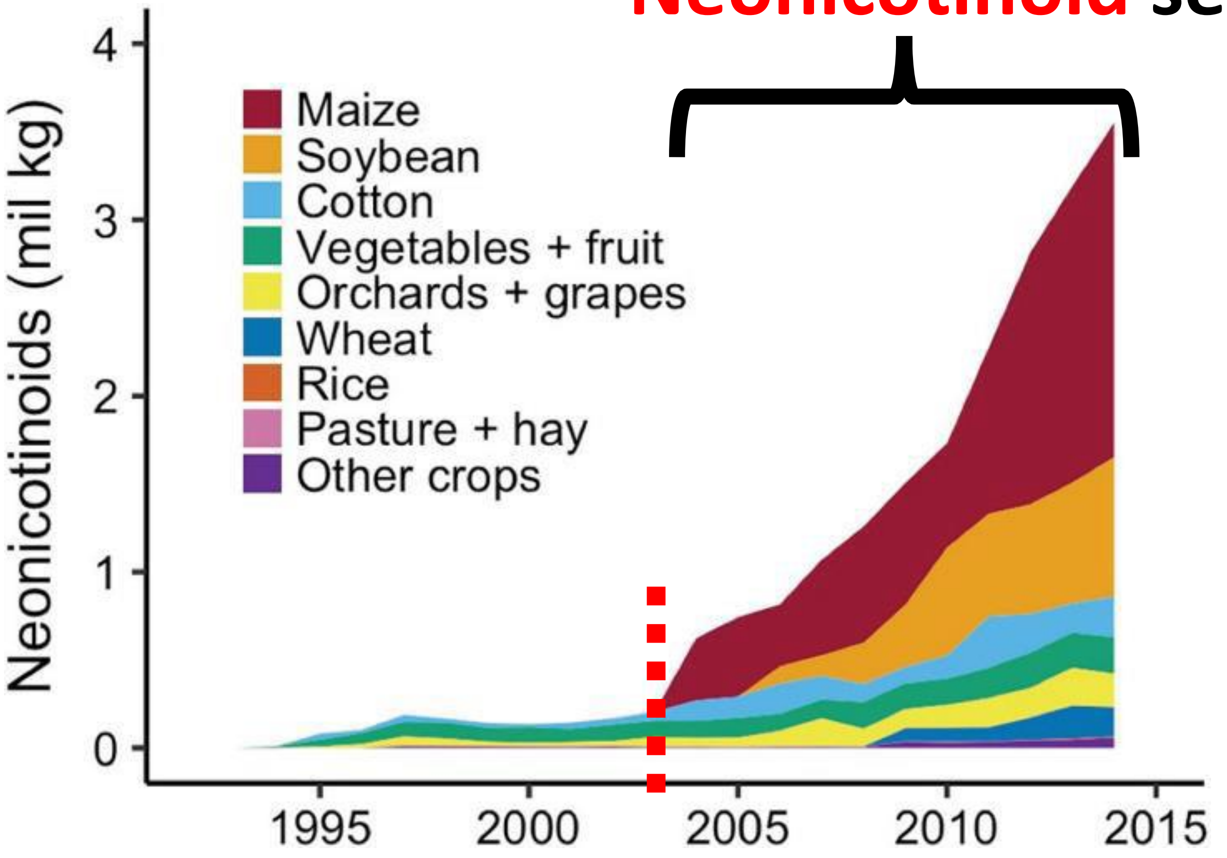
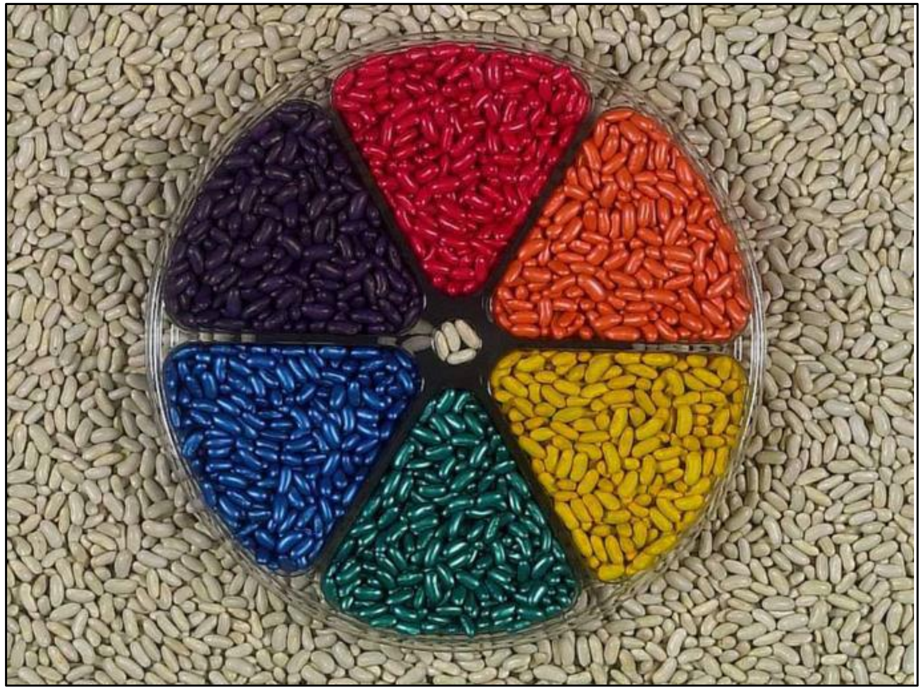


Neonicotinoid seed treatment revolution



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Risks to consider when using neonicotinoids

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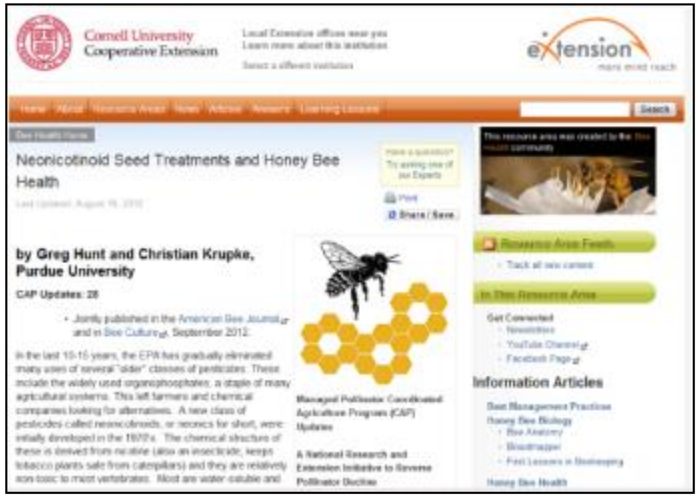

Will neonicotinoids be banned in agricultural crops?

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Yes and no… NY signed the Birds & Bees Protection Act in 2023...

NEW YORK STATE OF OPPORTUNITY. | Agriculture and Markets

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This bill will limit the use of neonicotinoid seed treatments on **corn** (including sweet corn), **soybeans,** and **wheat by 2029!**

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NEW YORK STATE OF OPPORTUNITY. Agriculture and Markets

Vermont and Illinois are seeking to ban neonicotinoids in agricultural production, and are watching New York

Will neonicotinoids be banned in agricultural crops?

Large retail grocery stores have adopted policies to phase out pesticides harmful to bees on produce they will market

Will neonicotinoids be banned in agricultural crops?

Large retail grocery stores have adopted policies to phase out *pesticides harmful to bees* on produce they will market

Goal

- **Evaluate performance of non-neonicotinoid insecticide seed treatments for protecting vegetable crops from early-season insect pests**

Alternatives to neonicotinoid seed treatments group

- **USA**
  - California
  - Delaware
  - New York
  - Oregon
  - Washington
  - Wisconsin
- **Canada**
  - Ontario

Alternatives to neonicotinoid seed treatments in vegetable crops working group

Alternatives to neonicotinoid seed treatments group

Cornell University

Brian Nault

Alan Taylor

Ethan Grundberg

Christy Hoepting

University of Guelph

Mary Ruth McDonald

Kevin Vander Kooi

University of Delaware

David Owens

University of Wisconsin-Madison

Russel Groves

University of California

Rob Wilson

Washington State University

Tim Waters

Oregon State University

Stuart Reitz

Outline

I. Neonicotinoid insecticides as seed treatments

II. Case studies in vegetable crops

Case Studies

- **Insect pest control in sweet corn**

- **Insect pest control in beans**

- **Insect pest control in onions**

Case Studies

- **Insect pest control in sweet corn**

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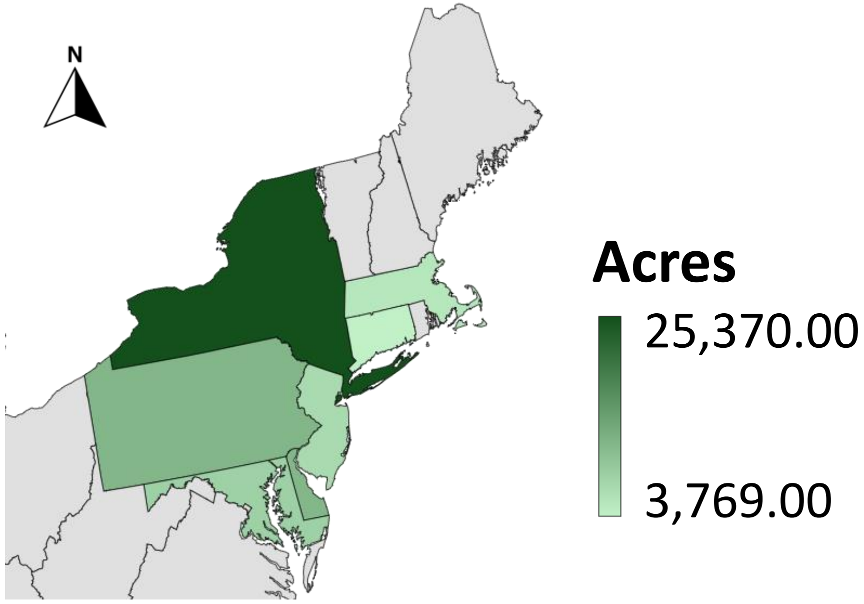
Sweet Corn Production in the Northeast

- In 2017, the Northeast produced over 72,000 acres of sweet corn (USDA NASS)



USDA NASS 2017 census

Sweet Corn Production in the Northeast

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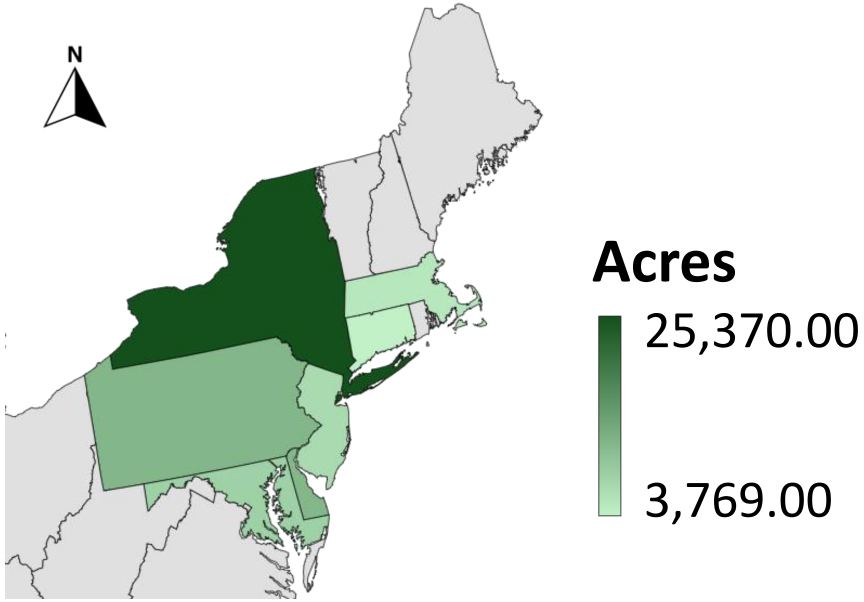
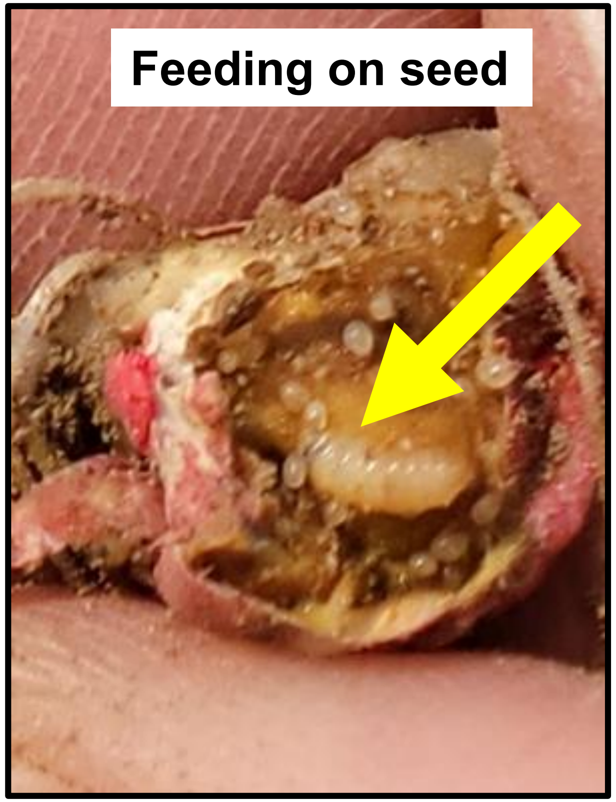
- **75% of sweet corn is** produced for the **fresh market**, while **25% is for processing** (frozen and canned).

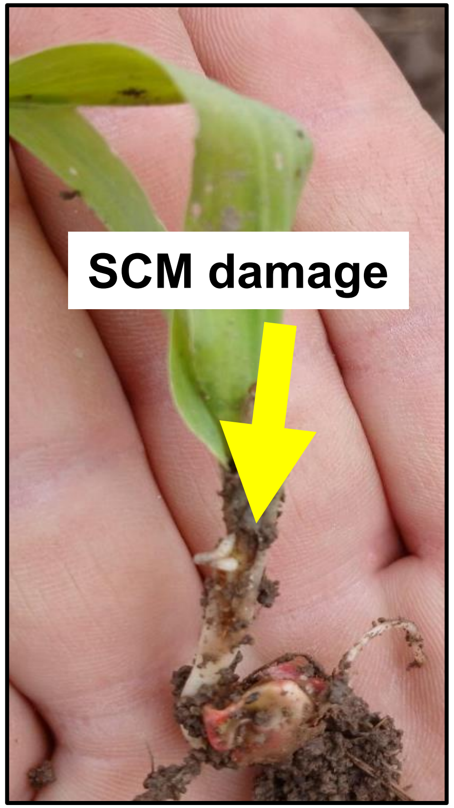


USDA NASS 2017 census

Photo credit: Burns' Sweet Corn

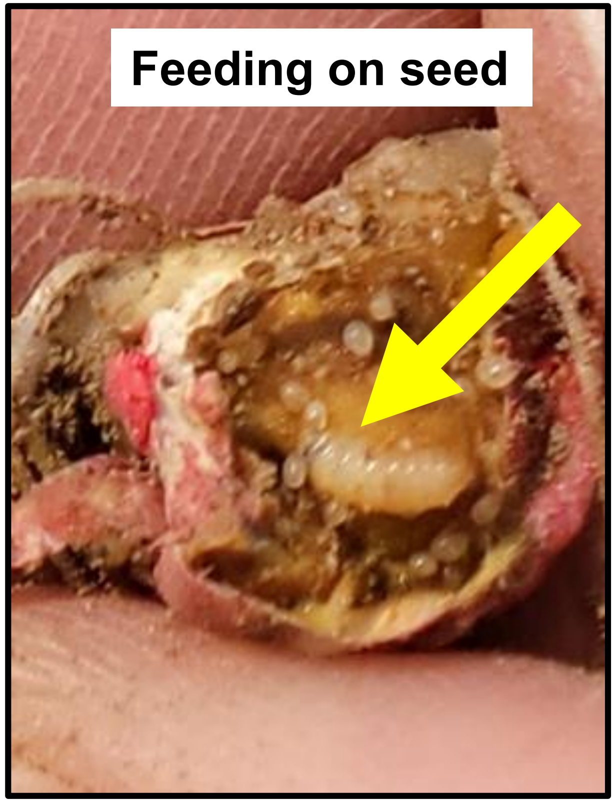
Major sweet corn pests

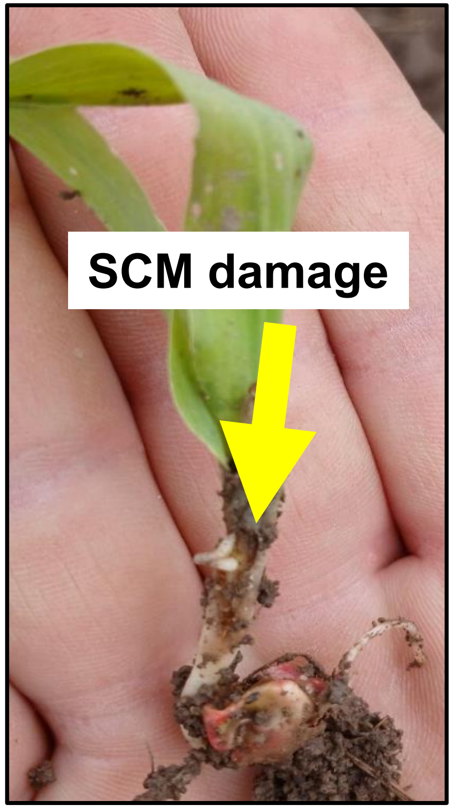




Seedcorn Maggot (SCM)
(*Delia platura*)

Major sweet corn pests





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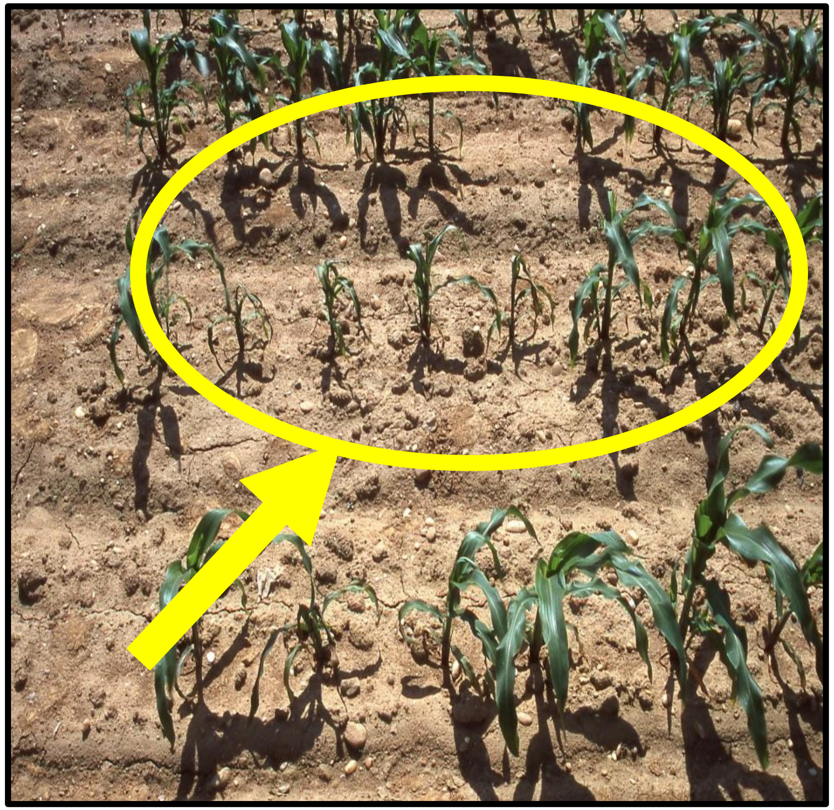
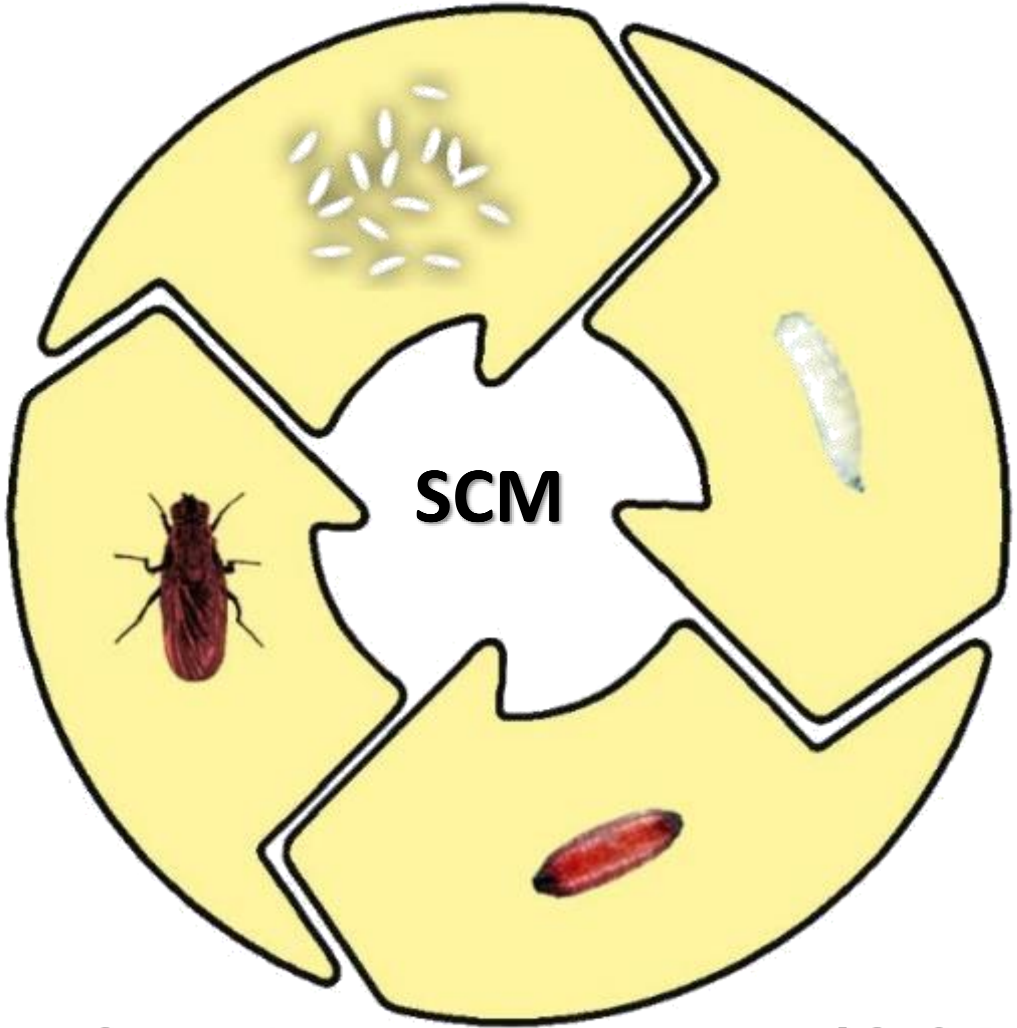


Corn flea beetle (CFB)
(*Chaetocnema pulicaria*)

Seedcorn maggot (SCM) (*Delia platura*)



Seedcorn maggot (SCM)

Diptera (Anthomyiidae)

3 to 5 generations per year

Overwinters as a puparium in soil

Eggs laid on decaying organic material as well as recently planted crops

Pictures credits: J. Ogrodnik

Damage to Sweet Corn

Photos: J. Ogrodnick

SCM damage in sweet corn

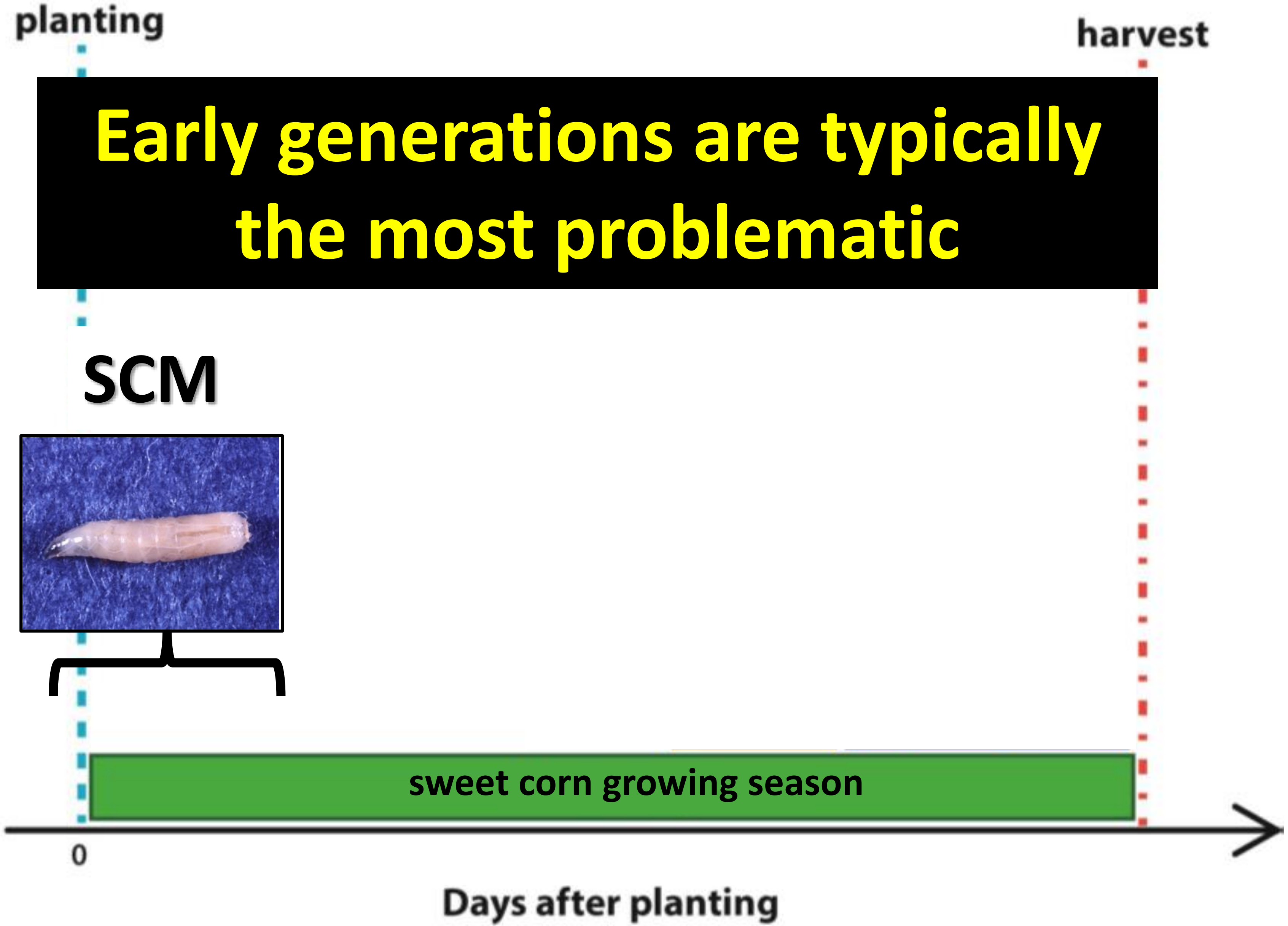
Picture Credit: North Carolina State University

