A scenic landscape featuring a green field in the foreground, a white building with a green roof in the middle ground, and a blue sky with scattered white clouds above.

Exploring the influence of cover-crop termination in annual cropping systems on predator communities and predation

Jared S. Adam, John F. Tooker, and John M. Wallace

3/10/2024

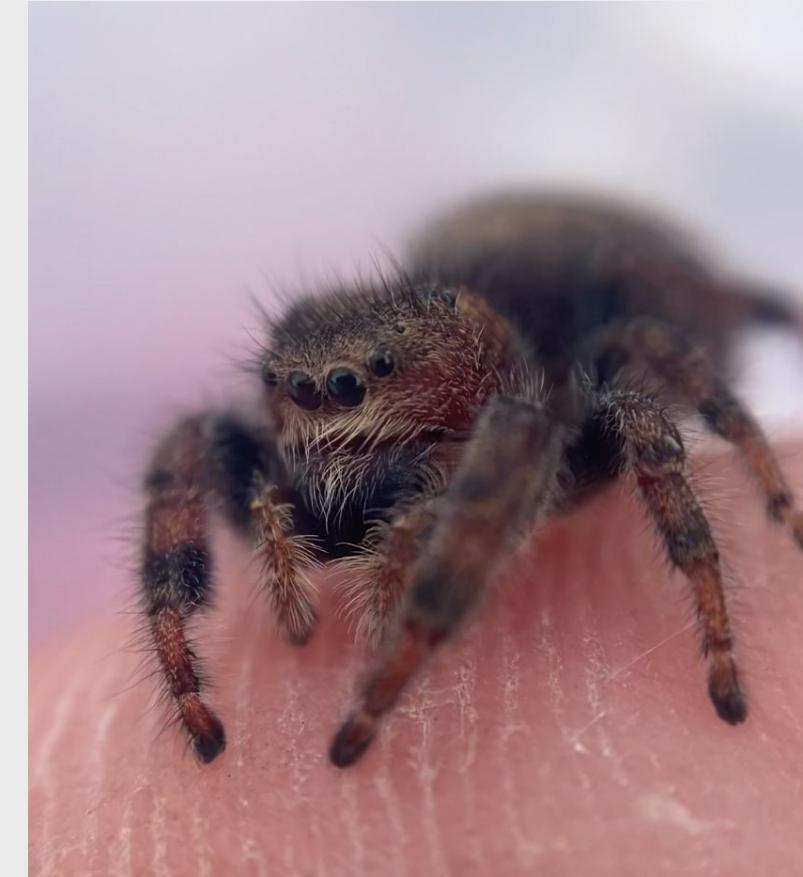
Key points

Conservation biological control in agronomic systems

Slugs of the corn

Cover crops can promote prey consumption

Predator x slug interactions



What is no-till farming?

Tilling: turning over top 6-10 inches



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Tilling: turning over top 6-10 inches

No-Till: You guessed it; the opposite of tilling



What are cover crops and how do I “plant green”?

Cover crops: a plant grown in between cash crops



What are cover crops and how do I “plant green”?

Cover crops: a plant grown in between cash crops

Planting green: no-till planting into **actively** living cover crops



Why would I plant cover crops and no-till?

Benefits

Slow erosion of soil and nutrients

Improve soil health

Enhance water availability



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- Improve soil health
- Enhance water availability
- Smother weeds
- Help control pests and diseases