Stand losses

Risk period for SCM attacking sweet corn

Risk period for SCM attacking sweet corn

Early generations are typically the most problematic



Management of SCM in vegetable crops

Integrated pest management

Plant Resistance

Chemical Control

Cultural Control

Biological Control

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- Avoid fields recently treated with manure or has decaying organic matter
- Avoid planting into cold, wet soils
- Avoid planting during peak activity

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- Insecticide at planting (no rescue treatments available)

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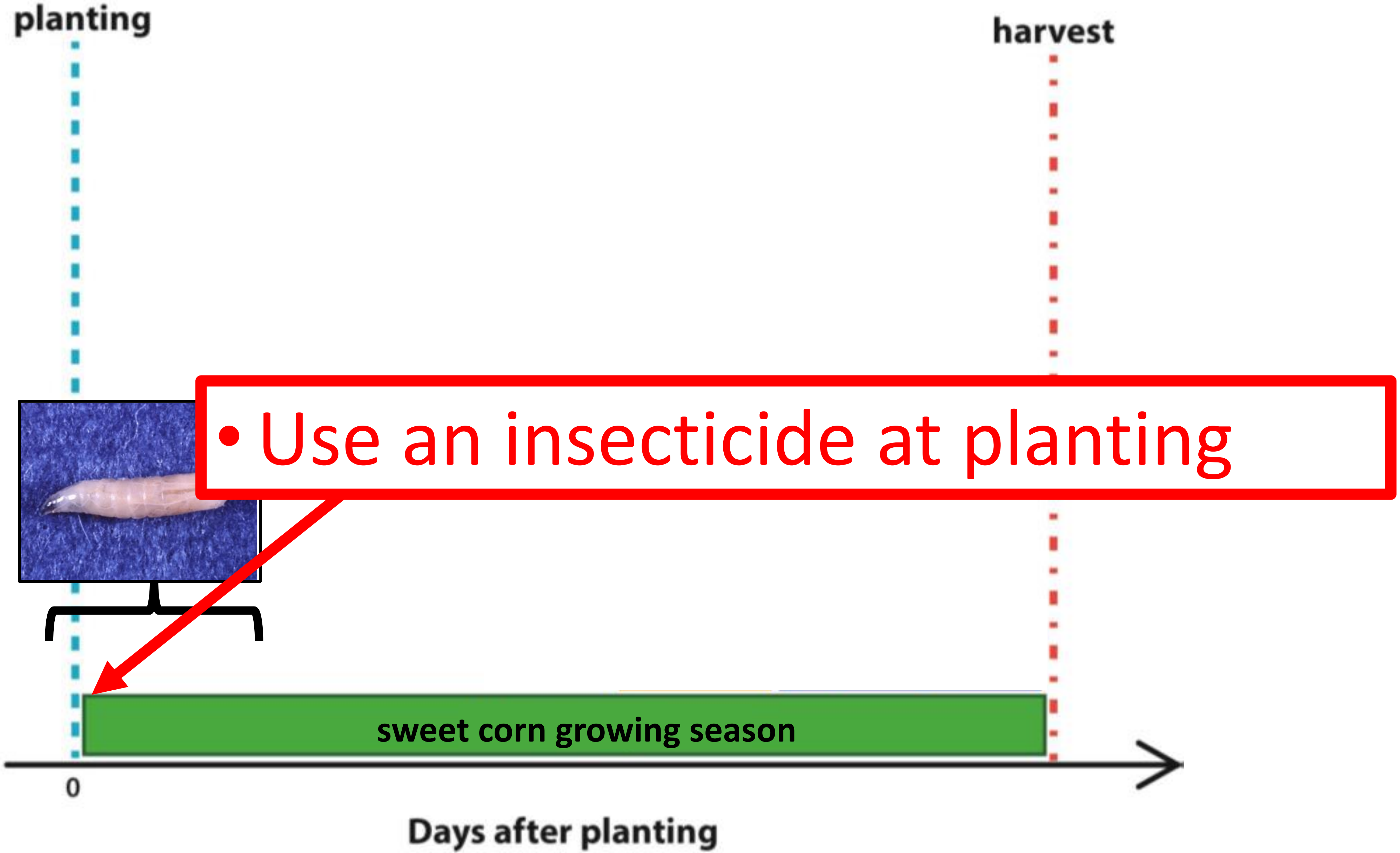
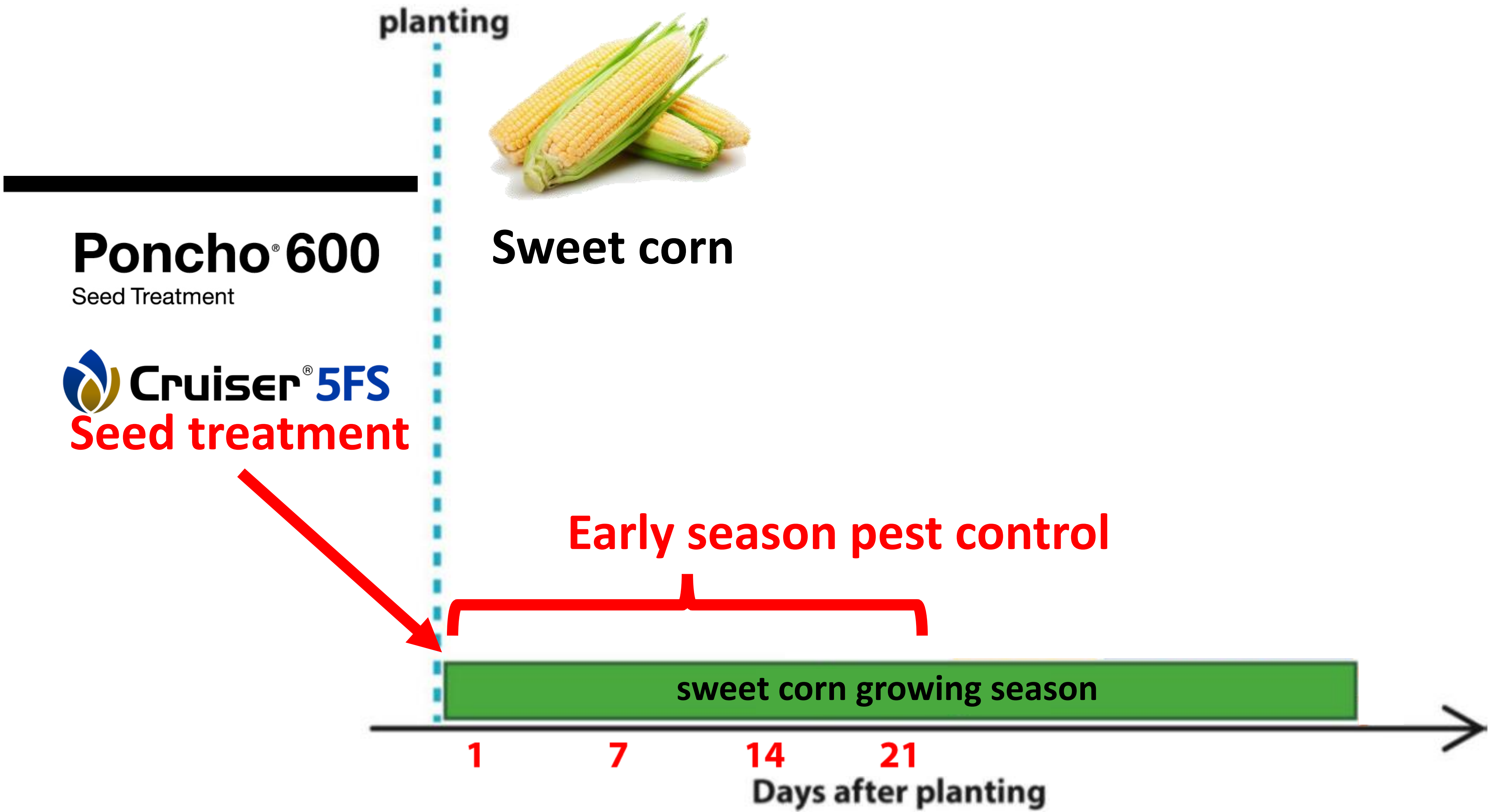
Management of SCM in sweet corn



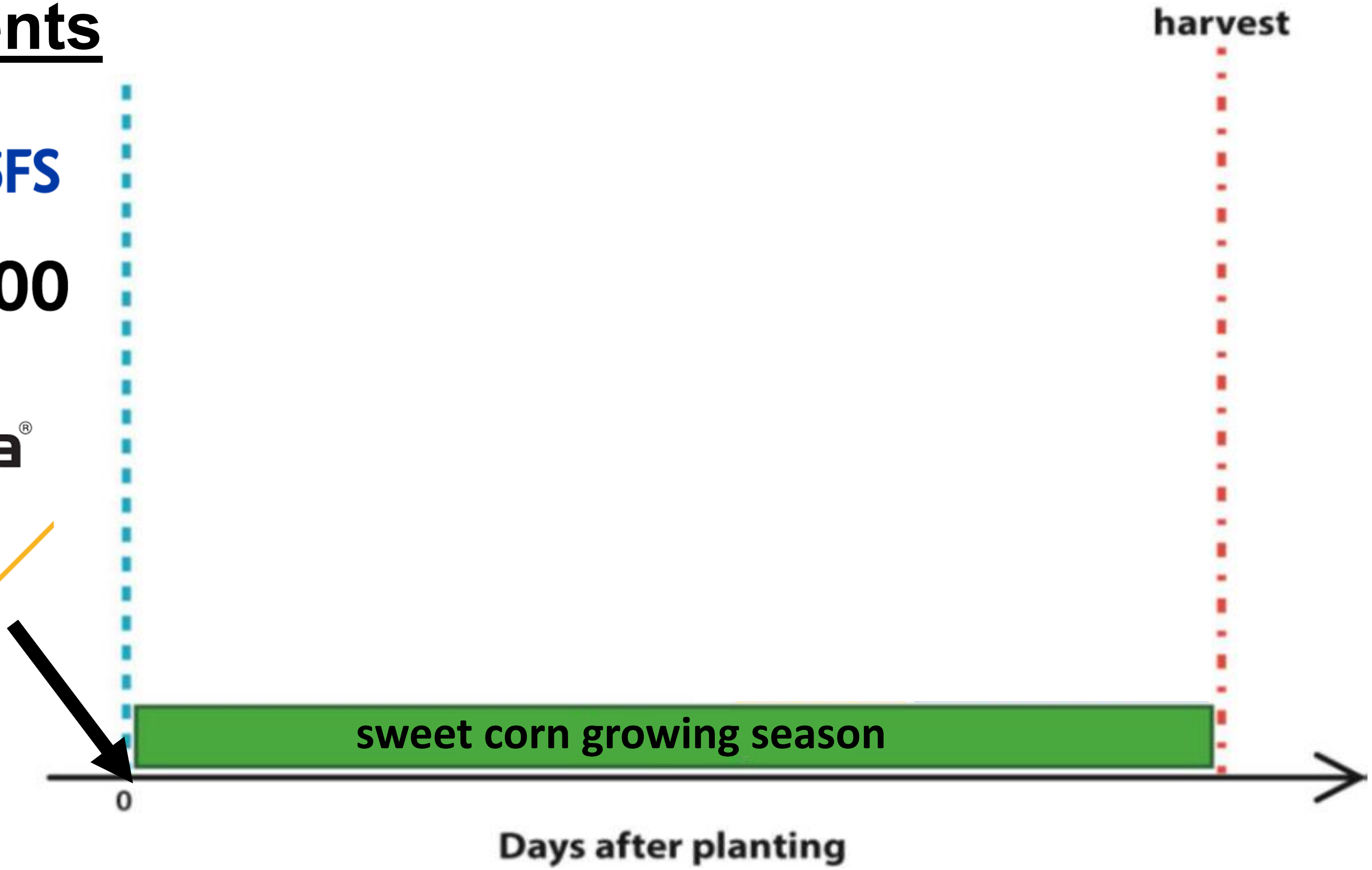
Neonicotinoid use in seeded vegetable crops



Insect pest control in sweet corn

Seed treatments

1. Cruiser® 5FS
2. Poncho® 600 Seed Treatment
3. Fortenza®
4. Lumivia® INSECTICIDE SEED TREATMENT



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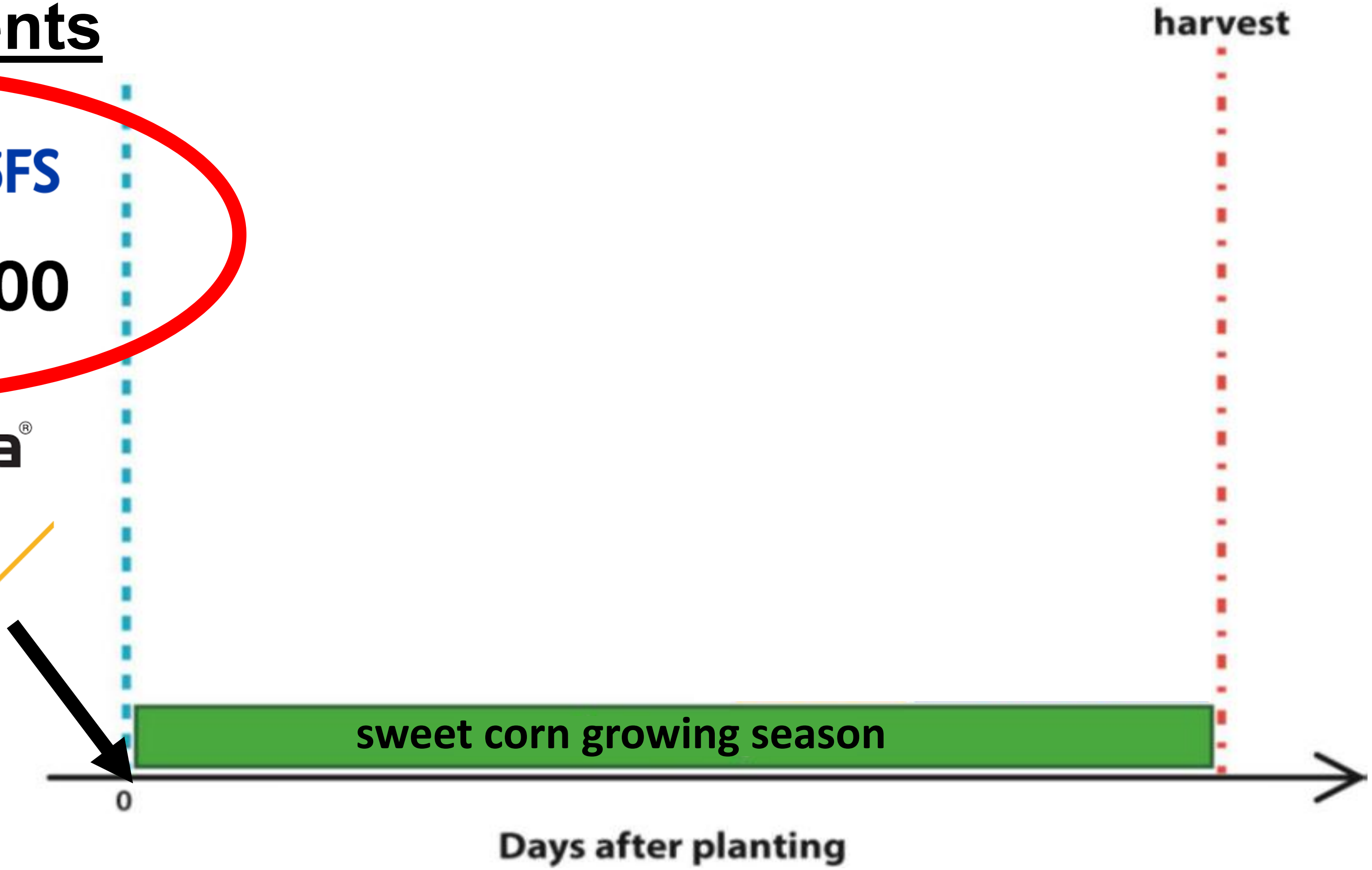

Insecticide seed treatments evaluated for SCM control in sweet corn in 2022-2023

Treatments	Active ingredient	Rate	IRAC Class

[a] All seeds were treated with the following fungicides: Vibrance Cinco (azoxystrobin, mefenoxam, fludioxonil, sedaxane, thiabendazole) at a rate of 30.5 g ai/100kg seed and Vayantis (picarbutrazox) at rate of 2.5 g ai/100 kg seed.

[b] Not labeled on sweet corn

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Lumiverd[b]	spinosad	0.2 mg a.i./seed	5

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Lumiverd[b]	spinosad	0.2 mg a.i./seed	5
PLINAZOLIN technology[b]	isocycloseram	0.25 & 0.5 mg a.i./ seed	30

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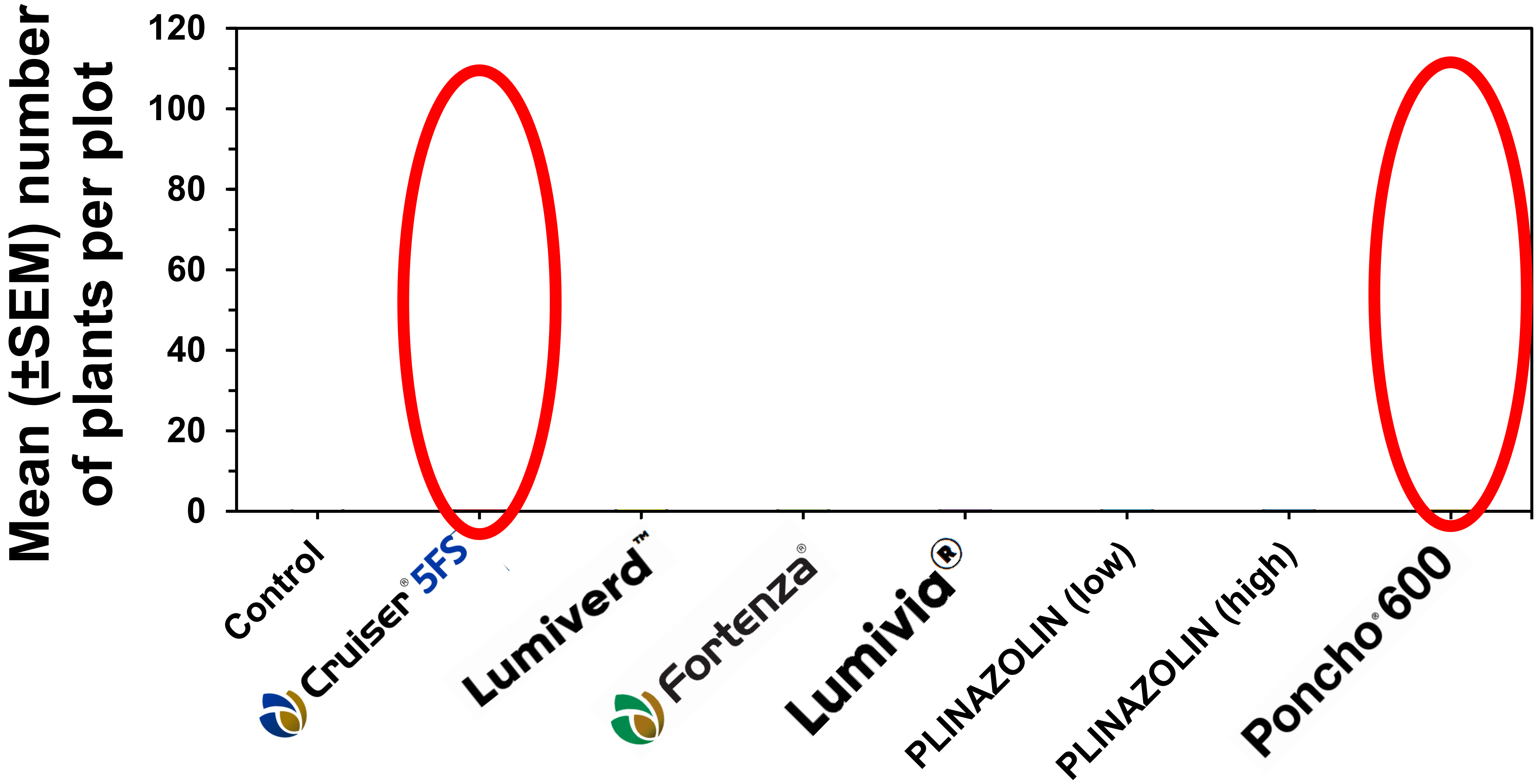
[b] **Not labeled on sweet corn**

Approach

Photo: B. Nault

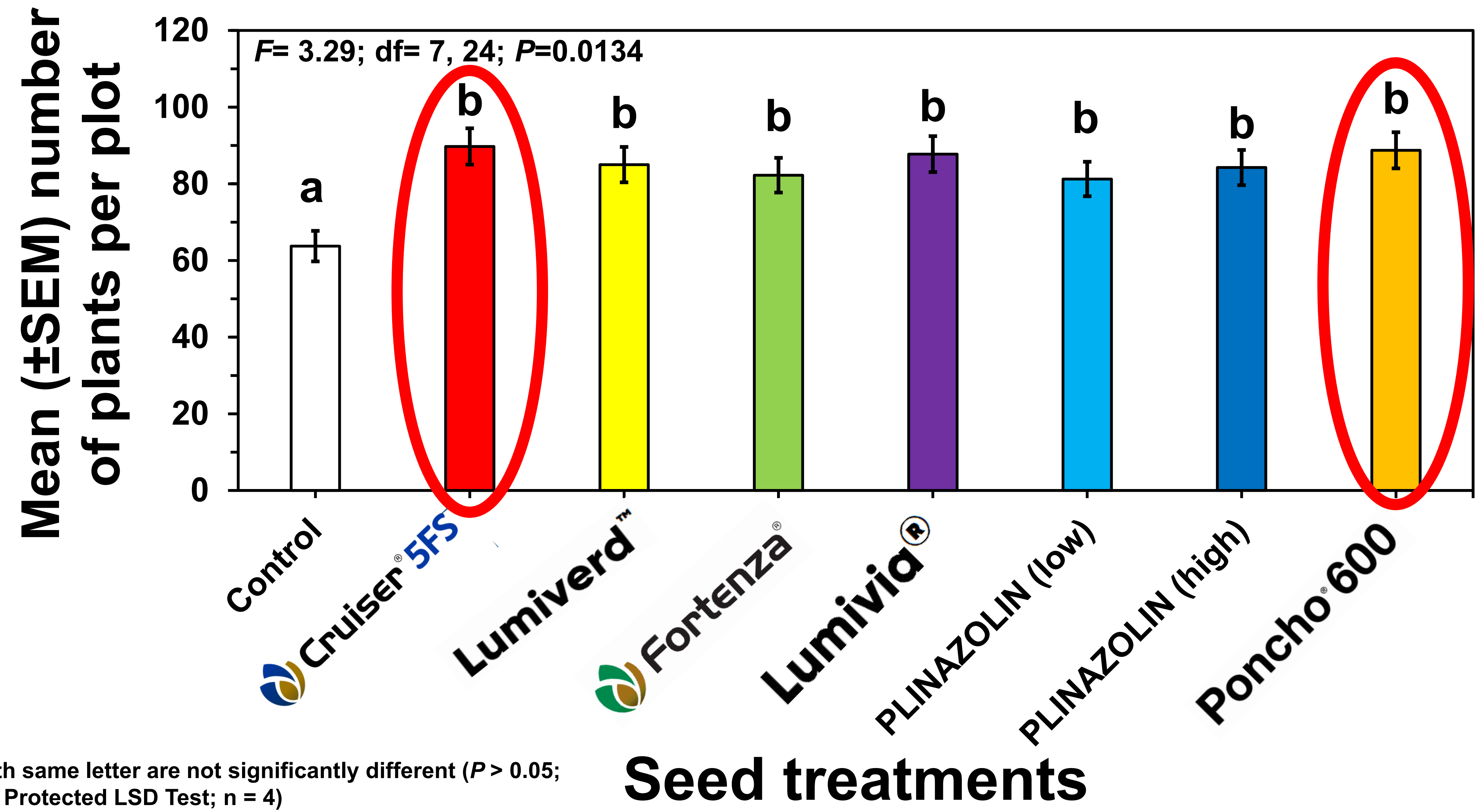
- Conducted in DE, NY, WA & WI in 2022 and 2023
- No soil amendments in WA
- Plant stand counts were made 16 d after planting (WA)