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Concerns

- Increase in insect and slug pests and disease



Preventative Pest Management in corn



Background

Project layout

Slugs

Predation

Predators

Yield

Conclusions
/Future

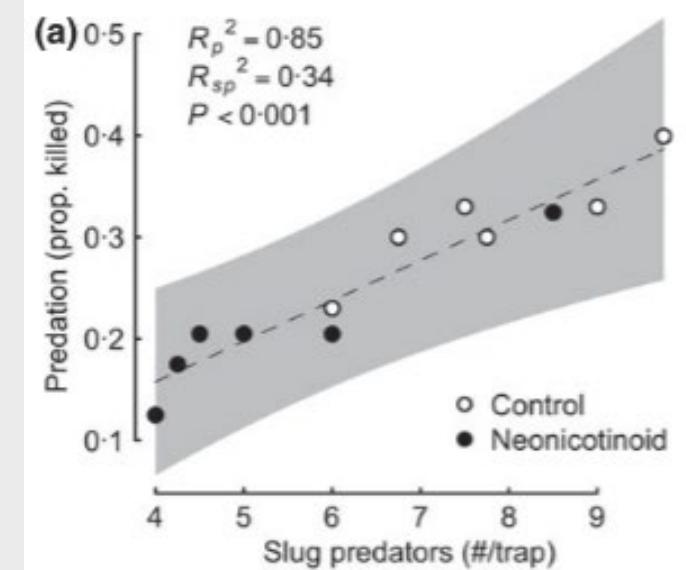
Question 1

What happens when we remove insecticides?

EDITOR'S CHOICE: Neonicotinoid insecticide travels through a soil food chain, disrupting biological control of non-target pests and decreasing soya bean yield

Margaret R. Douglas✉, Jason R. Rohr, John F. Tooker

Decrease in insecticides = more predators

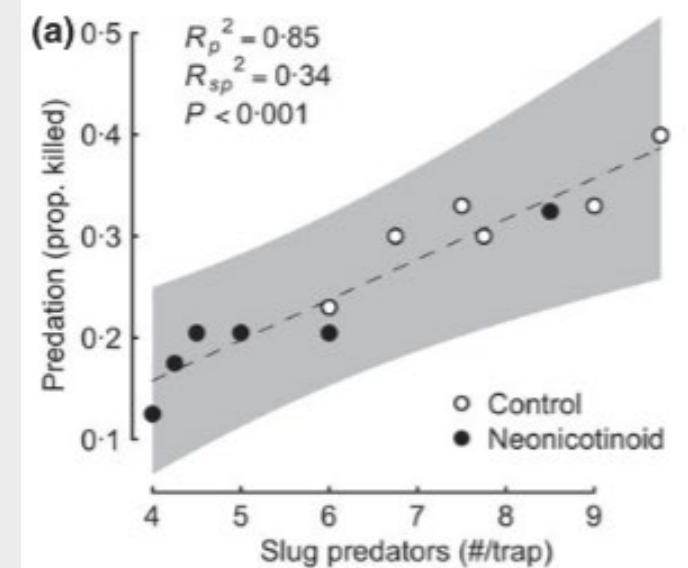
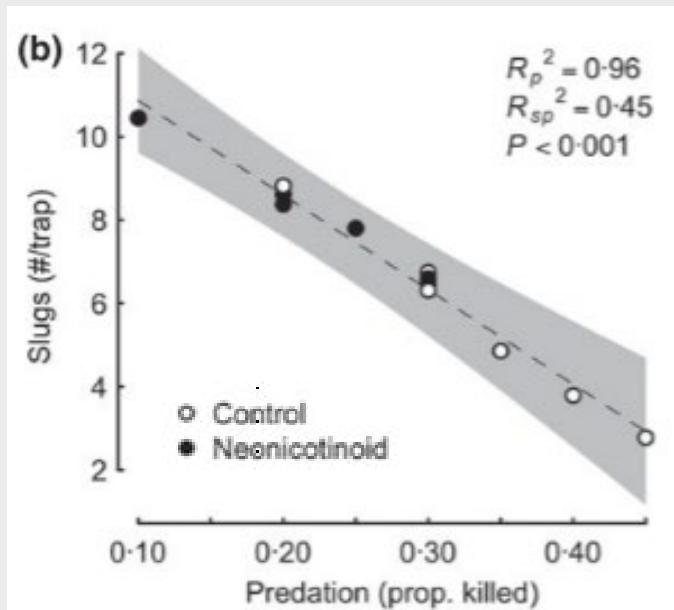


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Decrease in insecticides = more predators

More predation



Question 2

What happens if we remove insecticides and combine no-till with cover crops?

Early-season plant cover supports more effective pest control than insecticide applications

Elizabeth K. Rowen¹  | Kirsten A. Pearson¹ | Richard G. Smith² |
Kyle Wickings³ | John F. Tooker¹

3-year study in corn-soy rotations evaluating cover crop, insecticide, and predator interactions

Predators did as well or better than insecticide treatments in protecting crops

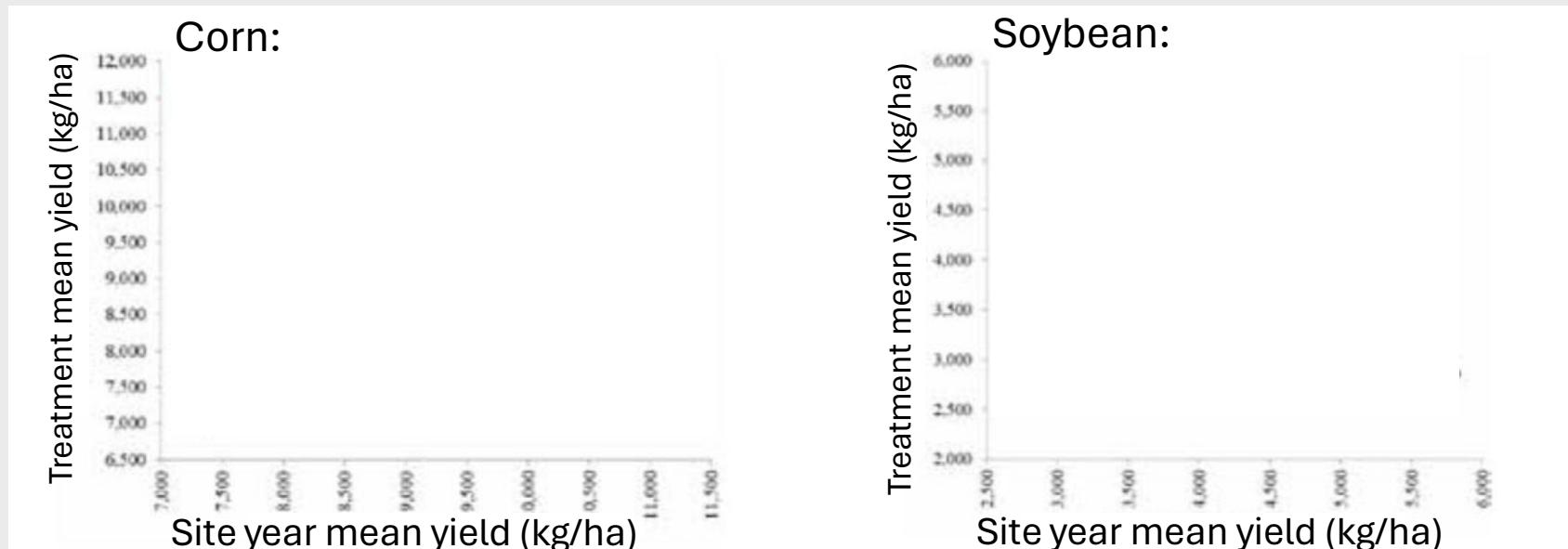
Question 3

Are there ways to manage cover crops to promote predators?