Efficacy of insecticide seed treatments for SCM control in sweet corn in WA in 2022



Means with same letter are not significantly different (*P* > 0.05; Fisher's Protected LSD Test; n = 4)

Efficacy of insecticide seed treatments for SCM control in sweet corn in WA in 2022



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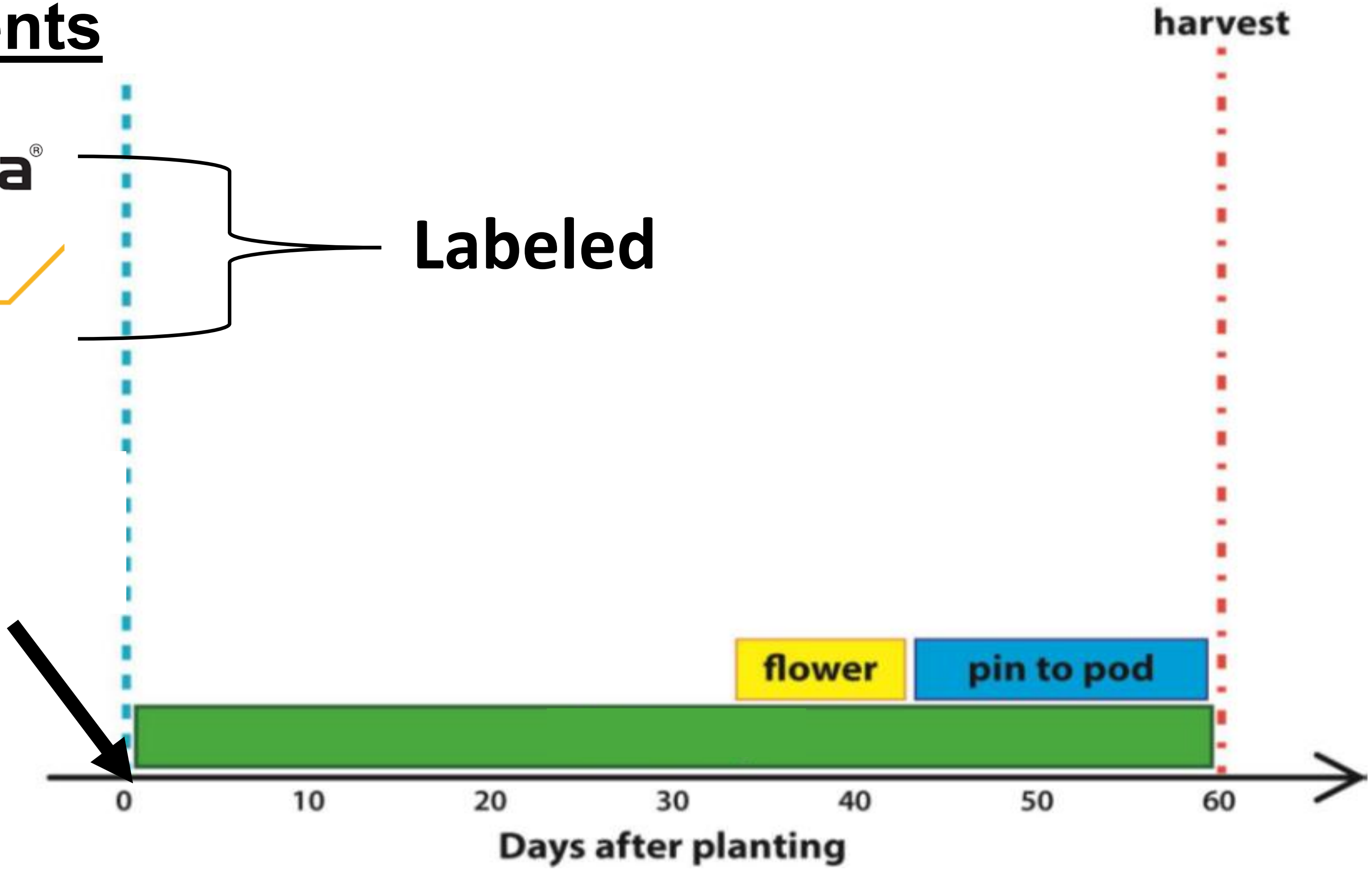
Alternatives to Cruiser® 5FS for SCM control in sweet corn

Seed treatments

1 Fortenza®

2 Lumivia® INSECTICIDE SEED TREATMENT

Labeled



Alternatives to Cruiser® 5FS for SCM control in sweet corn

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1 Fortenza®

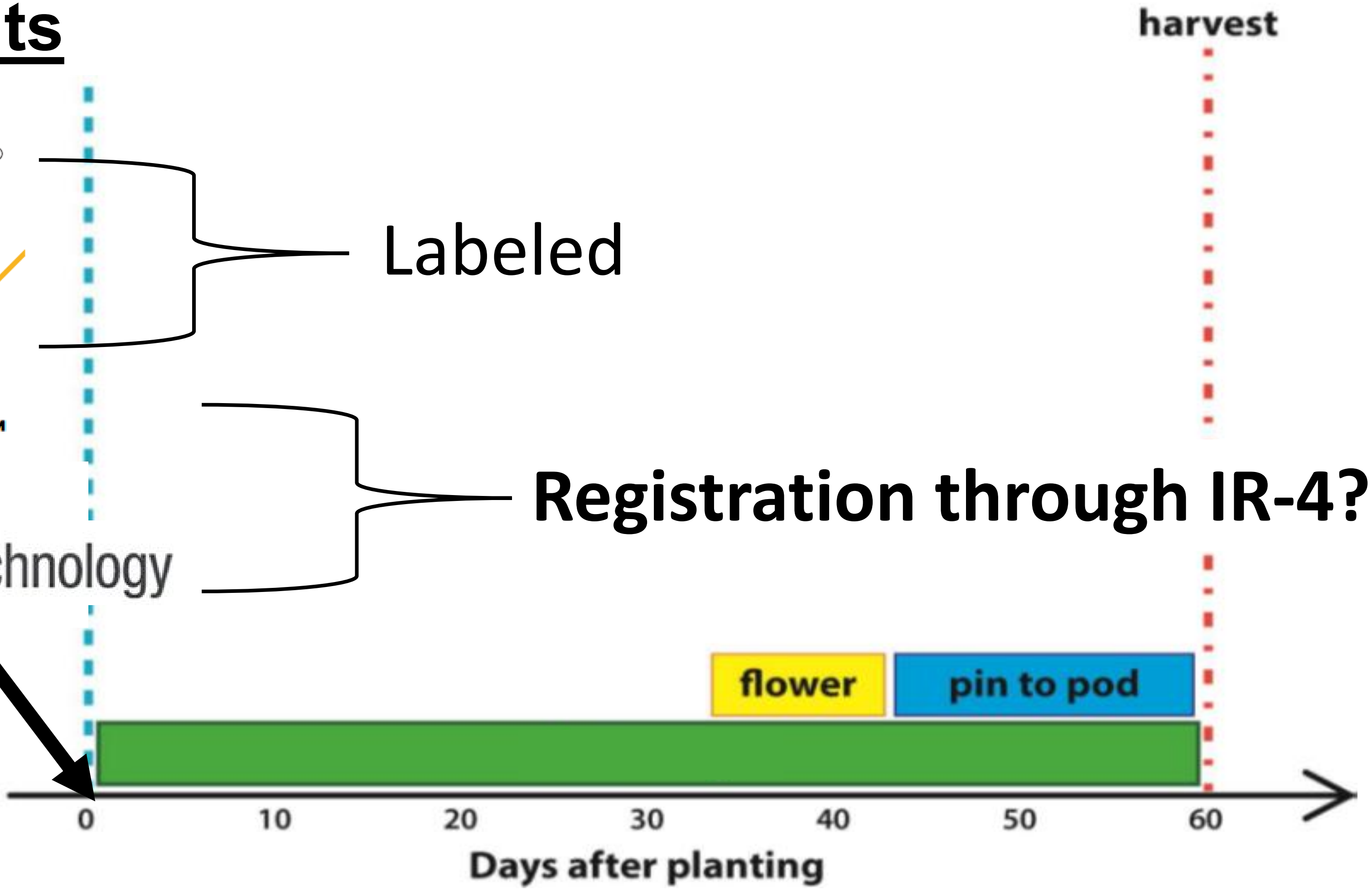
2 Lumivia® INSECTICIDE SEED TREATMENT

Labeled

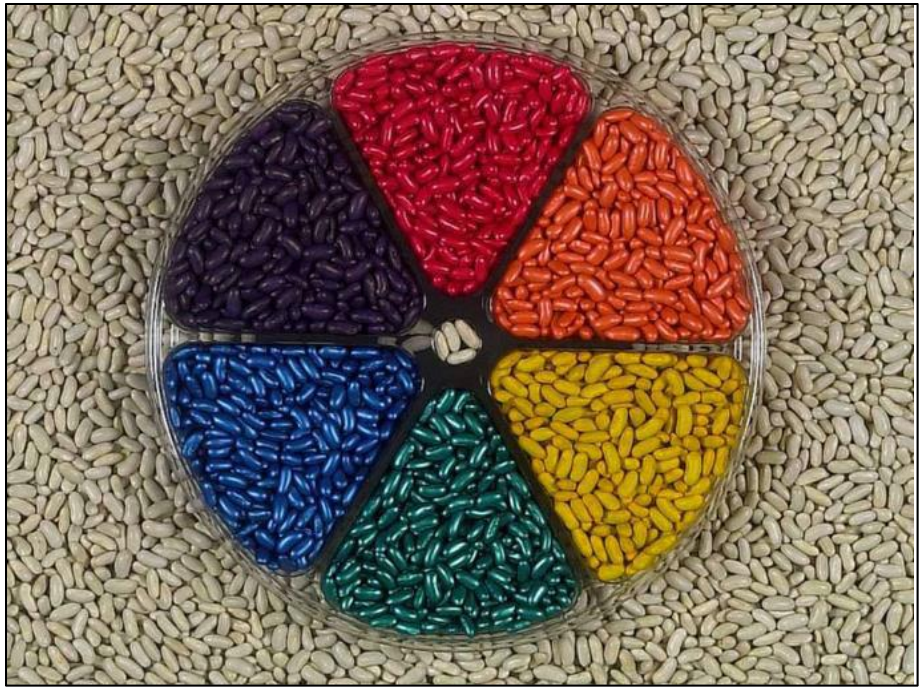
3 Lumiverd™

4 PLINAZOLIN® technology

Registration through IR-4?



Questions?



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Case Studies

- Insect pest control in sweet corn

- **Insect pest control in beans**

- Insect pest control in onions

Bean Production in the Northeast

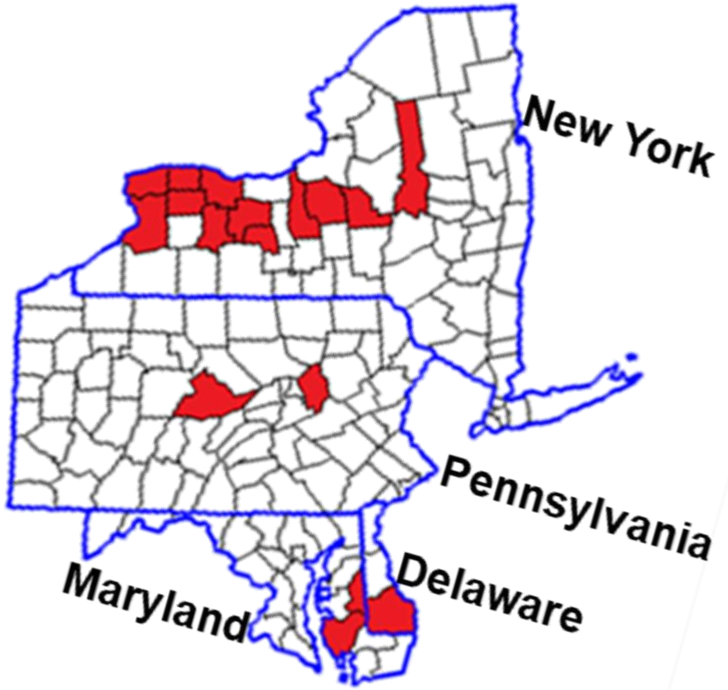
- In 2024, the Northeast produced over 21,500 acres of beans (USDA NASS)

Picture credit: Pavlovic et al. 2024

Bean Production in the Northeast

- In 2024, the Northeast produced over 21,500 acres of beans (USDA NASS)

- The majority is produced in New York and Pennsylvania

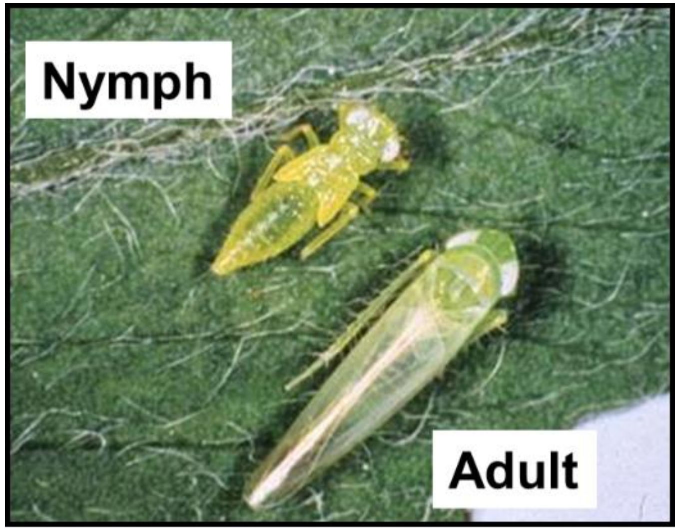


Picture credit: Pavlovic et al. 2024


Photo: Francesco Di Gioia, Penn State

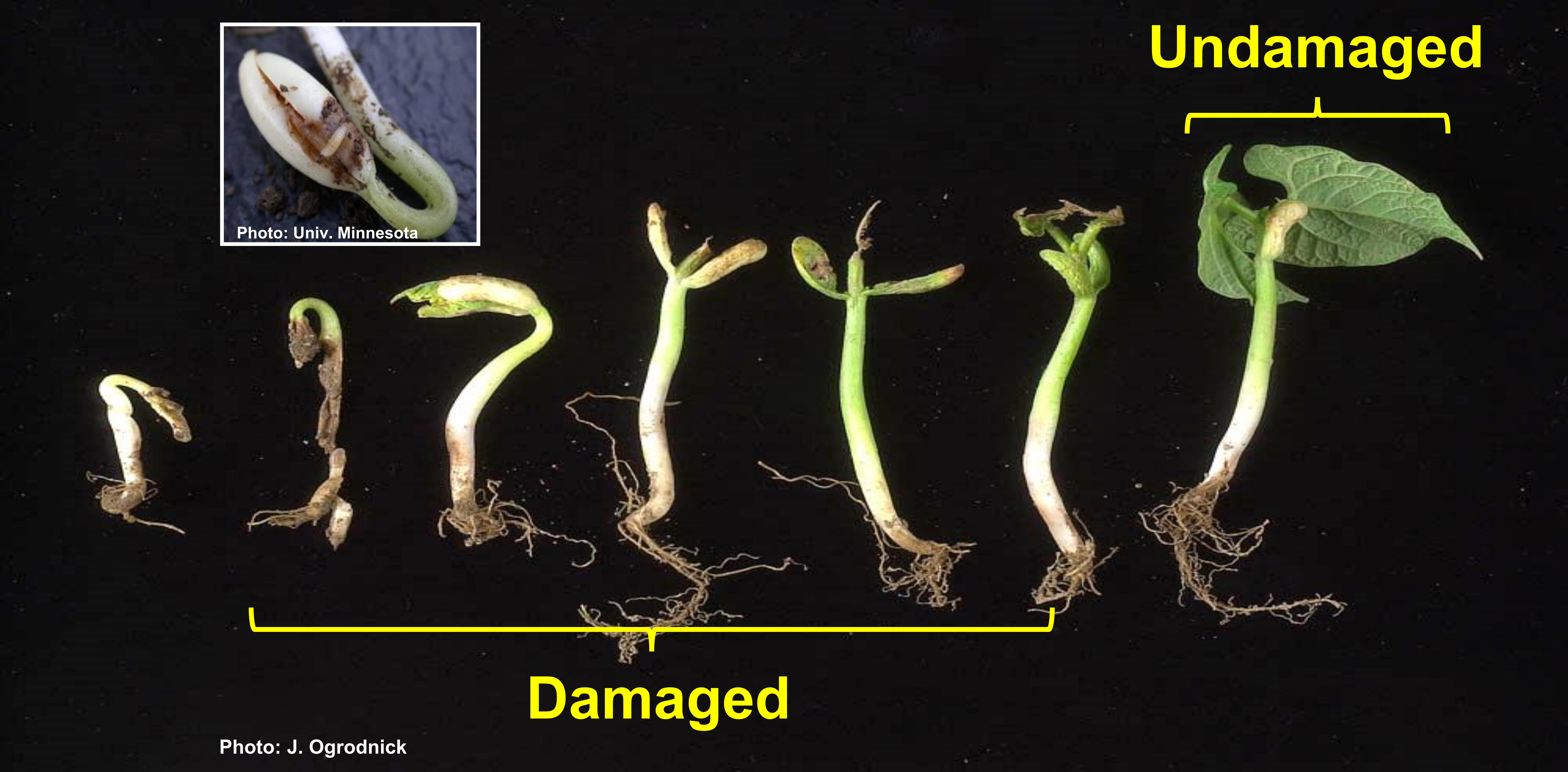
Major bean insect pests

Seedcorn Maggot (SCM)
(*Delia platura*)

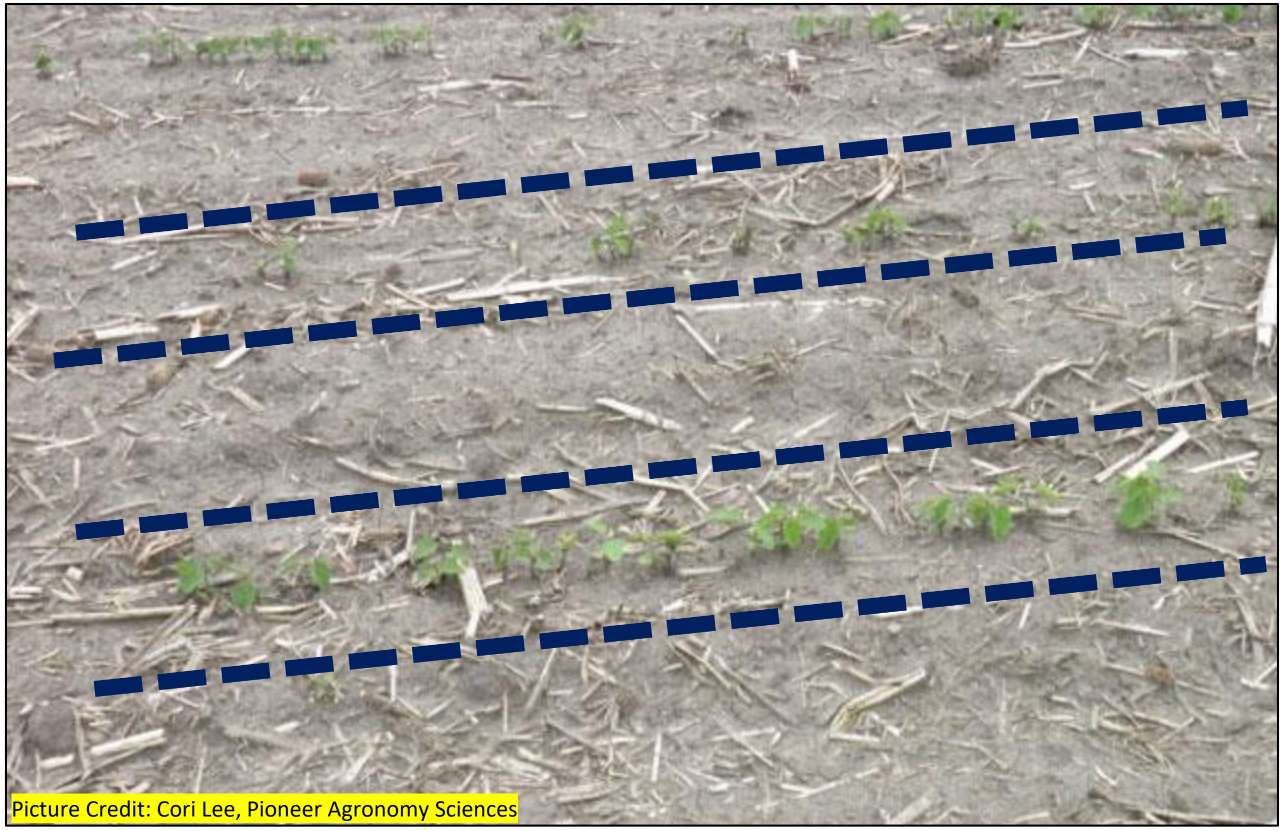


Potato Leafhopper (PLH)
(*Empoasca fabae*)

Damage to beans



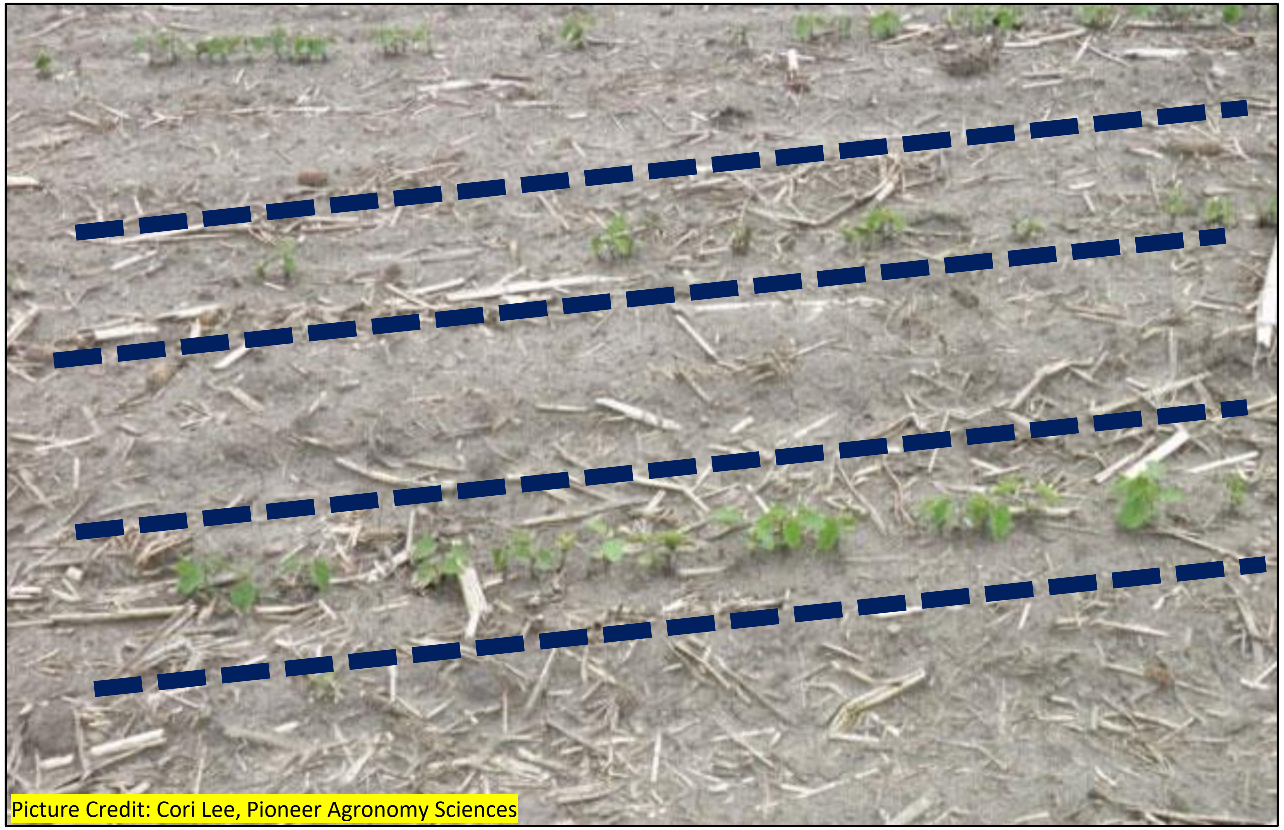
SCM damage in vegetable crops



Stand losses

[3] Miles(1948) – Bulletin of Entomological Research, 38(4), 559-574. [4] Yu et al. Env. Ent. (1975): 545-548.

SCM damage in beans



Stand losses

Delay in plant maturity

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Management of SCM in beans

Integrated pest management

Plant Resistance

- None known

Chemical Control

- Insecticide at planting (<u>no rescue treatments available</u>)

Cultural Control

- Avoid fields recently treated with manure or has decaying organic matter
- Avoid planting into cold, wet soils
- Avoid planting during peak activity

Biological Control

- Some predators and entomopathogens

Neonicotinoid use in seeded vegetable crops

Dry beans

Snap beans

Cruiser® 5FS
Seed treatment

Insecticide seed treatments evaluated for SCM control in snap bean and dry bean in 2022-2024

Treatments	Active ingredient	Rate	IRAC Class
Cruiser 5FS	thiamethoxam	0.5 mg a.i./ seed	4A

[a] All seed was treated with the following fungicides Apron XL (mefenoxam) at a rate of 3.75 g a.i./ 100kg of seed, Vibrance (sedaxane) at a rate of 5 g a.i./ 100kg of seed, and Maxim 4FS (fludioxonil) at a rate of 2.5 g a.i./ 100kg of seed.

[b] Not labeled on snap bean

[c] Labeled on dry bean

Insecticide seed treatments evaluated for SCM control in snap bean and dry bean in 2022-2024

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Fortenza 5FS[b]	cyantraniliprole	0.5 mg a.i./ seed	28
Lumivia[b, c]	chlorantraniliprole	0.5 mg a.i./ seed	28

[a] All seed was treated with the following fungicides Apron XL (mefenoxam) at a rate of 3.75 g a.i./ 100kg of seed, Vibrance (sedaxane) at a rate of 5 g a.i./ 100kg of seed, and Maxim 4FS (fludioxonil) at a rate of 2.5 g a.i./ 100kg of seed.

[b] Not labeled on snap bean

[c] Labeled on dry bean

Insecticide seed treatments evaluated for SCM control in snap bean and dry bean in 2022-2024

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Lumiverd[b] products available OMRI LISTED	spinosad	0.05 mg a.i./seed	5
PLINAZOLIN technology[b]	isocycloseram	0.25 & 0.5 mg a.i./ seed	30

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Approach

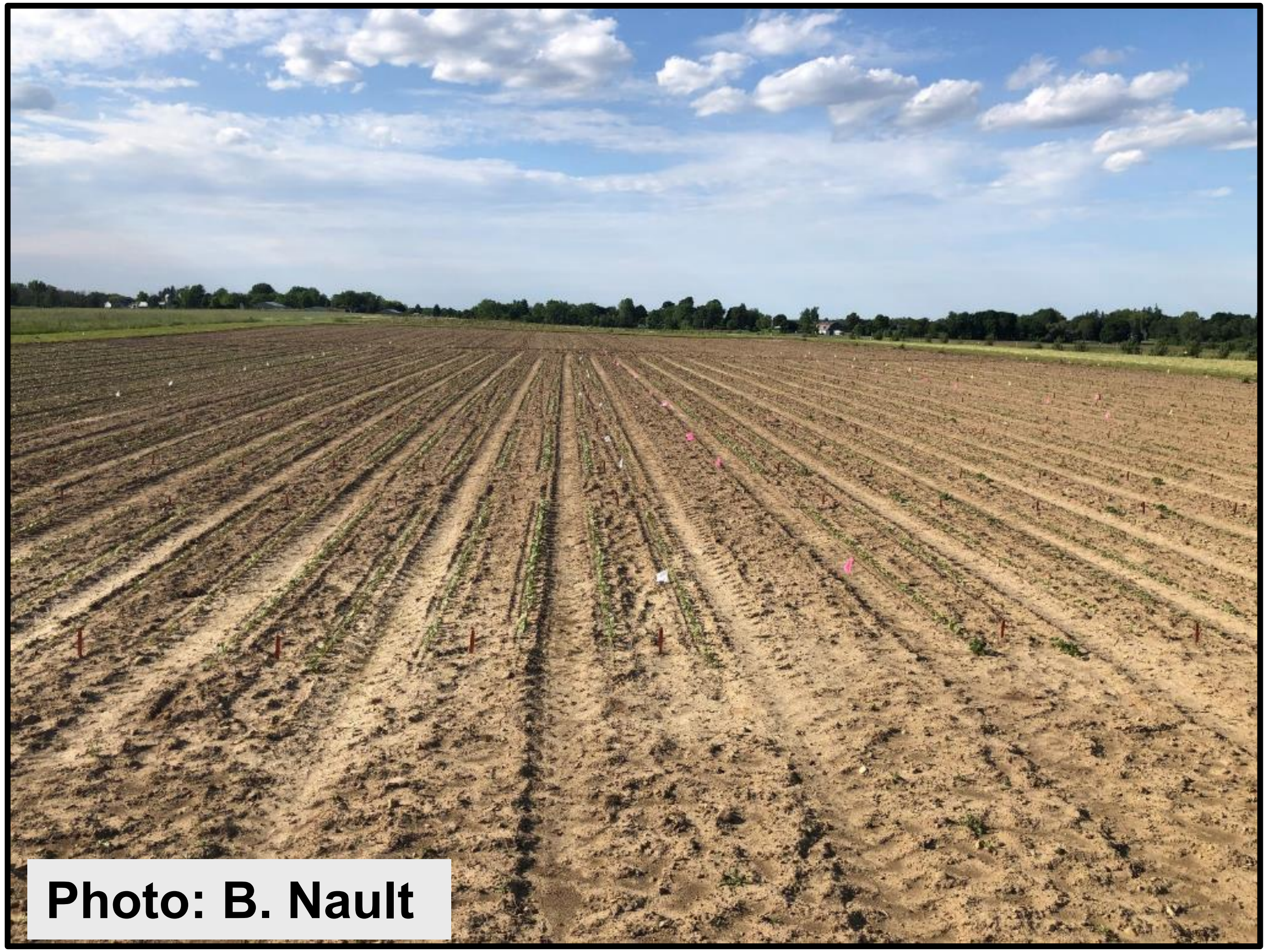
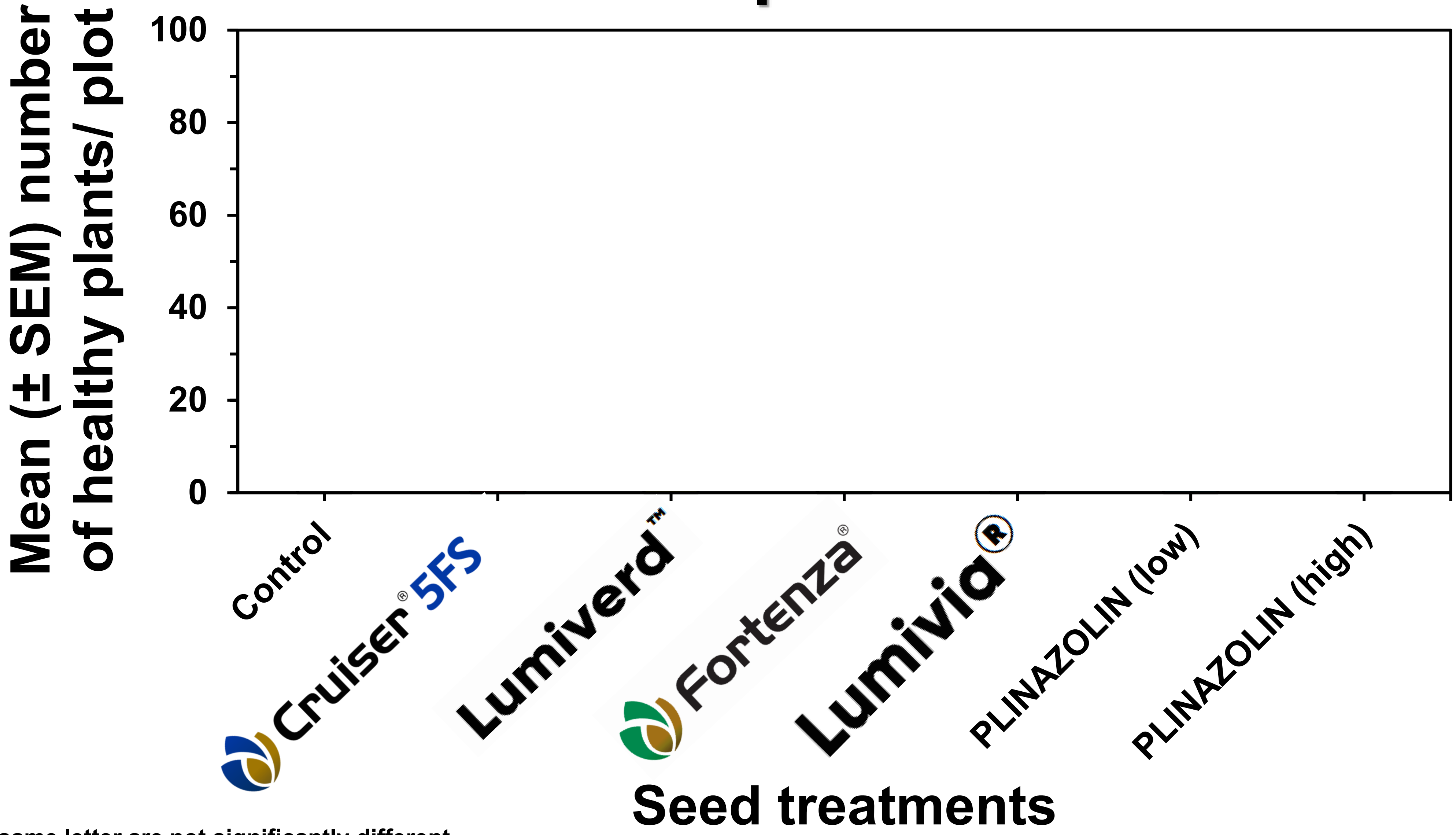


Photo: B. Nault

- Conducted in DE, NY, WA and WI in 2022 through 2024
- Bone and meat meal applied on top of furrow after planting
- Plant stand counts made 17 d after planting

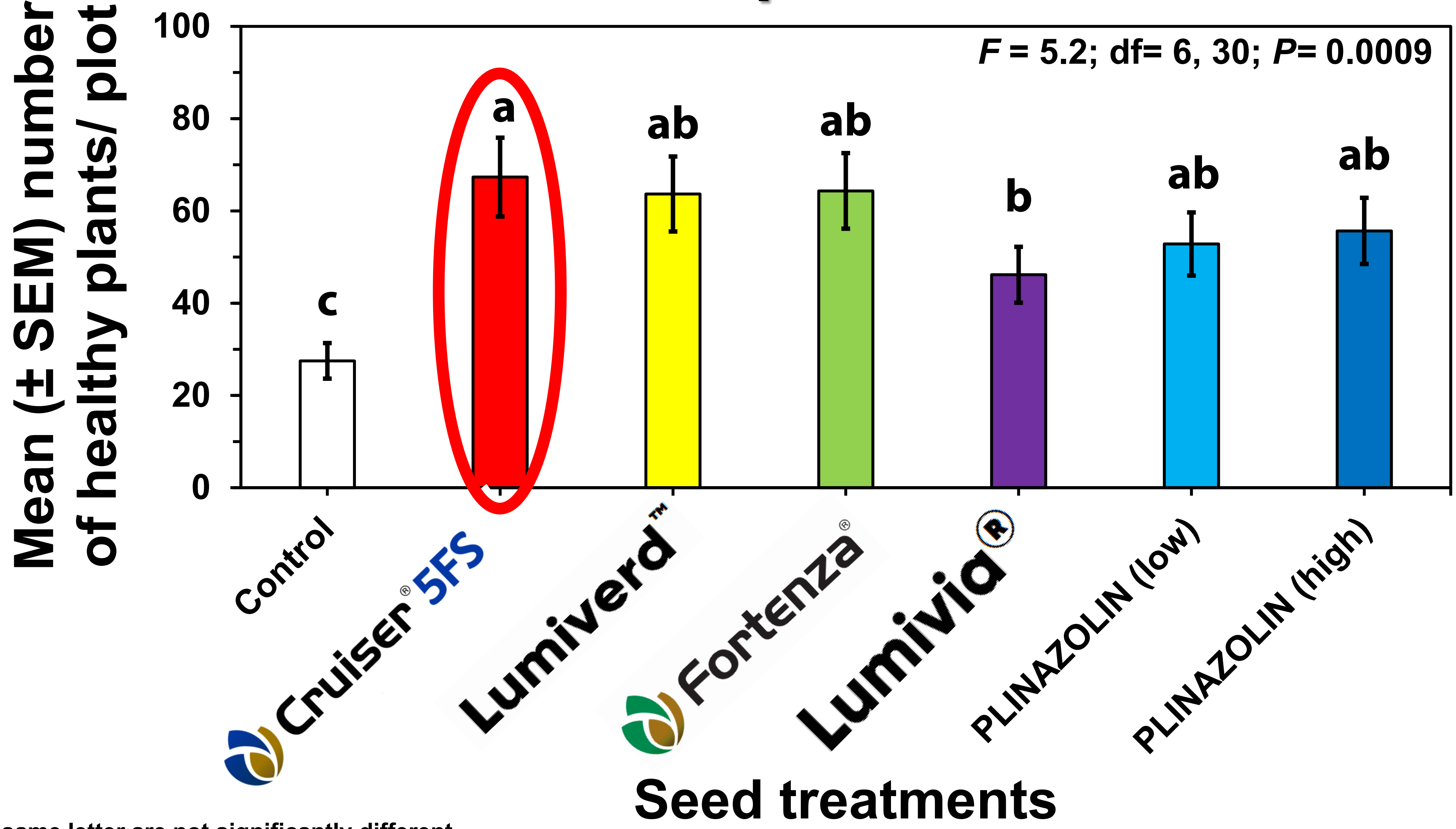
SCM damage

Efficacy of insecticide seed treatments for SCM control in snap bean in NY in 2024



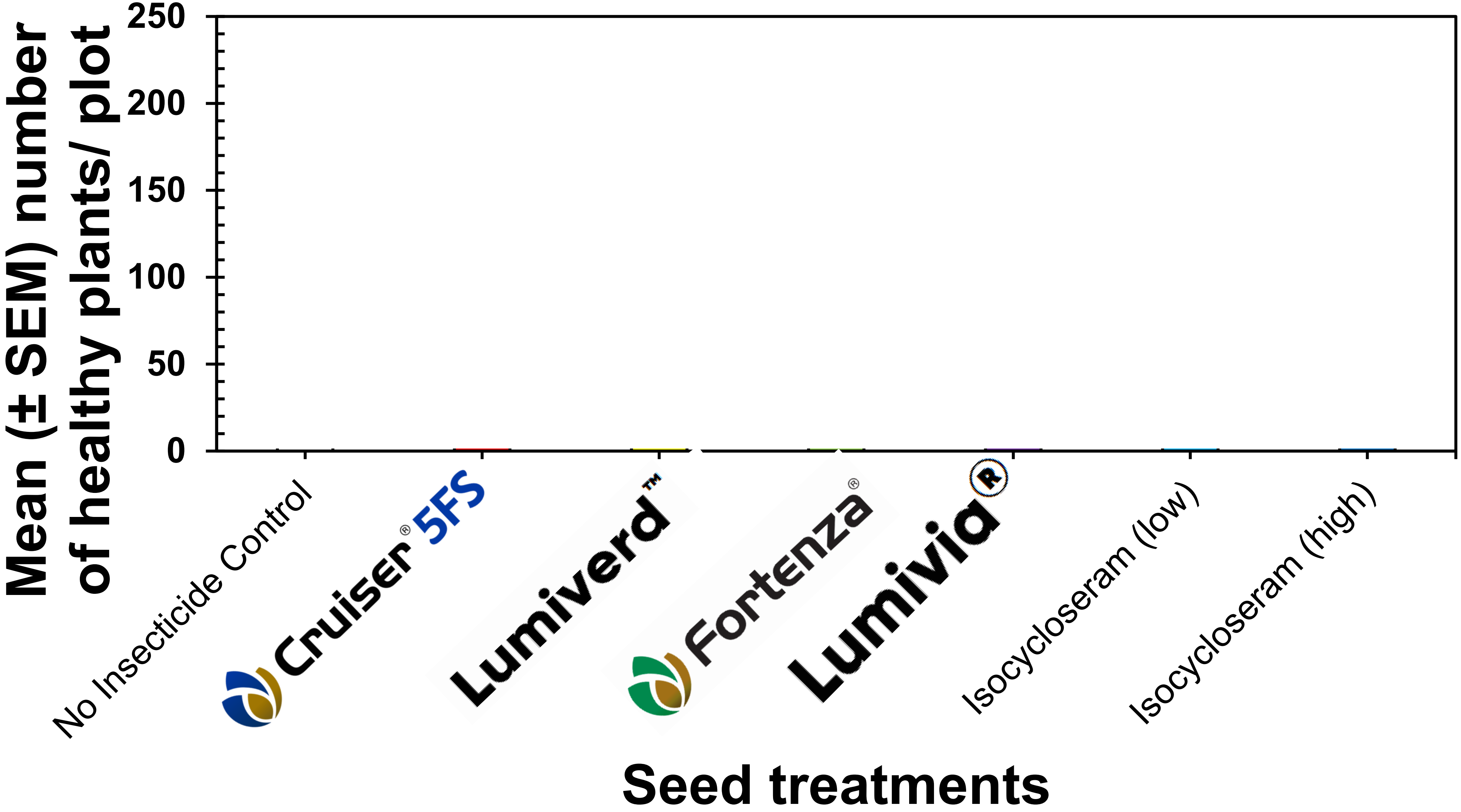
Means with same letter are not significantly different (*P* > 0.05; Fisher's Protected LSD Test; n = 6)

Efficacy of insecticide seed treatments for SCM control in snap bean in NY in 2024



Means with same letter are not significantly different ($P > 0.05$; Fisher's Protected LSD Test; n = 6)

Efficacy of insecticide seed treatments for SCM control in dry bean in NY in 2022



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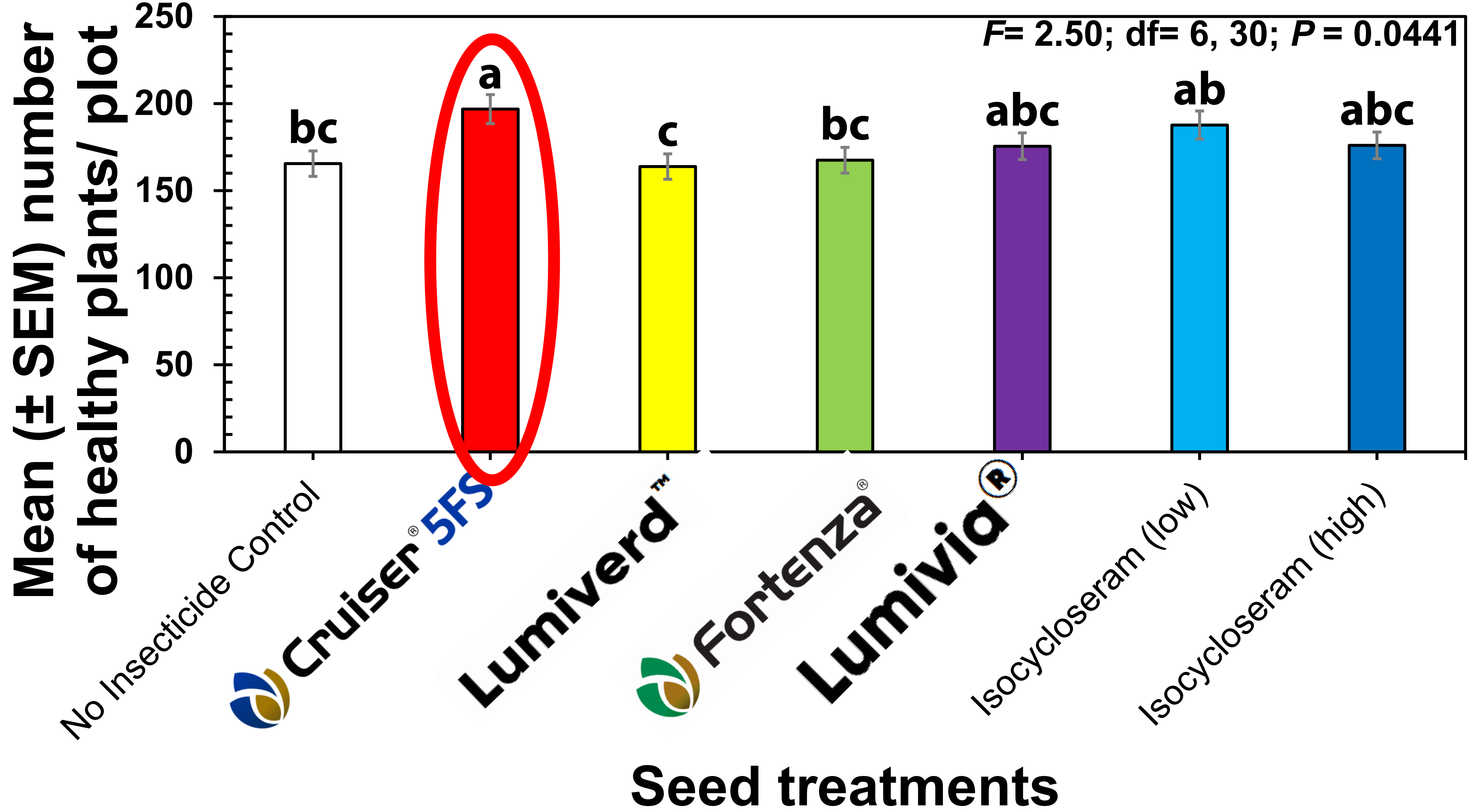
Efficacy of insecticide seed treatments for SCM control in dry bean in NY in 2022



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Future alternatives to Cruiser® 5FS for SCM control in beans

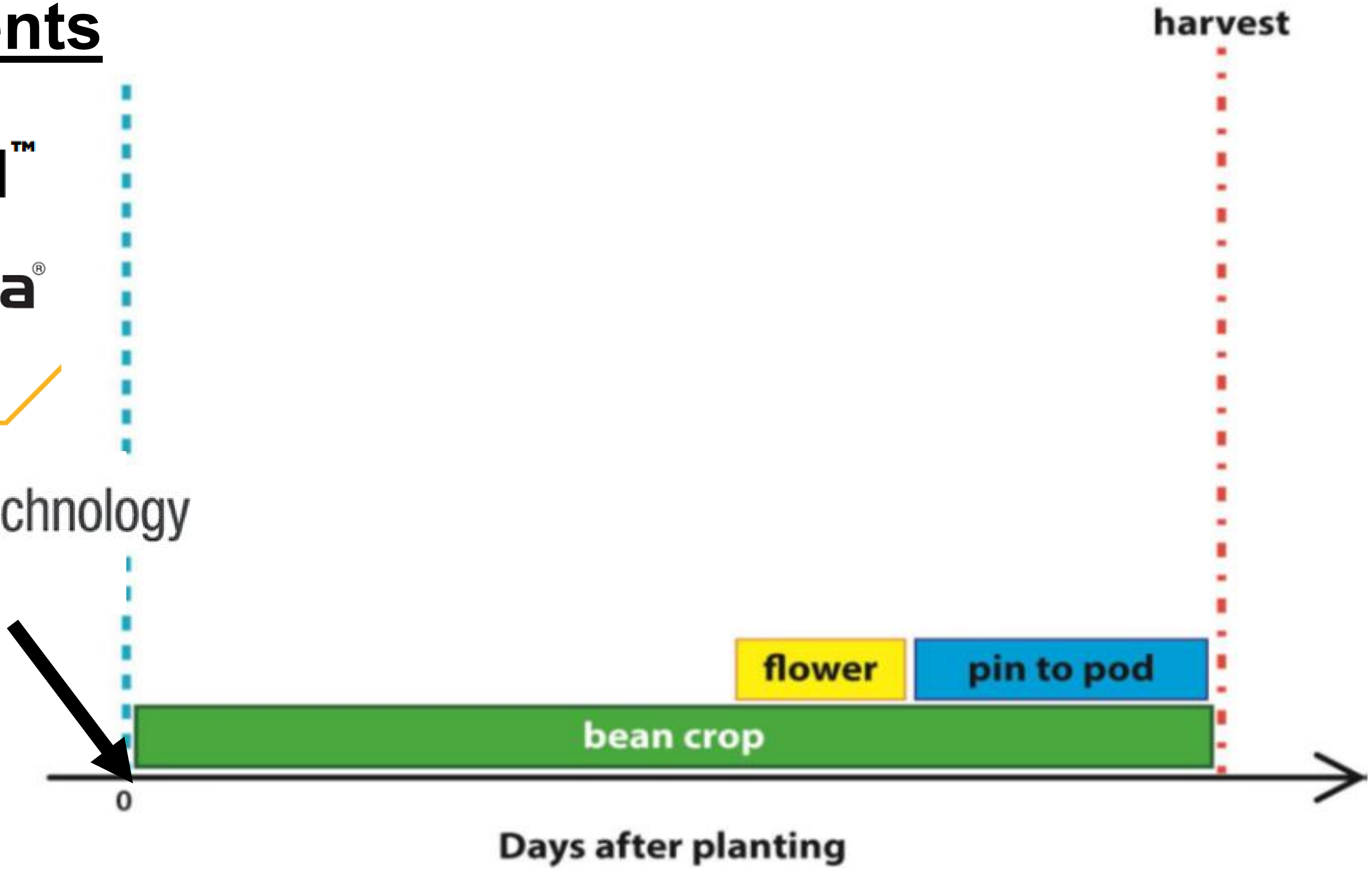
Seed treatments

1 Lumiverd™

2 Fortenza®

3 Lumivia® INSECTICIDE SEED TREATMENT

4 PLINAZOLIN® technology




Future alternatives to Cruiser® 5FS for SCM control in beans

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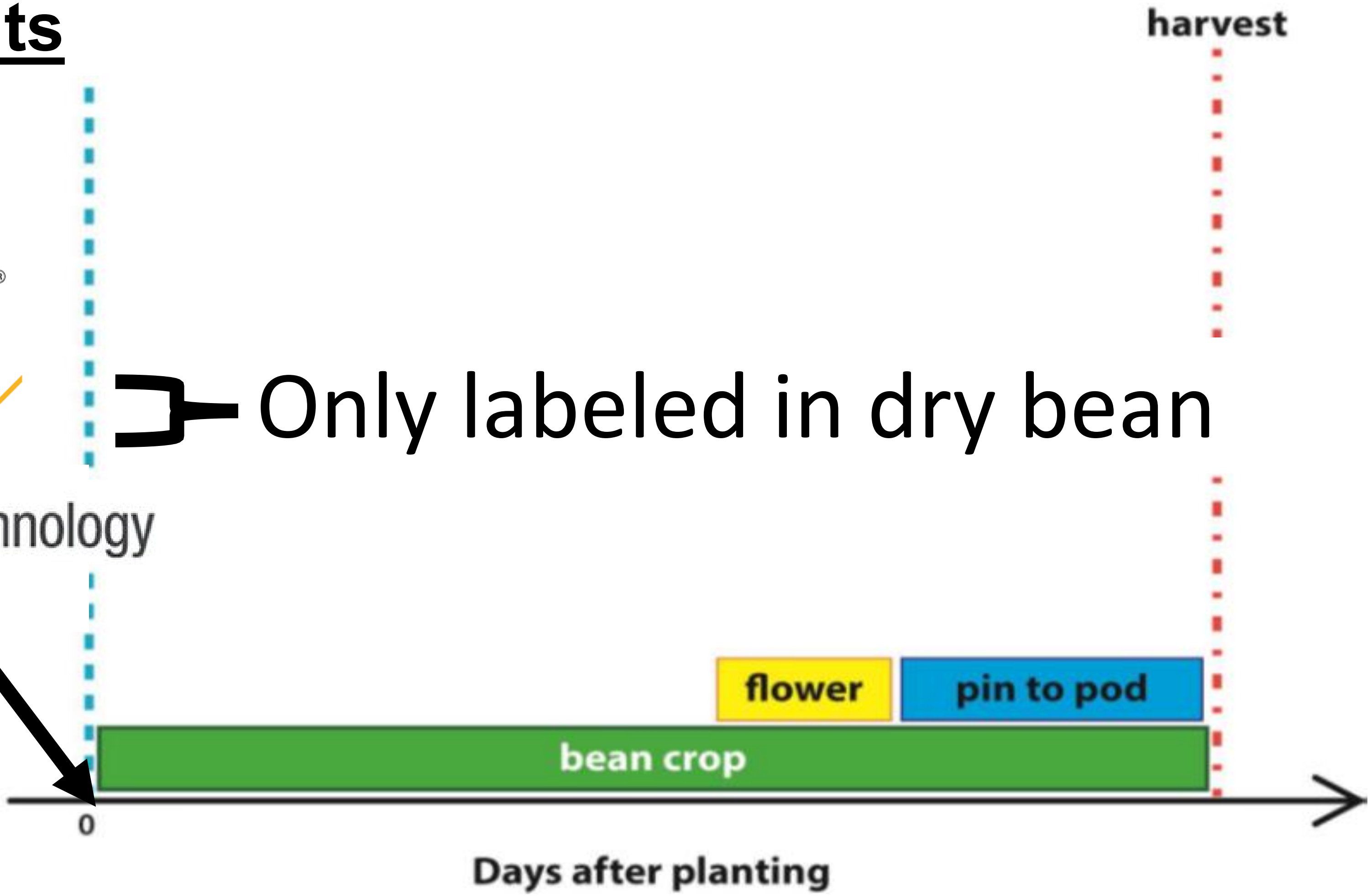
4 PLINAZOLIN® technology