Planting Green Effects on Corn and Soybean Production

Heidi K. Reed,* Heather D. Karsten, William S. Curran, John F. Tooker, and Sjoerd W. Duiker

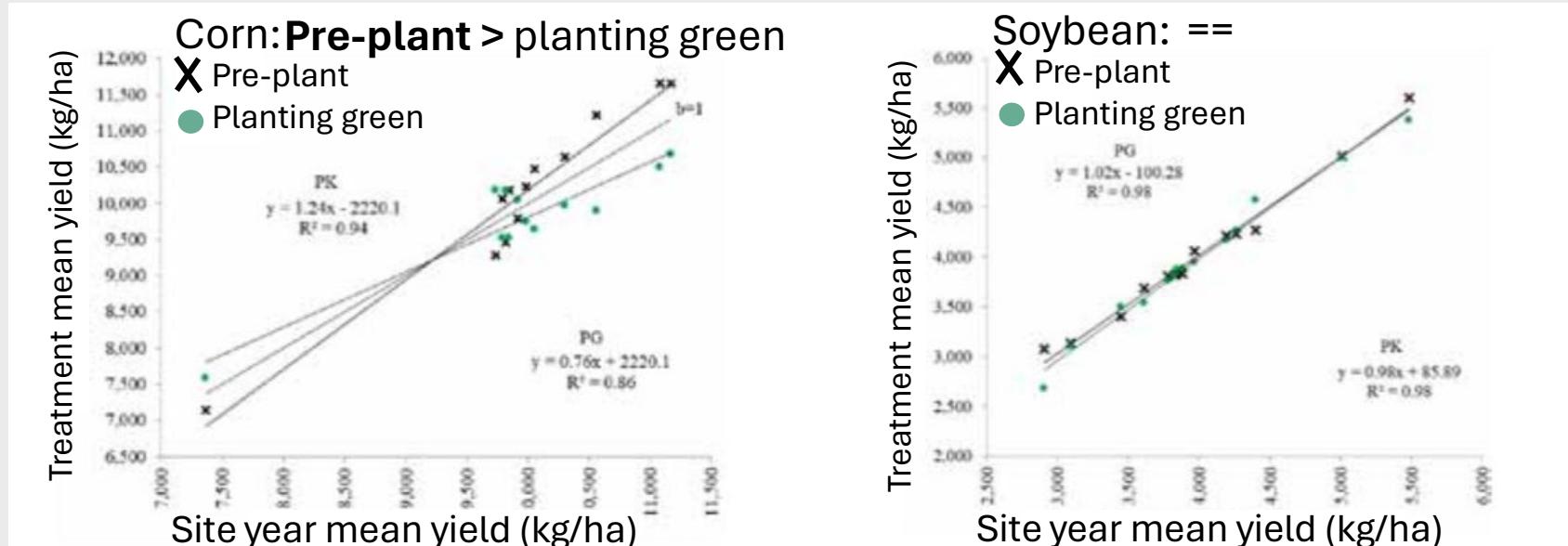
Planting green (post-plant cc termination) vs Pre-plant cc termination



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Heidi K. Reed,* Heather D. Karsten, William S. Curran, John F. Tooker, and Sjoerd W. Duiker