Only labeled in dry bean




Future alternatives to Cruiser® 5FS for SCM control in beans

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2 Fortenza®
} Not labeled

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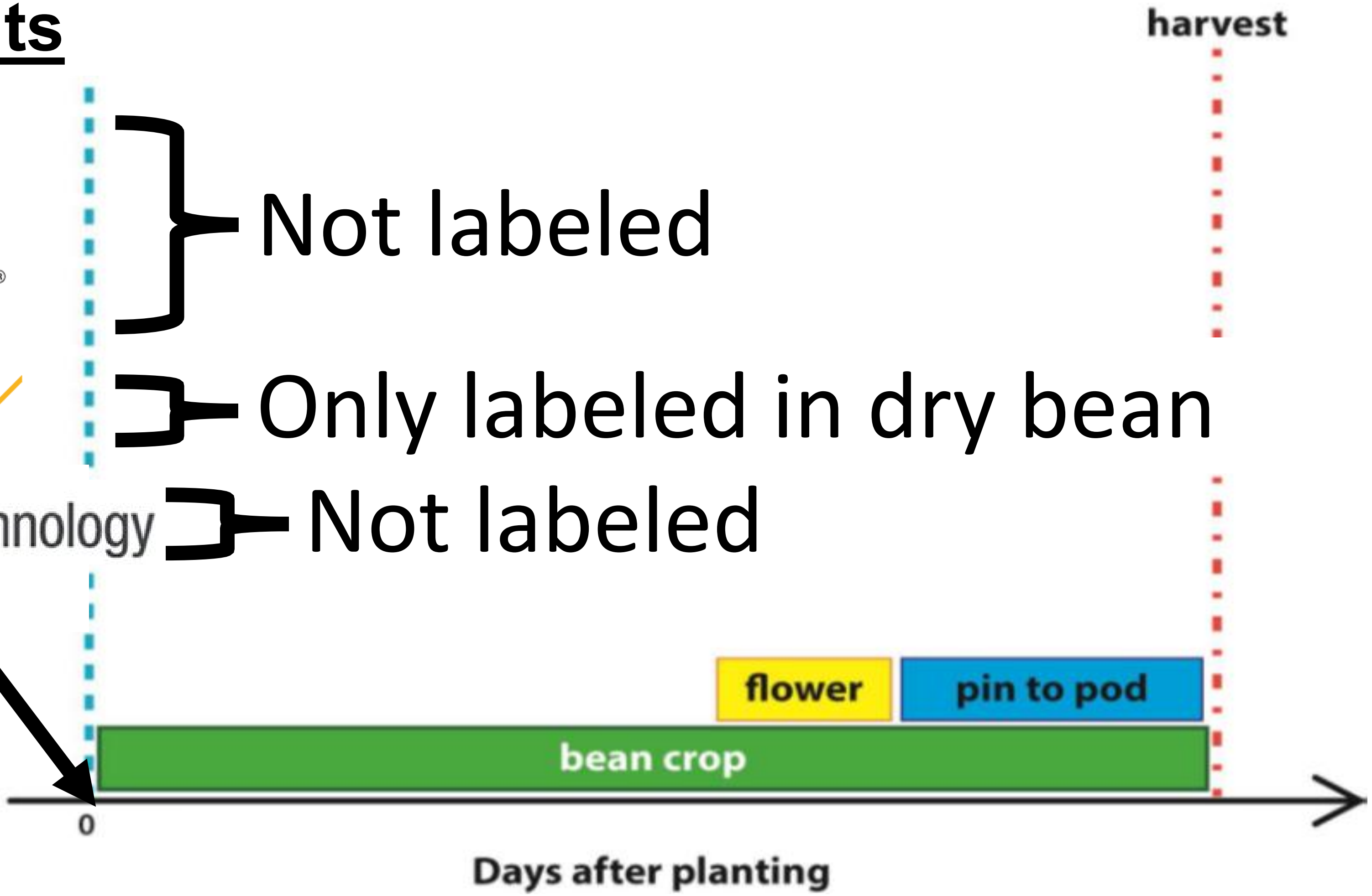
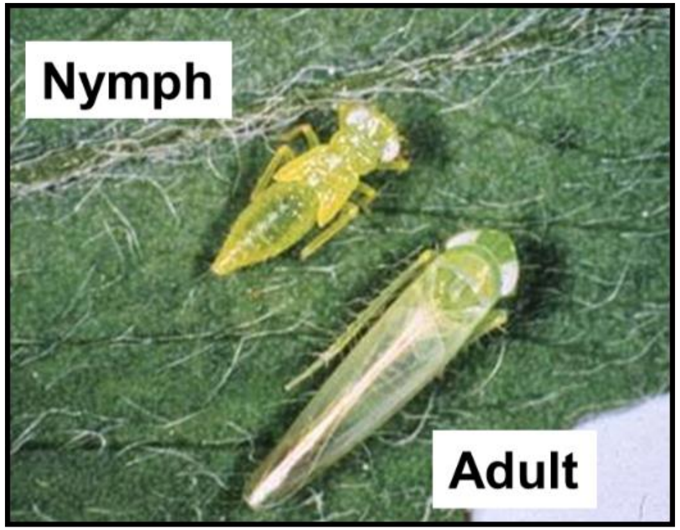


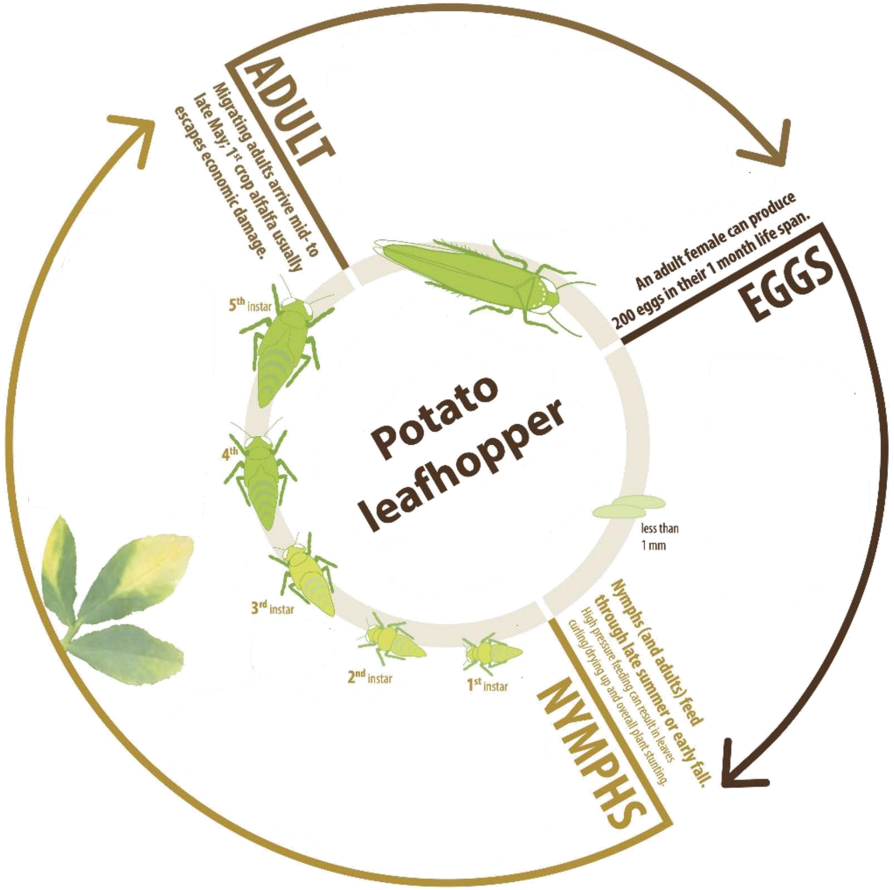
Major bean insect pests

Seedcorn Maggot (SCM)
(*Delia platura*)

Potato Leafhopper (PLH)
(*Empoasca fabae*)



Potato leafhopper (PLH) (*Empoasca fabae*)



1 to 2 generations per year

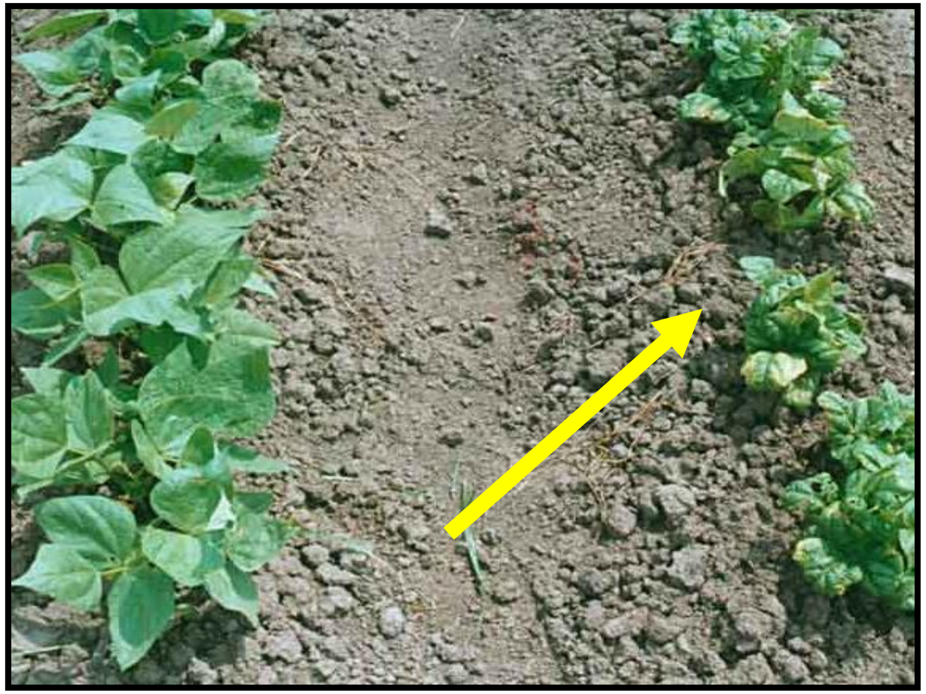
Do not overwinter in NY and migrates from the southern US

Causes damage by feeding in plants

Potato leafhopper (PLH)

Pictures credits: North Central IPM Center

Potato leafhopper damage to beans



Leaf curling, yellow and brown leaf margins (“hopperburn”) and stunting can cause lower bean yields

Management of PLH in beans

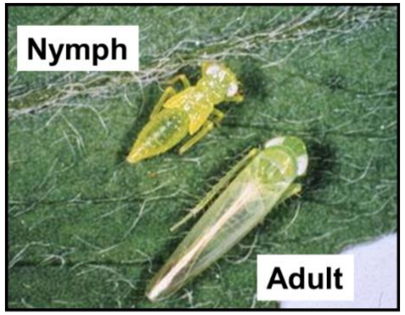
Integrated pest management

Plant Resistance

- None commercially used

Chemical Control

- Insecticide at planting and/or foliar sprays



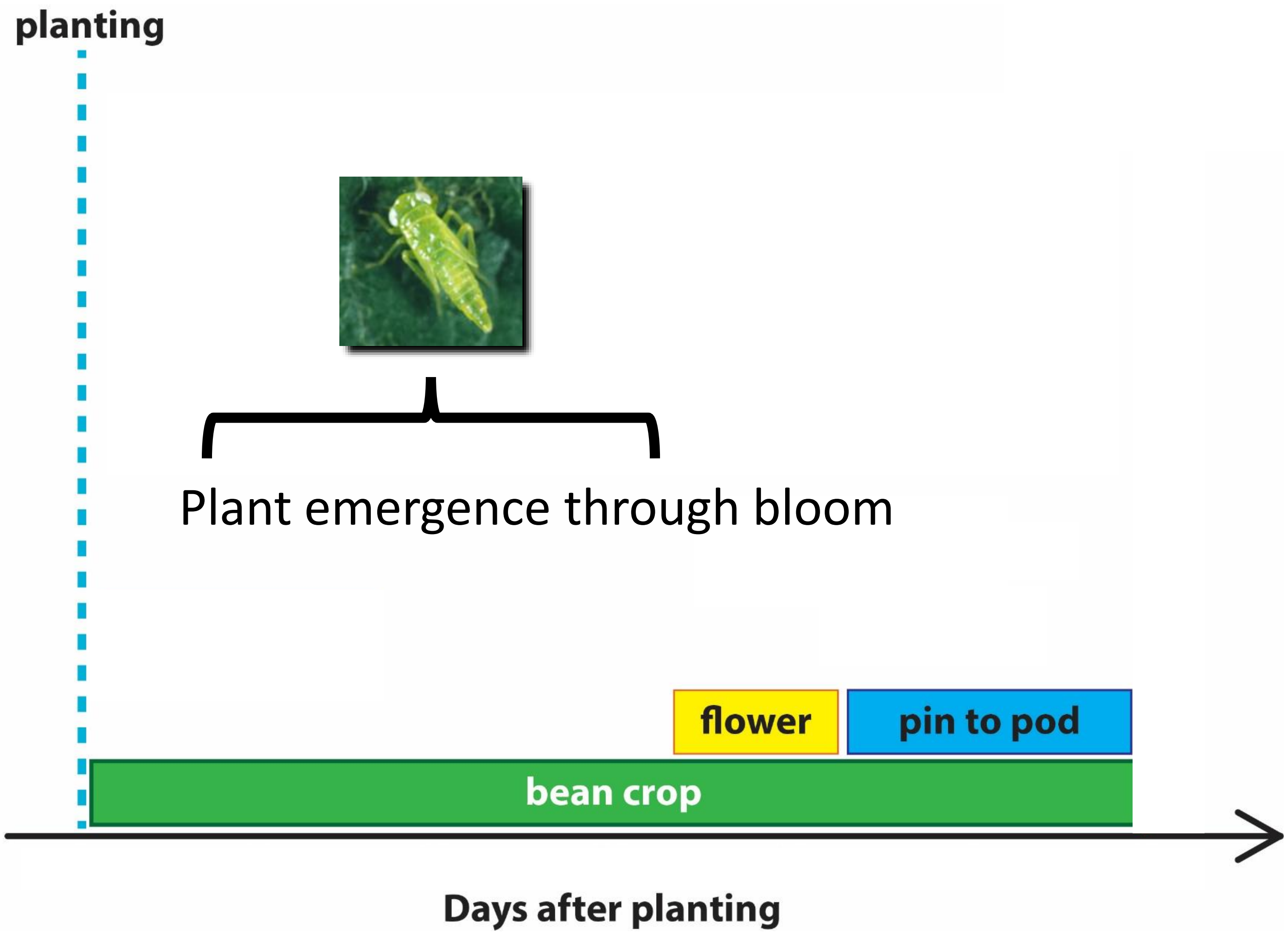
Cultural Control

- Avoid fields adjacent to alfalfa

Biological Control

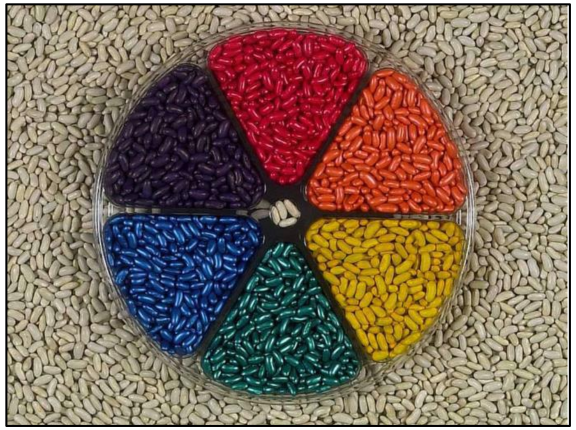
- None

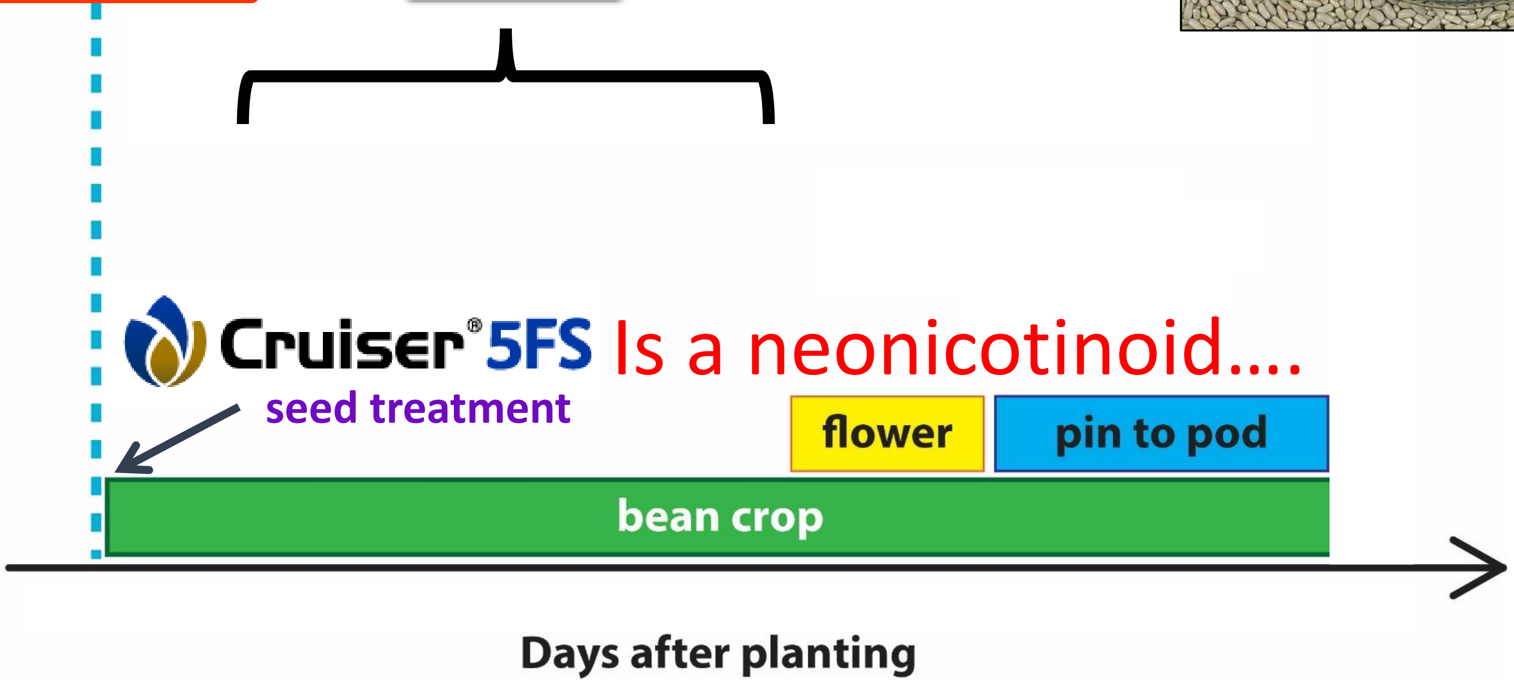
Risk period for PLH attacking beans



Management of PLH in conventional beans

- Use an insecticide seed treatment[1]

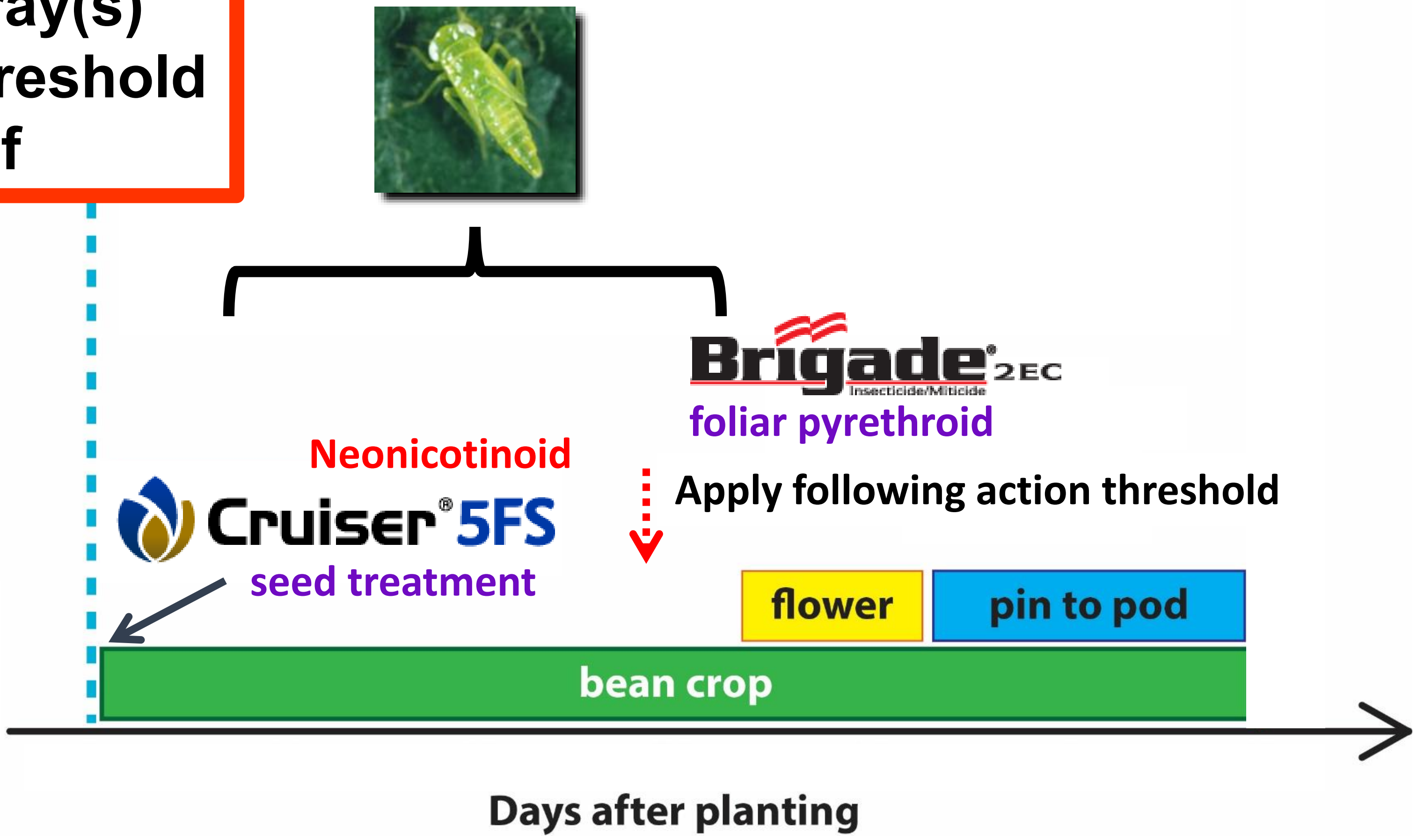




[1]Nault et al. 2004, Crop Protection 23 147–154

Management of PLH in conventional beans

- Use an insecticide seed treatment[1]
- Apply foliar spray(s) using action threshold of 1 nymph/ leaf



[1]Nault et al. 2004, Crop Protection 23 147–154

Insecticide seed treatments evaluated for PLH control in snap bean and dry bean in 2022-2024

Treatments	Active ingredient	Rate	IRAC Class
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Approach

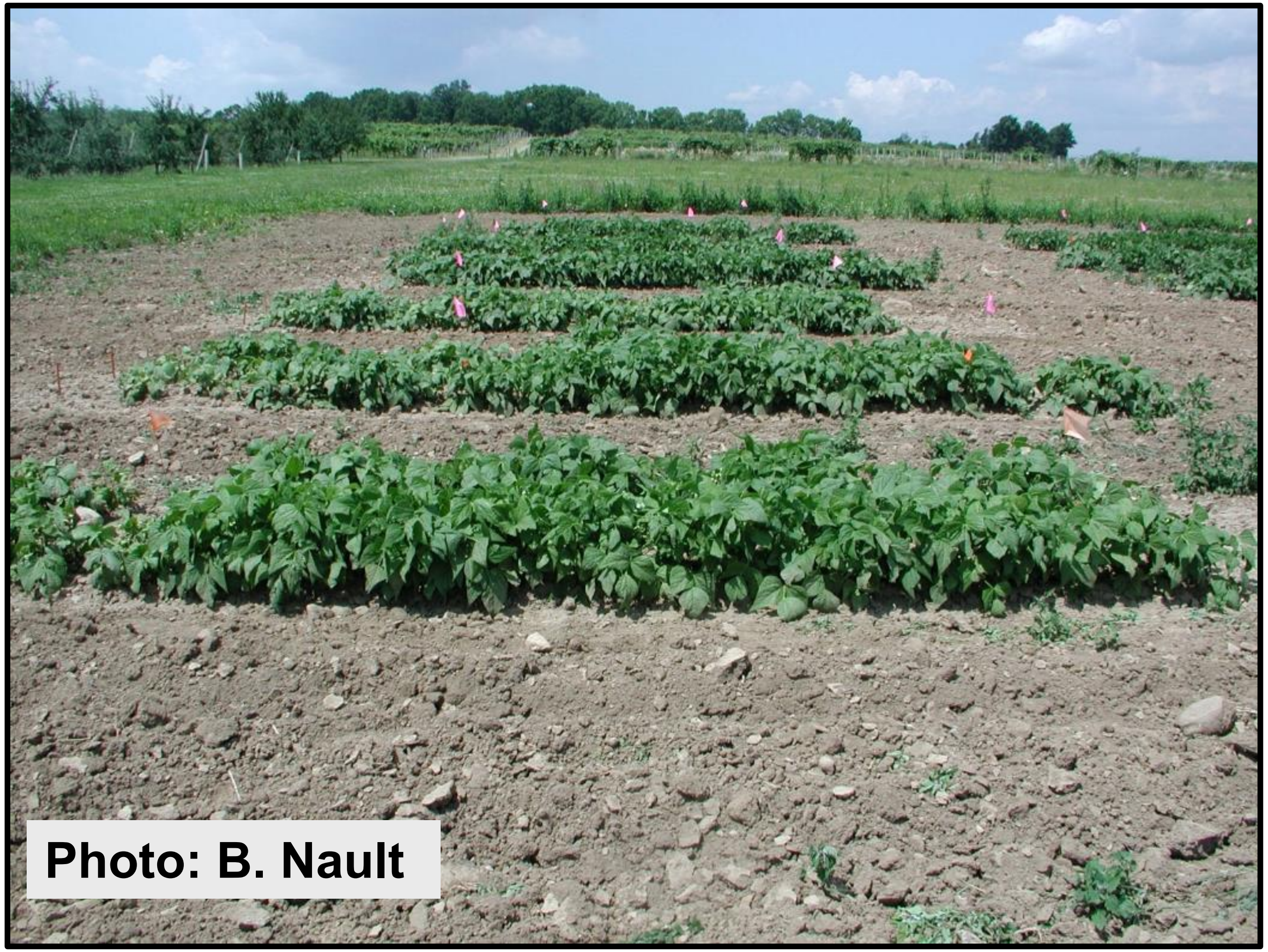
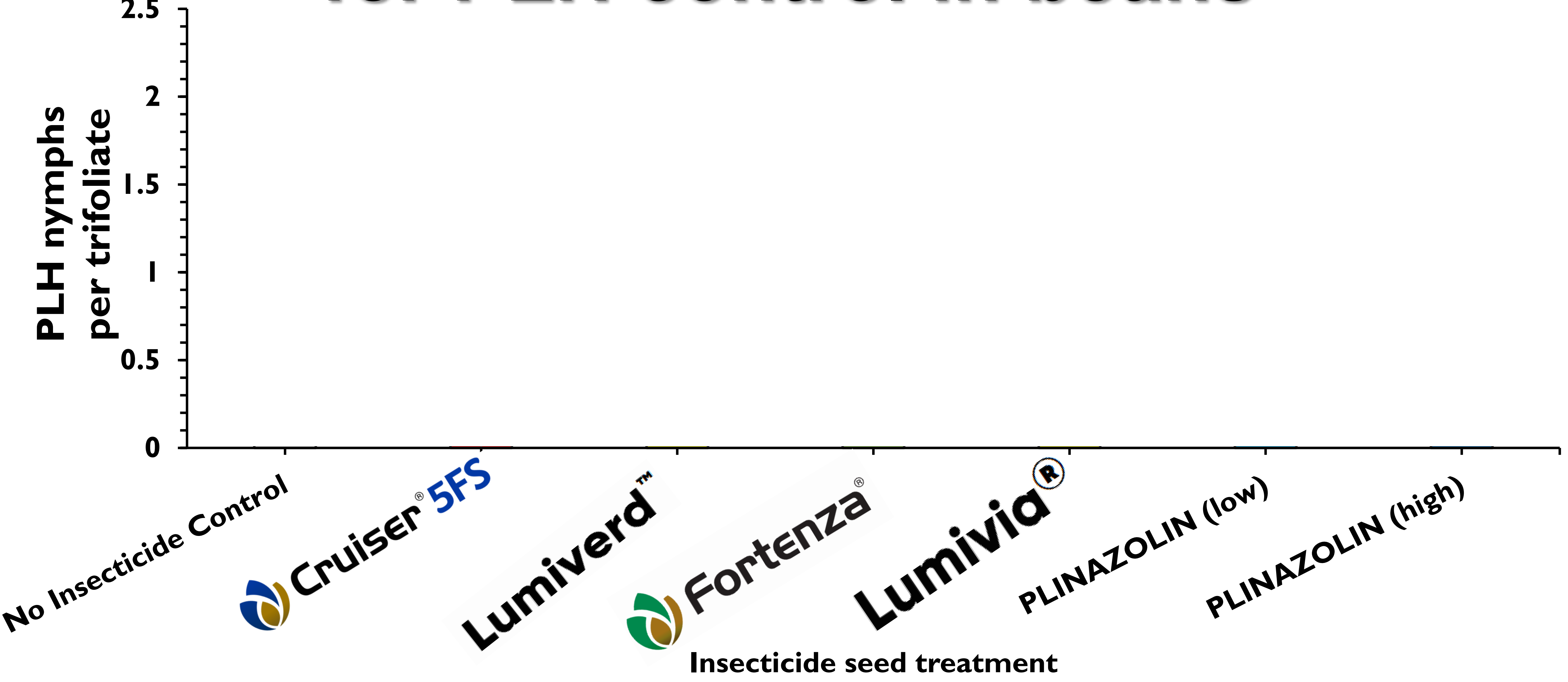


Photo: B. Nault

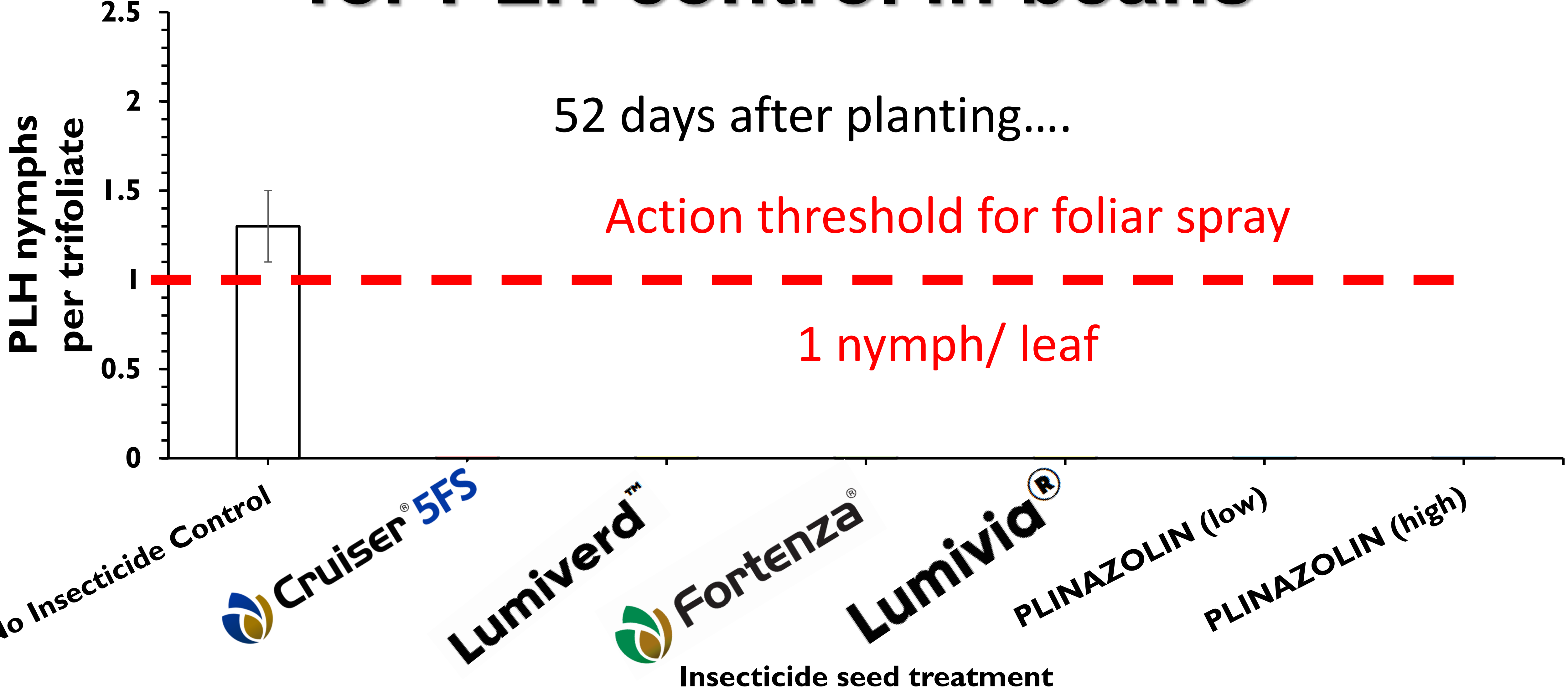
- Planted in NY in 2023 and 2024
- Counted PLH nymphs on 20 trifoliate leaves

Insecticide seed treatments evaluated for PLH control in beans



Geneva, NY 2023

Insecticide seed treatments evaluated for PLH control in beans



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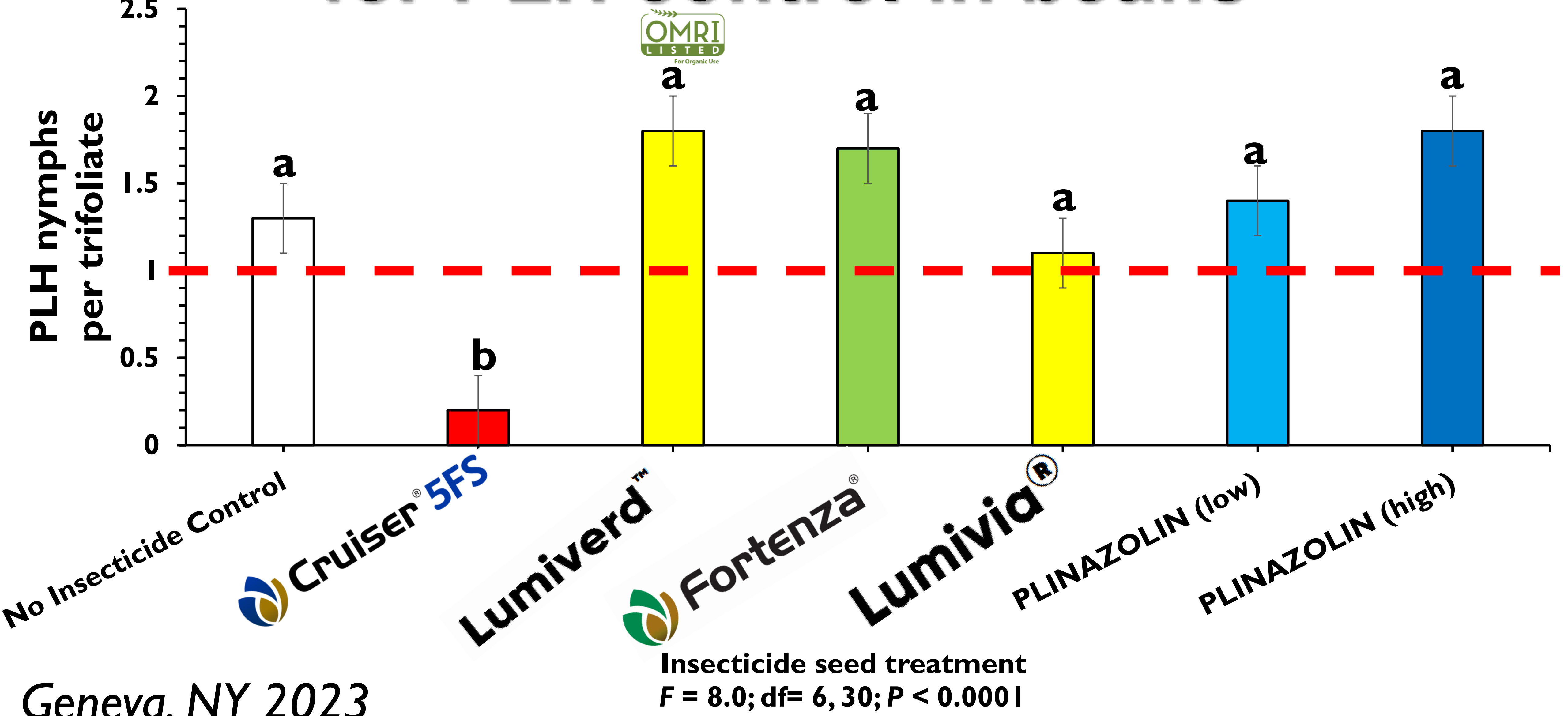

Geneva, NY 2023

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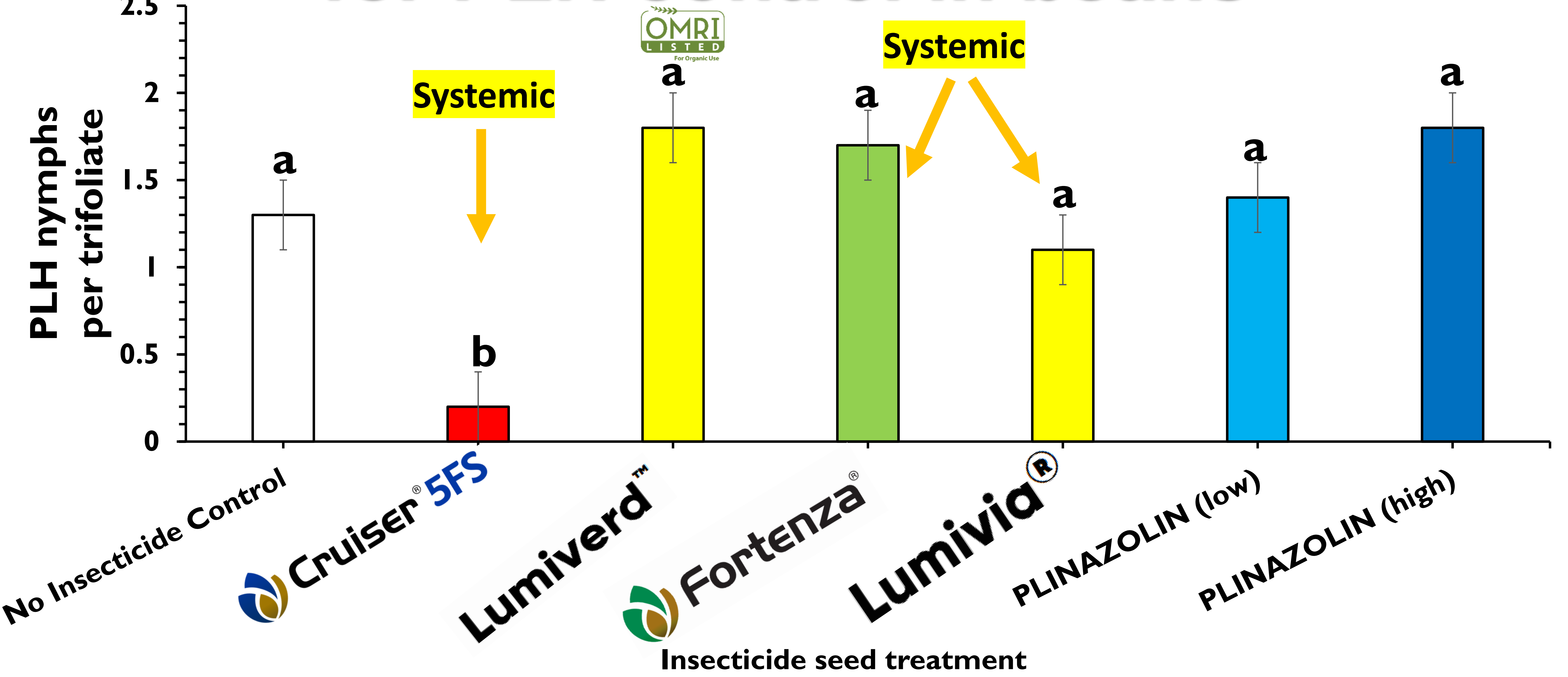
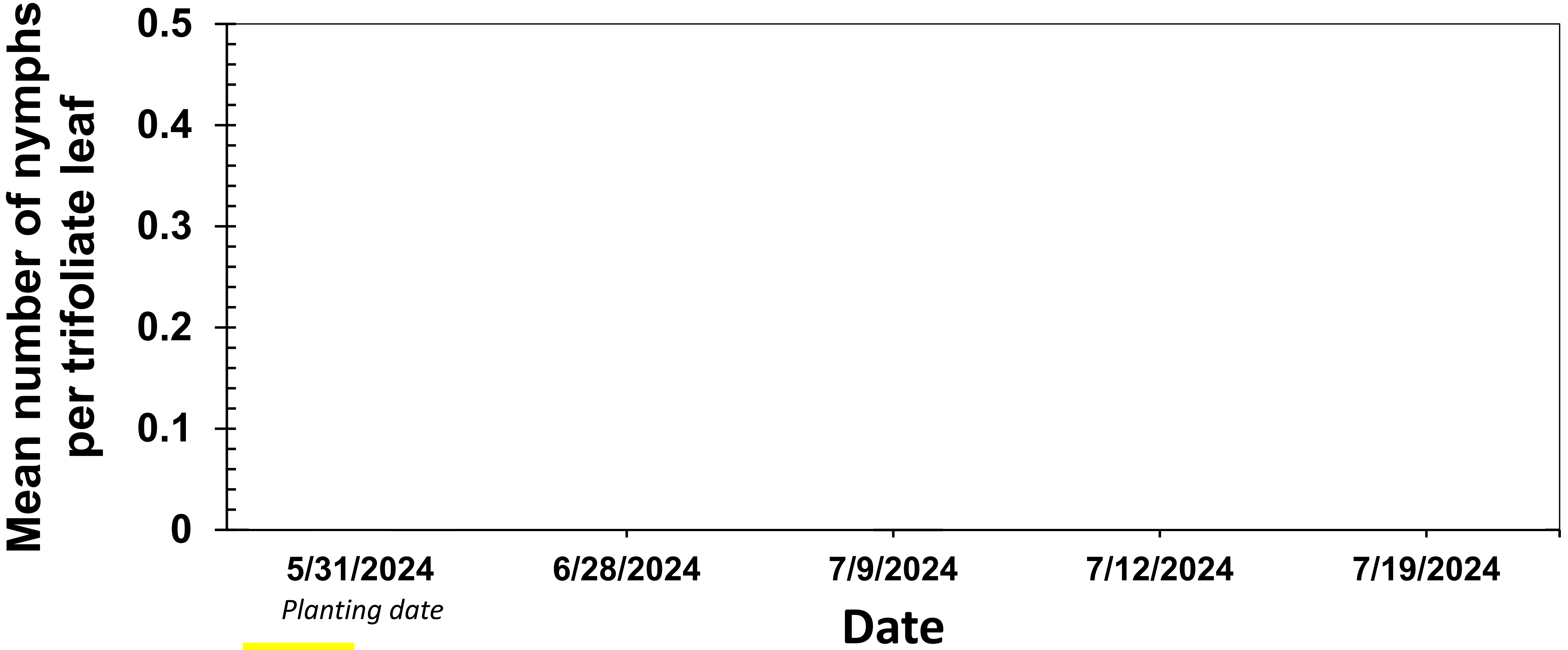


F = 8.0; df= 6, 30; *P* < 0.0001

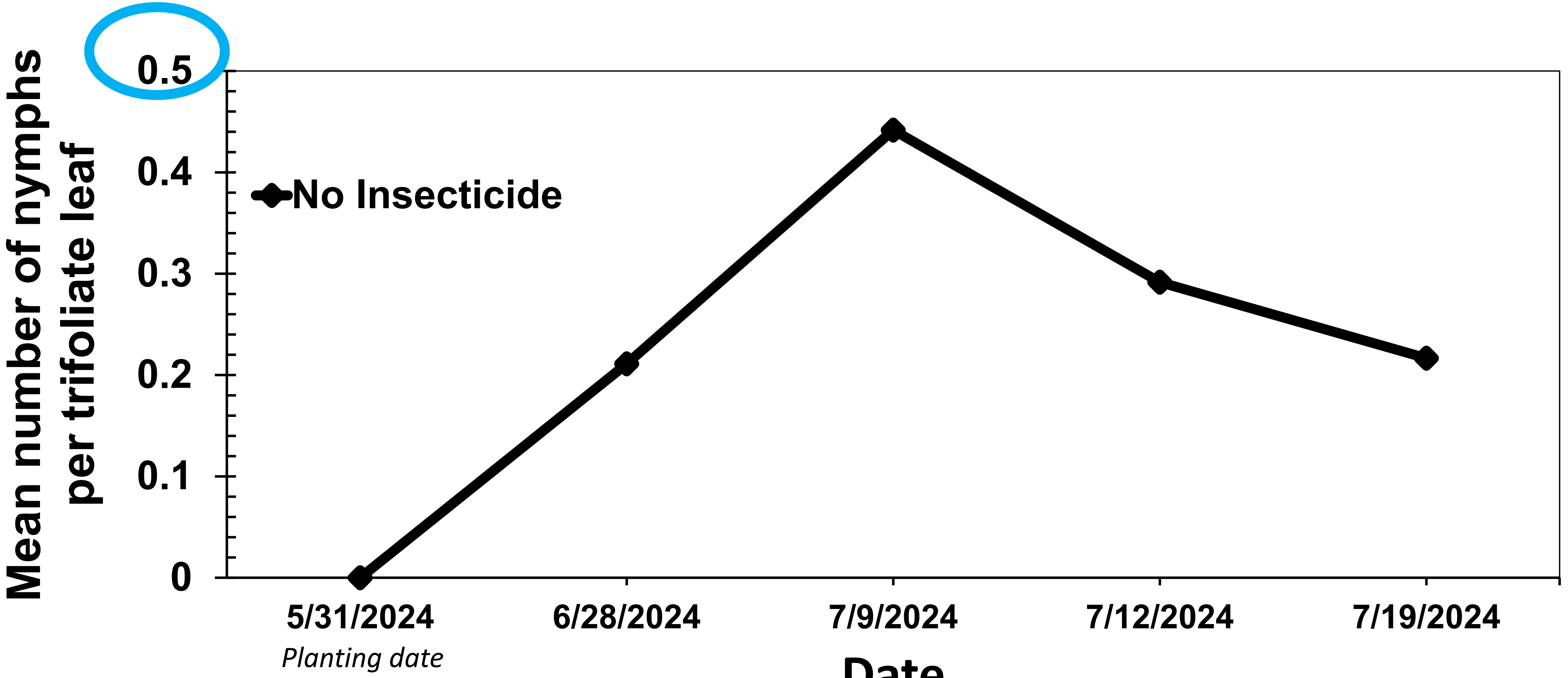
Geneva, NY 2023

Insecticide seed treatments evaluated for PLH control in dry bean



Geneva, NY 2024

Insecticide seed treatments evaluated for PLH control in beans



Geneva, NY 2024

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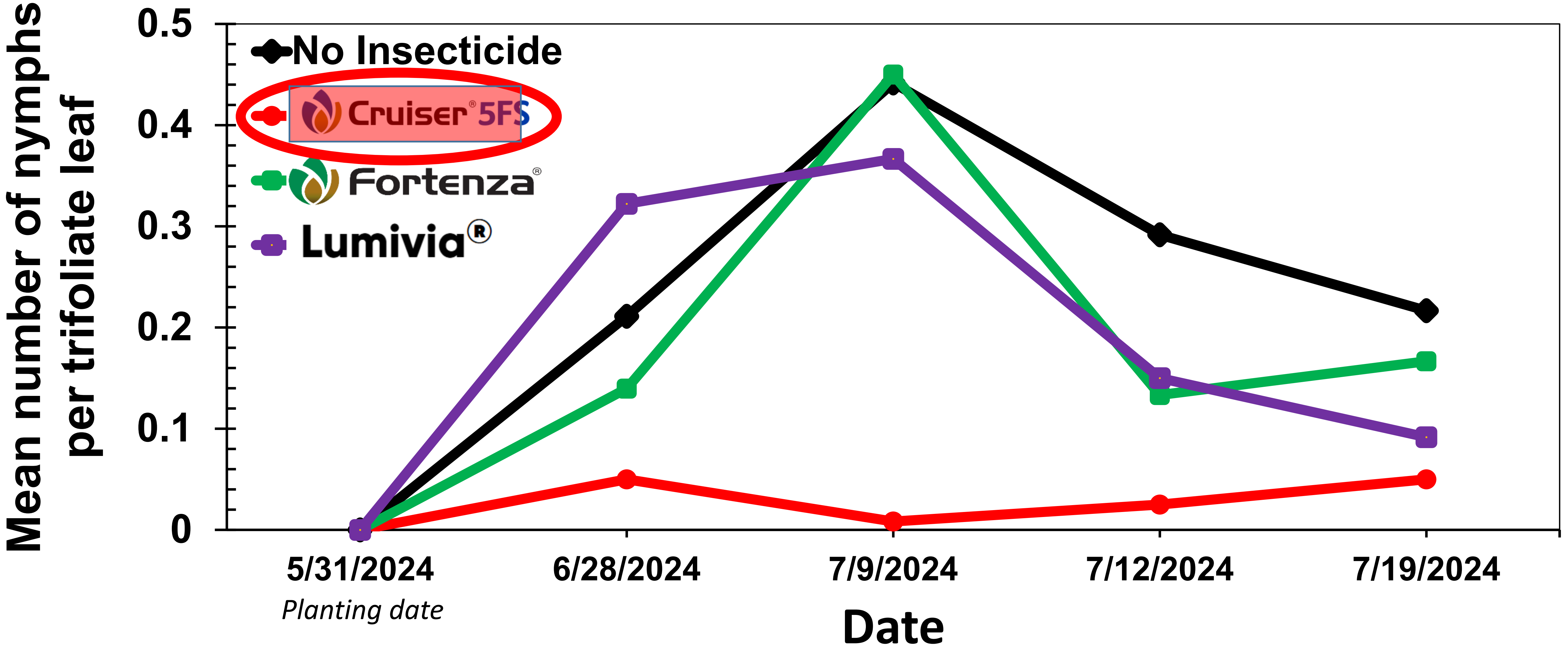