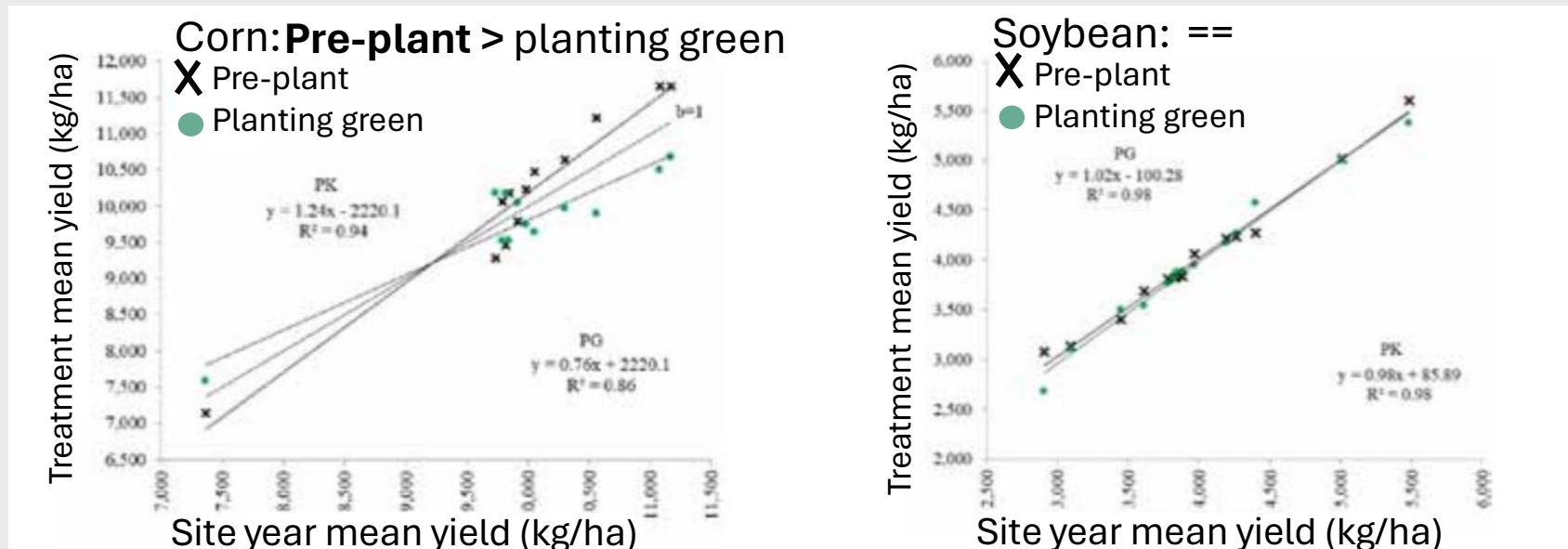
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Planting Green Effects on Corn and Soybean Production

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Planting green (post-plant cc termination) vs Pre-plant cc termination



Planting green, on average, had **more** slug damage

The Project

Interdisciplinary approach investigating affects of delaying cover crop termination on pest interactions

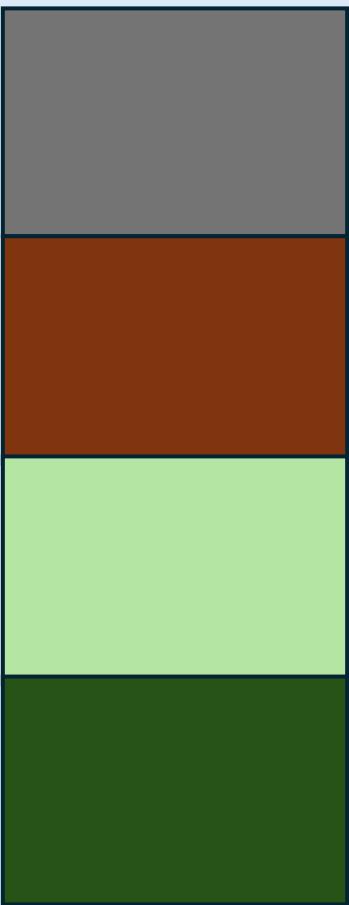
Quantify and explain the effects of cover crop termination on insect populations, diseases, and weeds

3-year experiment

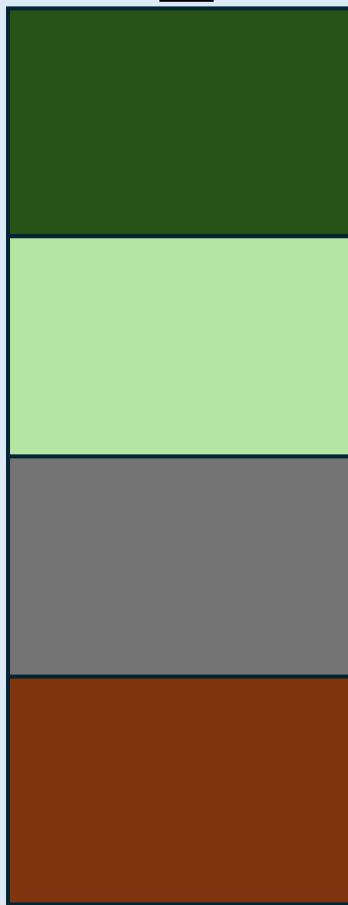
Cereal rye (*Secale cereale*) cover crop