Geneva, NY 2024

Scenario without Cruiser® 5FS

Seed treatments

1 Lumiverd™

2 Fortenza®

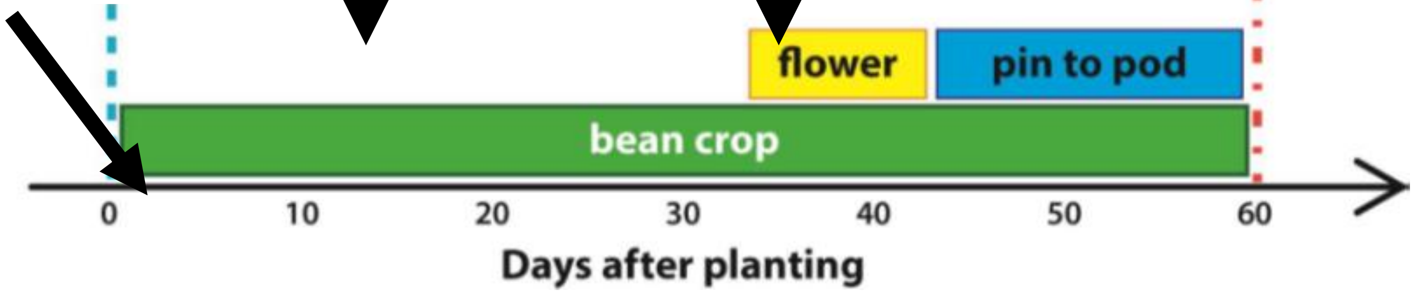
3 Lumivia®
INSECTICIDE SEED TREATMENT

4 PLINAZOLIN® technology

harvest

Foliar sprays will be needed to manage potato leafhopper

Warrior II
with Zeon Technology®



Case Studies

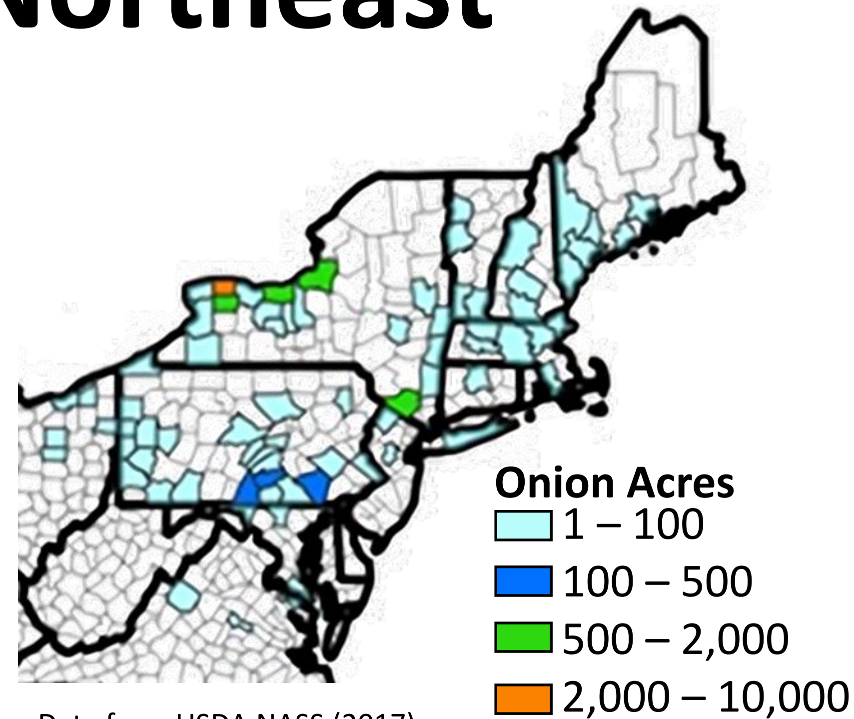
- Insect pest control in sweet corn

- Insect pest control in beans

- **Insect pest control in onions**

Onion Production in the Northeast

- In 2017, the Northeast produced over 8,000 acres of onions on over 3,000 farms (USDA NASS)



Data from USDA NASS (2017)
Picture credit: alliumnet.com

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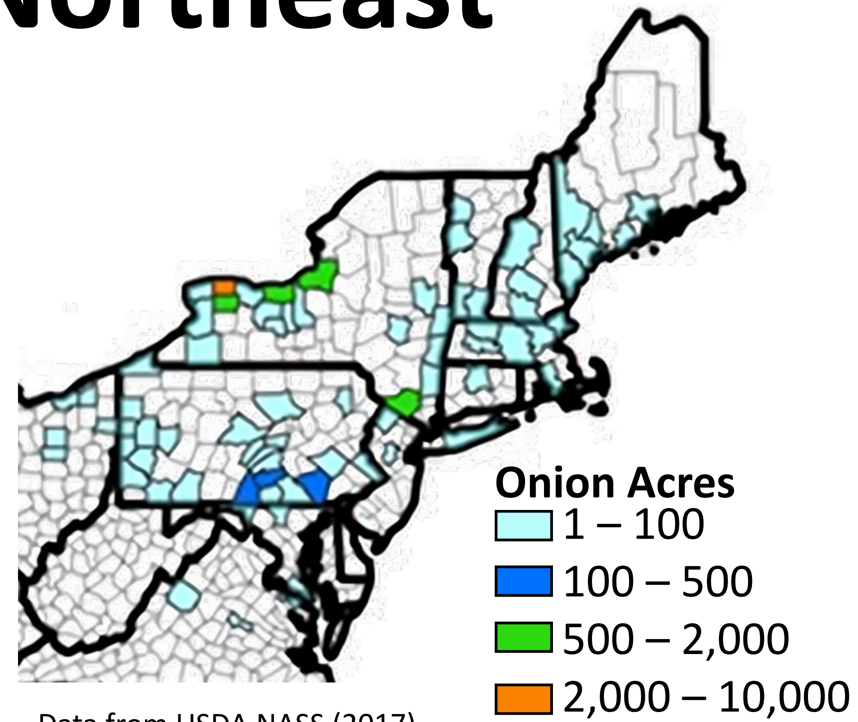


Data from USDA NASS (2017)
Picture credit: alliumnet.com

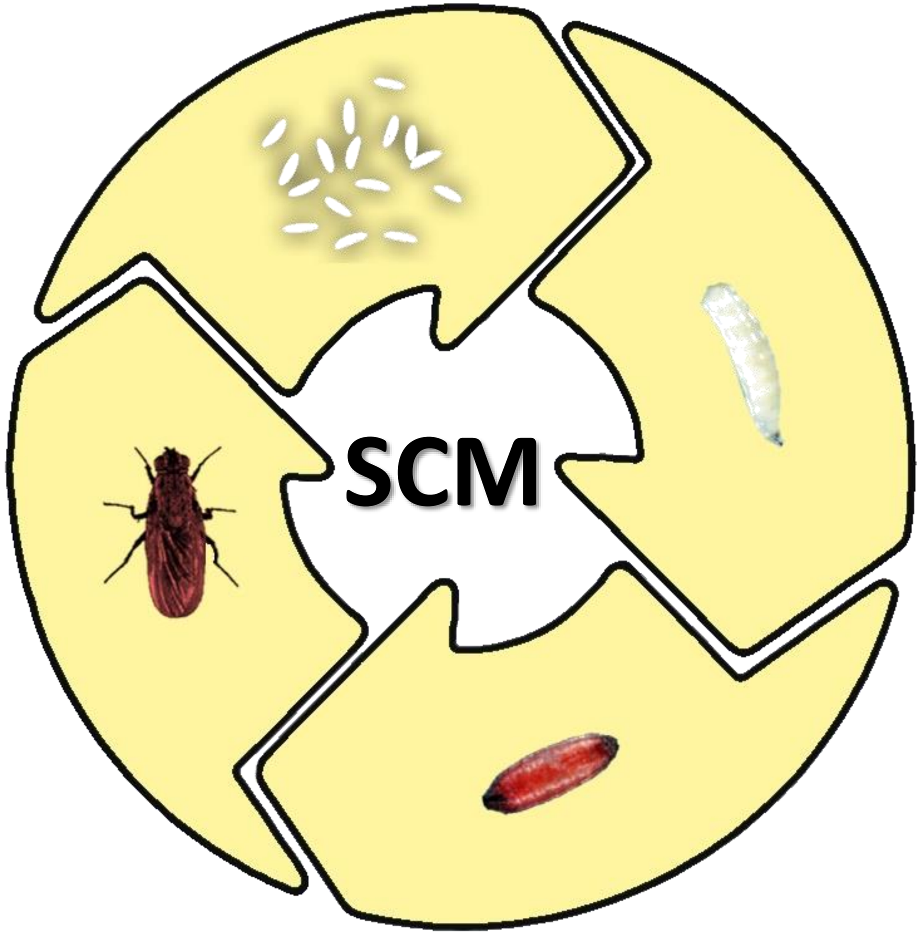
- Almost 97% of onion production occurs in New York, primarily in muck (organic) soils

Maggot complex

Diptera: Anthomyiidae

Maggot complex

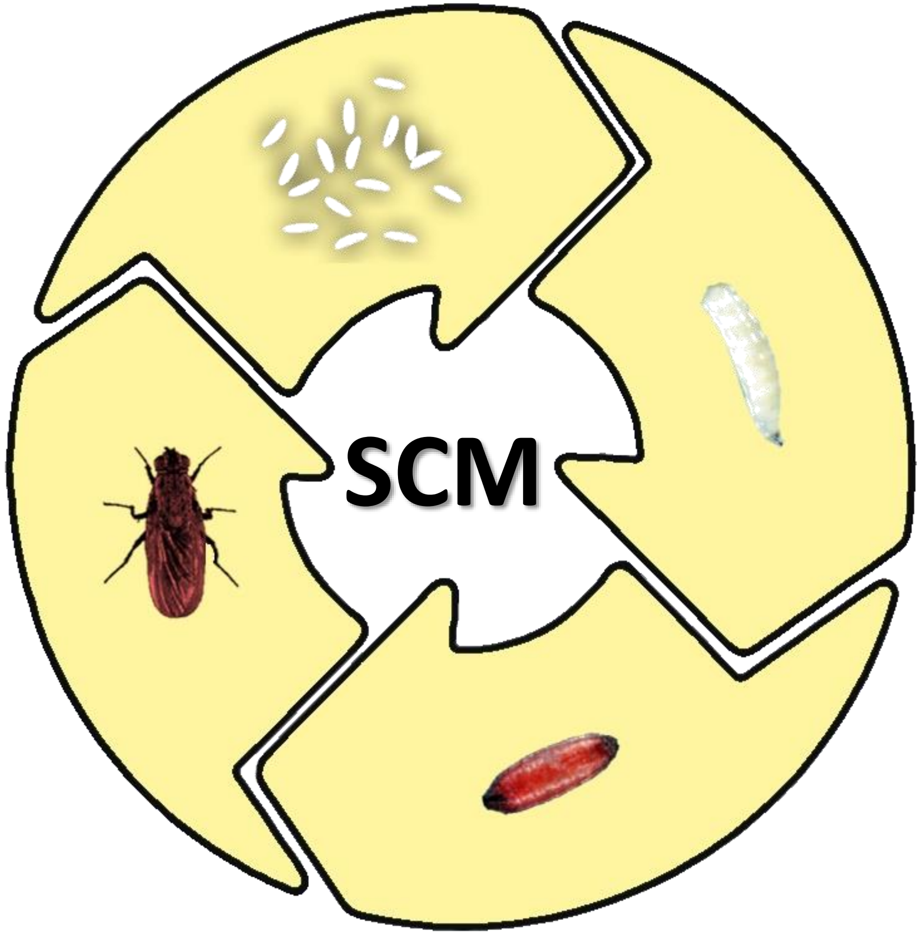
Diptera: Anthomyiidae



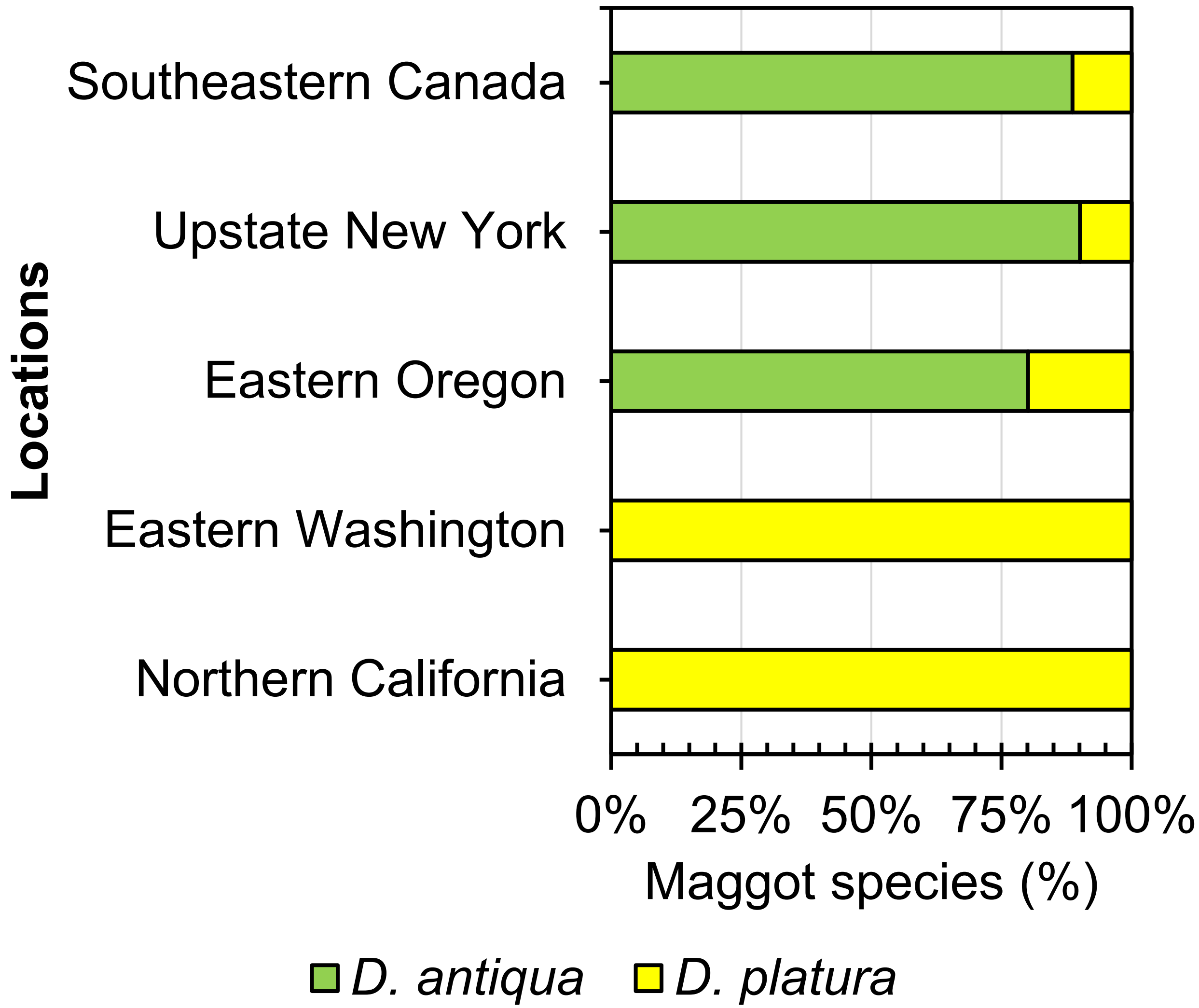
Seedcorn maggot (*Delia platura* Meigen)

Maggot complex

Diptera: Anthomyiidae



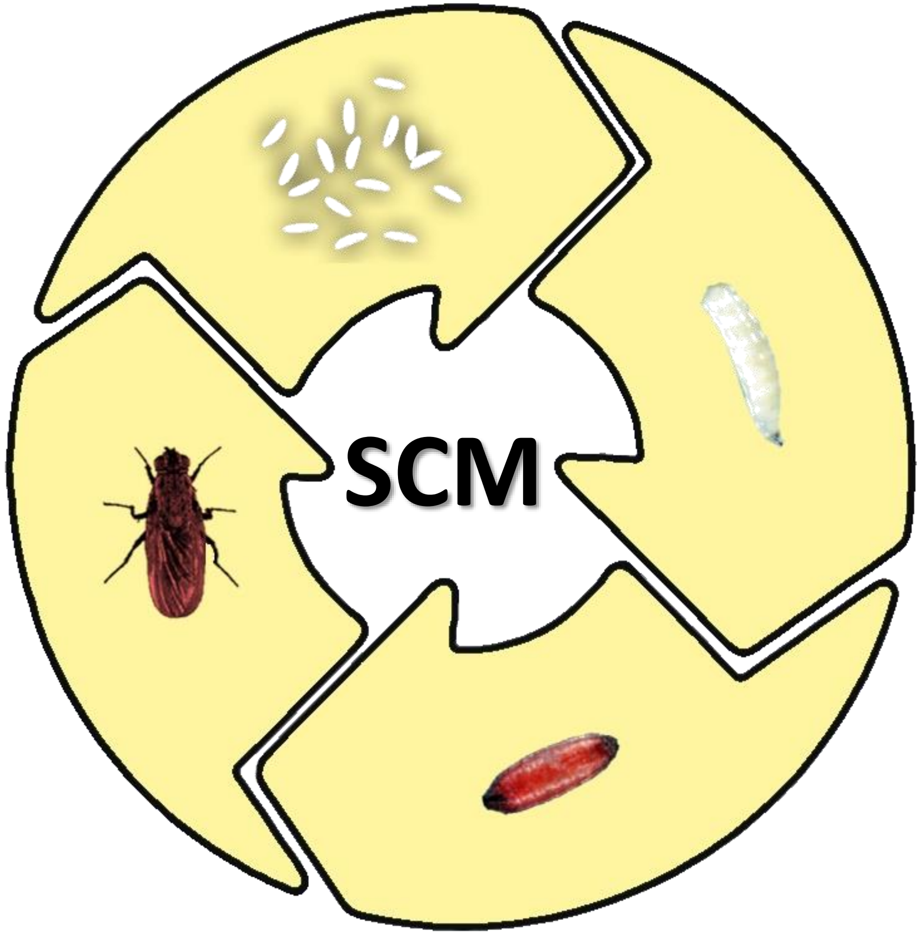
Seedcorn maggot (*Delia platura* Meigen)

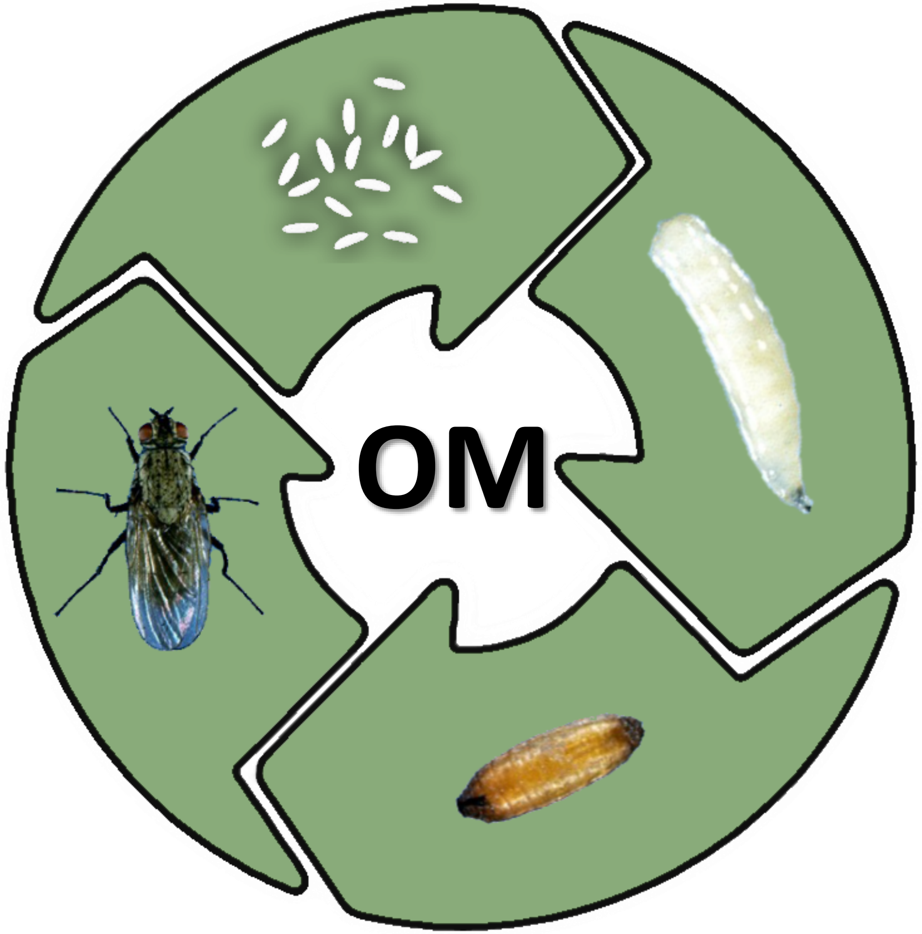


Salgado et. al unpublished data

Maggot complex

Diptera: Anthomyiidae





Seedcorn maggot (*Delia platura* Meigen)

Onion maggot (*Delia antiqua* Meigen)

Damage to Onions

Pictures credit: Leonardo Salgado

One maggot can kill 10 plants[1]


Picture Credit: Christy Hoepting

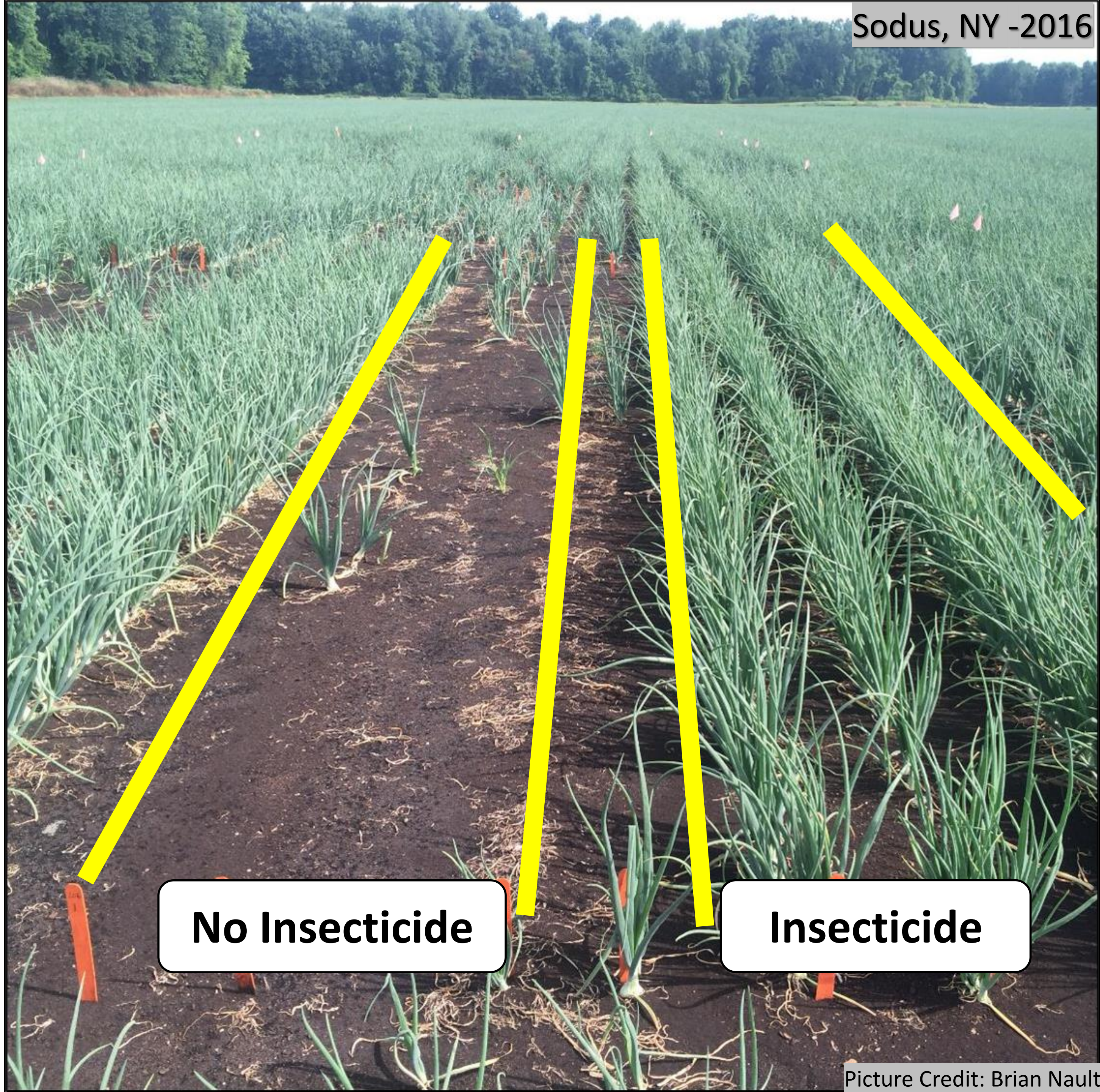

Picture Credit: Erica Moretti

[1] Workman 1958. PhD Dissertation Oregon State College.

Plant stands can be reduced by nearly 100% if left unprotected[1]

Management is preventive because once the damage occurs, nothing can be done!

[1]Nault et al. 2006 – Crop Prot., Salgado and Nault 2023 – AMT



Main risk period for maggots in onion

Seedcorn maggot & Onion maggot

Planting
Direct seeded
(late March – mid May)

Harvest
(late July – Sept.)

ONION GROWING SEASON

APRIL MAY JUNE JULY AUG SEPT

Main risk period for maggots in onion

Seedcorn maggot
& Onion maggot

Planting
Direct seeded
(late March – mid May)

Harvest
(late July – Sept.)

ONION GROWING SEASON

APRIL | MAY | JUNE | JULY | AUG | SEPT

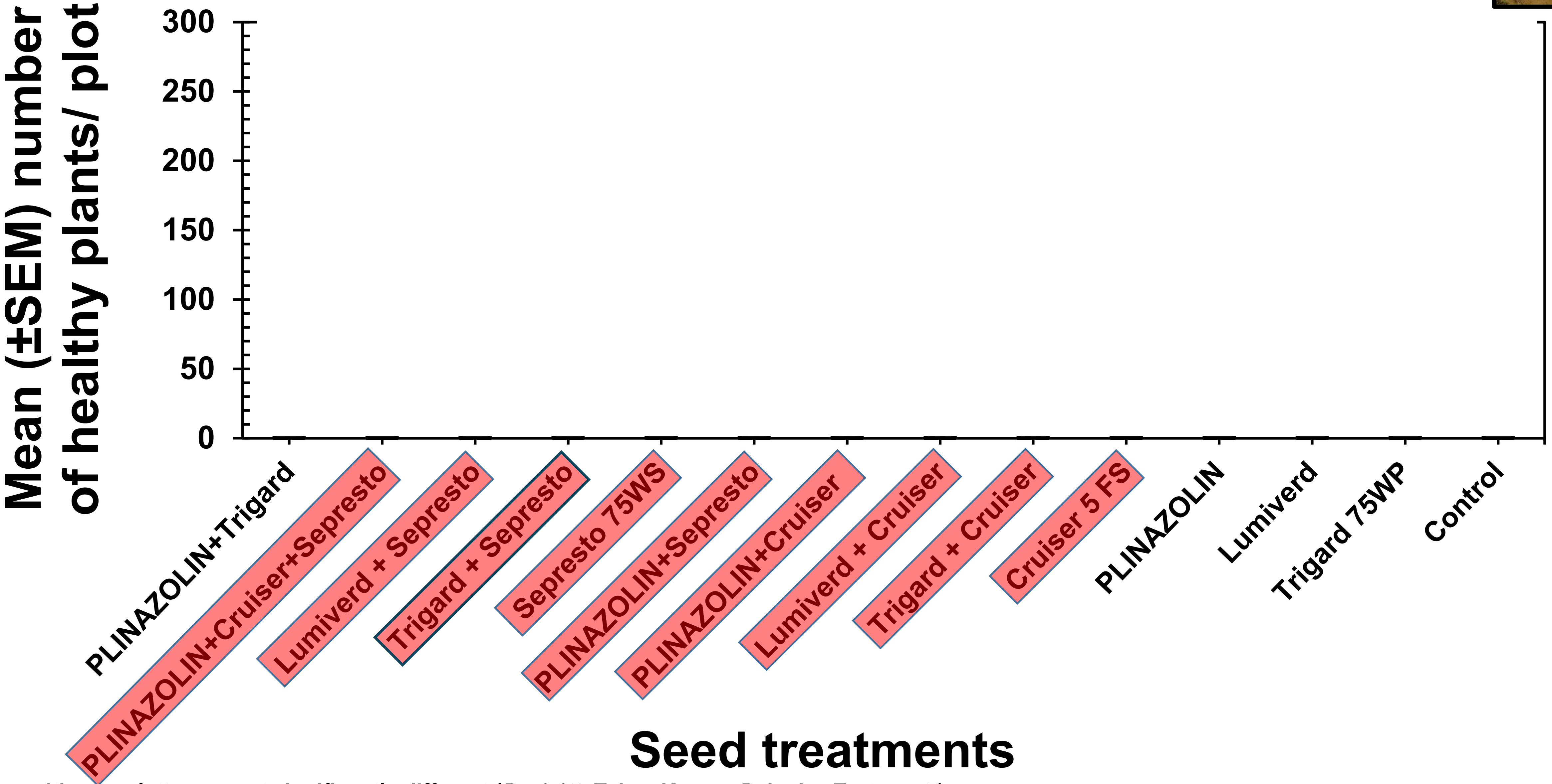
Approach

- **Research conducted in CA, NY, ON, OR and WA from 2022 through 2024**
- **No soil amendments**
- **Recorded number of maggot damaged plants 1-2 times/ week until early July & recorded final plant stand**

Insecticide seed treatments evaluated in 2024

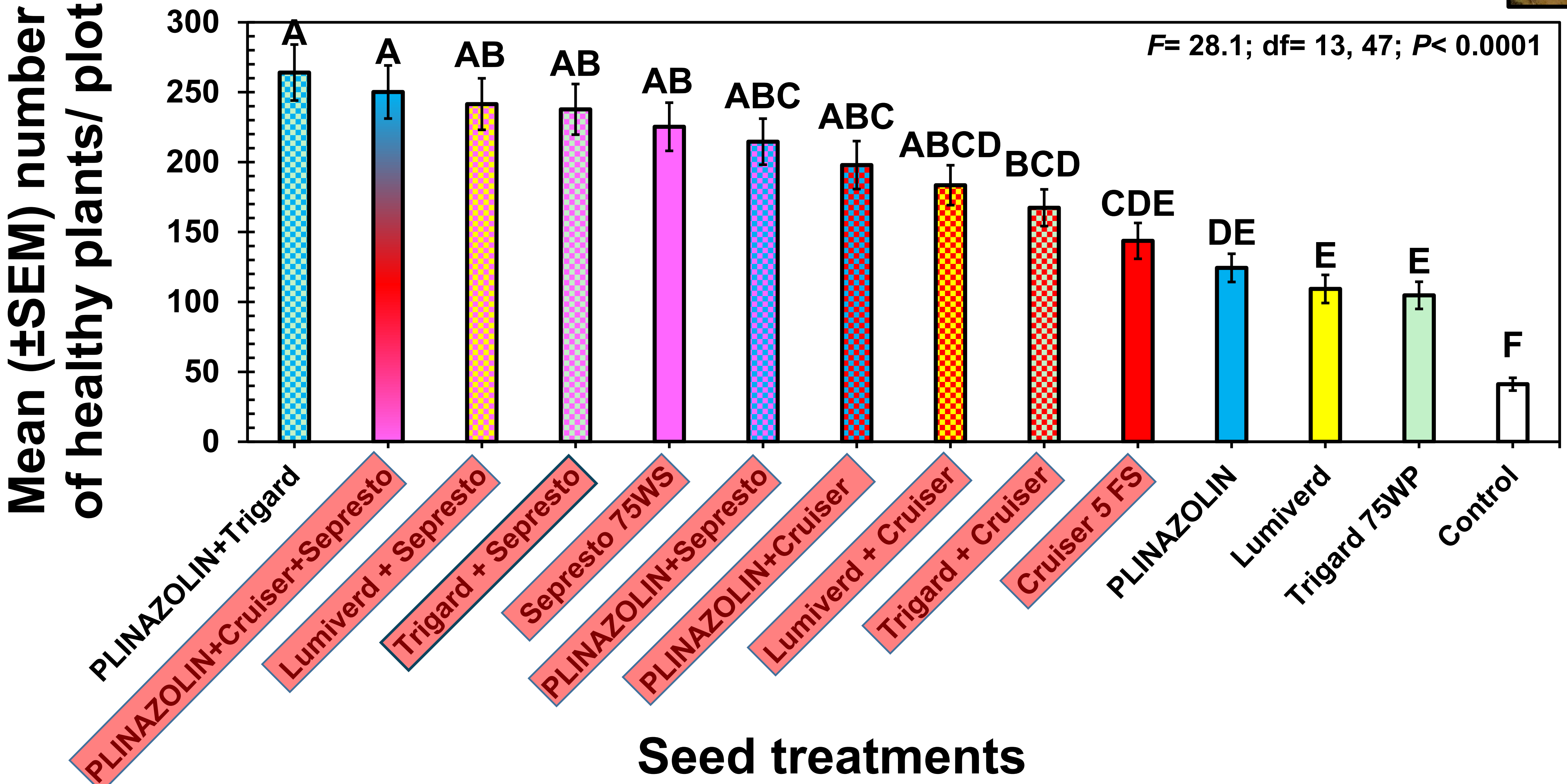
Trt#	Product(s)	Insecticide Active ingredient(s)	Rate (mg ai/seed)
1	No insecticide	N/A	N/A
2	Trigard 75WP	cyromazine	0.225 mg ai/seed
3	Lumiverd	spinosad	0.2 mg ai/seed
4	PLINAZOLIN technology	isocycloseram	0.0909 mg ai/seed
5	Cruiser 5 FS	thiamethoxam	0.2 mg ai/seed
6	Sepresto 75WS	clothianidin + imidacloprid	0.32 mg ai/seed
7	Trigard + Cruiser	cyromazine + thiamethoxam	0.225 mg ai/seed + 0.2 mg ai/seed
8	Trigard + Sepresto	cyromazine + clothianidin + imidacloprid	0.225 mg ai/seed + 0.32 mg ai/seed
9	Lumiverd + Cruiser	spinosad + thiamethoxam	0.2 mg ai/seed + 0.2 mg ai/seed
10	Lumiverd + Sepresto	spinosad + clothianidin + imidacloprid	0.2 mg ai/seed + 0.32 mg ai/seed
11	PLINAZOLIN + Cruiser	isocycloseram + thiamethoxam	0.0909 mg ai/seed + 0.2 mg ai/seed
12	PLINAZOLIN + Sepresto	isocycloseram + clothianidin + imidacloprid	0.0909 mg ai/seed + 0.32 mg ai/seed
13	PLINAZOLIN + Cruiser + Sepresto	isocycloseram + thiamethoxam + clothianidin + imidacloprid	0.0909 mg ai/seed + 0.2 mg ai/seed + 0.32 mg ai/seed
14	PLINAZOLIN + Trigard	isocycloseram + cyromazine	0.0909 mg ai/seed + 0.225 mg ai/seed

Efficacy of insecticide seed treatments for SCM & OM control in onion in NY in 2024



Means with same letter are not significantly different (*P* > 0.05; Tukey-Kramer Pairwise Test; n = 5)

Efficacy of insecticide seed treatments for SCM & OM control in onion in NY in 2024



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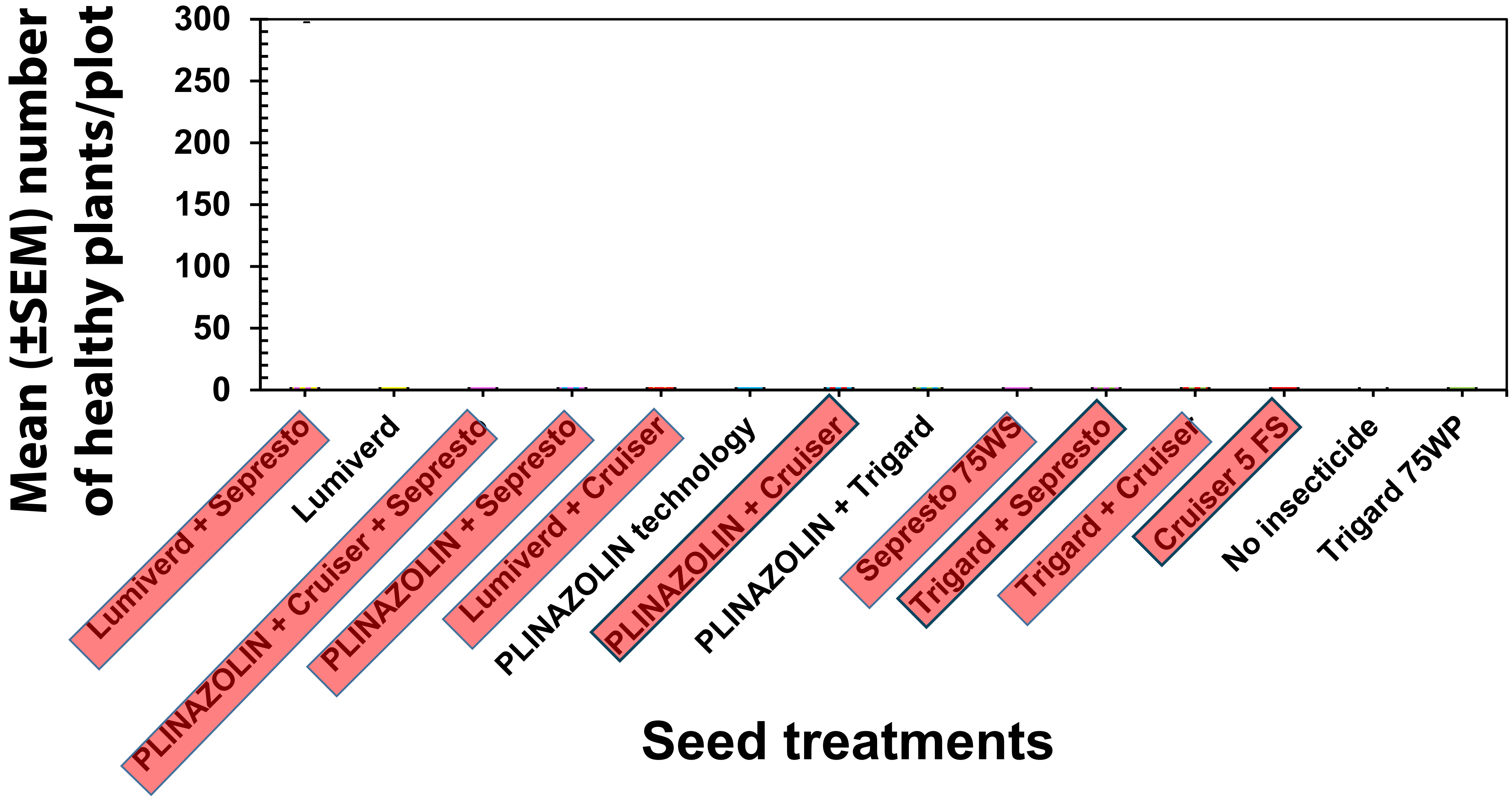
Efficacy of insecticide seed treatments for SCM control in onion in CA in 2024



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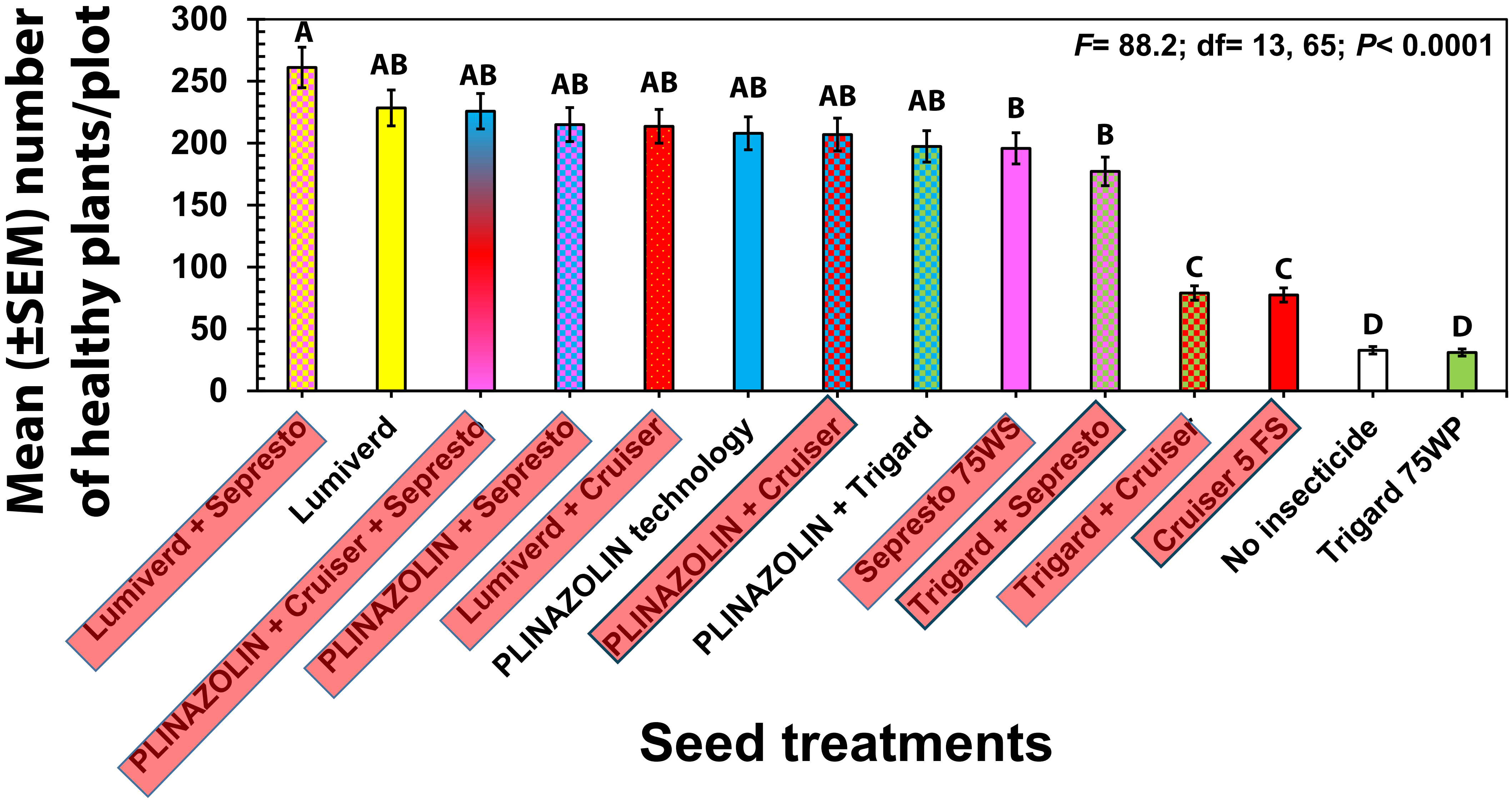
Efficacy of insecticide seed treatments for SCM control in onion in CA in 2024





Means with same letter are not significantly different ($P > 0.05$; Tukey-Kramer Pairwise Test; n = 5)

Scenario without Cruiser® 5FS Sepresto 75 WS

Seed treatments

1 Lumiverd™

2 Trigard®

Labeled on onion, but typically not effective enough alone

Guidelines for seed treatment use in NY 2025

Trade name of insecticide	Active Ingredient(s)	Group IRAC	Activity on Target Pests[1]	
			Seedcorn maggot	Onion maggot
Lumiverd™	spinosad	5	Excellent	Fair*
Trigard®	cyromazine	17	Poor	Fair
Cruiser® 5FS	thiamethoxam	4A	Poor	Good
Sepresto 75 WS	clothianidin + imidacloprid	4A	Very good	Excellent

* Onion maggot resistance to spinosad may occur in some locations

Seed treatment packages (insecticides + fungicides) to consider

Low maggot pressure			Moderate to high maggot pressure	
Package 1	Package 2	Package 3	Package 1	Package 2
Trigard	Lumiverd	Sepresto	Sepresto	Sepresto
Cruiser	Cruiser	**FarMore F300	Trigard	Lumiverd
**FarMore F300	**FarMore F300	**EverGol Prime	**FarMore F300	**FarMore F300
**EverGol Prime	**EverGol Prime		**EverGol Prime	**EverGol Prime

** **Fungicides: FarMore 300** includes Apron® XL (mefenoxam) + Maxim® 4FS (fludioxonil) + Dynasty® (azoxystrobin) to control damping off; **EverGol® Prime** (penflufen) controls onion smut.

Takeaway message

- Neonicotinoids continue to be highly effective for managing many vegetable insect pests
- Alternatives to neonicotinoids are not always effective for managing early-season vegetable insect pests
- Without neonicotinoids, insecticide use will increase in some vegetable crops and control will be more expensive

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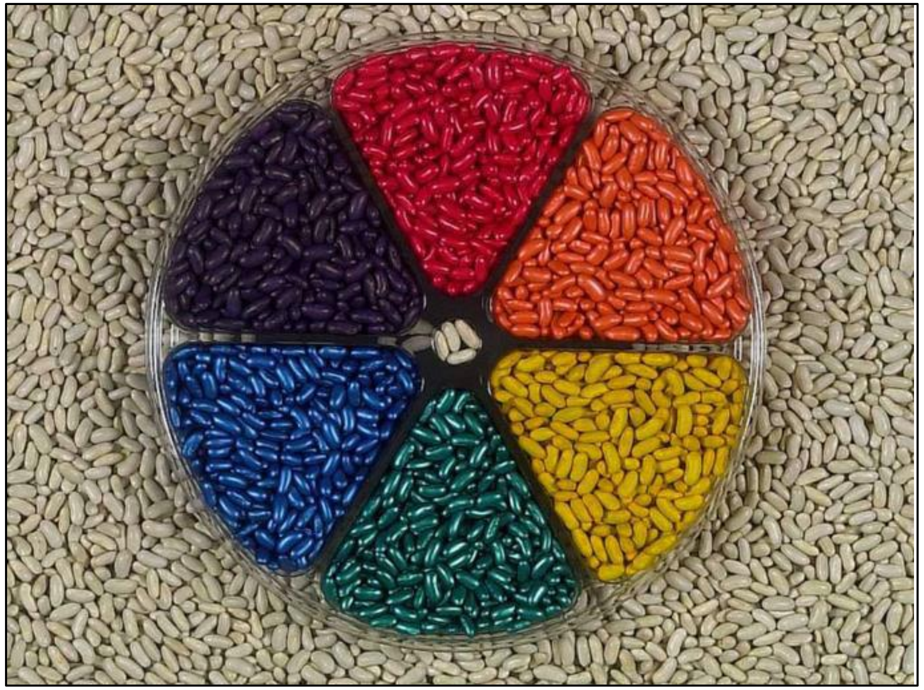
lds223@cornell.edu

Questions?



Northeastern IPM Center

Cornell AgriTech New York State Agricultural Experiment Station

Some Questions for you

Northeastern IPM Center

Upcoming Webinars

https://www.northeastipm.org/ipm-in-action/the-ipm-toolbox/

GROW: Bringing Research and Tools for Integrated Weed Management to Farmers
April 8, 2025, 11:00 a.m.
Presenters: Emily Unglesbee, Michael Flessner, John Wallace

Pesticide Label Changes Brought On by the Endangered Species Act
April 29, 2025 – 11:00 a.m. (eastern)
Presenters: Niranjana Krishna, Kurt Vollmer, Bill Chism, Mark VanGessel

USDA United States Department of Agriculture National Institute of Food and Agriculture

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