Project layout

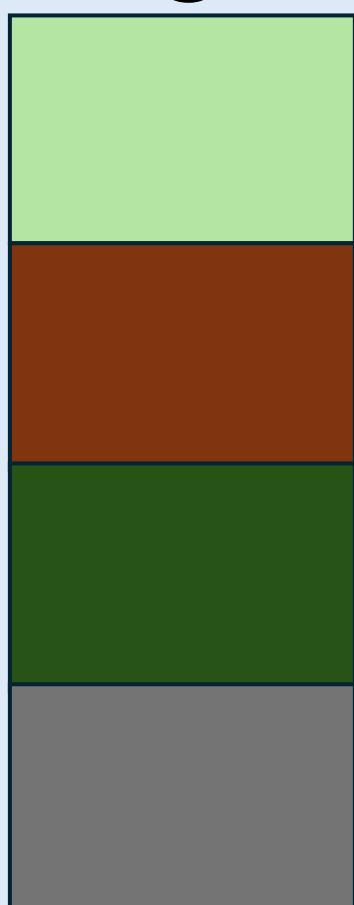
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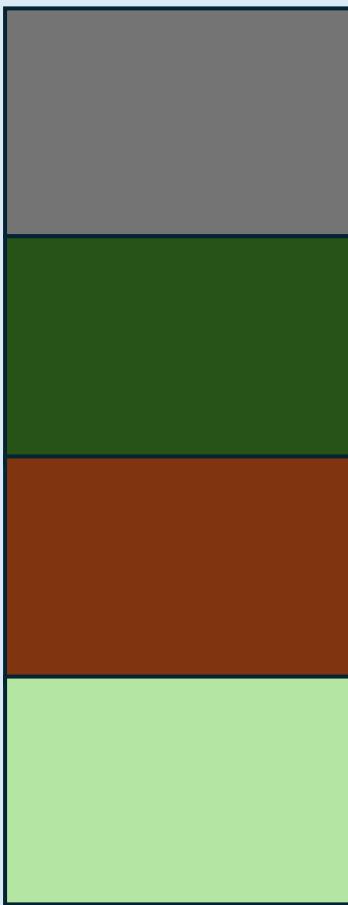
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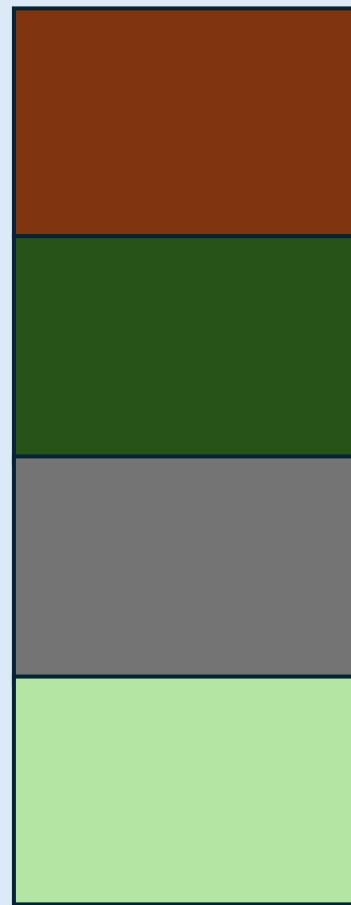
3



4



5



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Treatments

1

No cover crop (No CC) check

14-28 Day pre-plant (DPP) cover crop termination

3-7 DPP cover crop termination

1-3 Day after-plant (DAP) cover crop termination



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The data collected

Damage incidence



The data collected

Damage incidence

Damage type



The data collected

Damage incidence

Damage type

Sentinel prey



The data collected

Damage incidence

Damage type

Sentinel prey

Slug counts



The data collected

Damage incidence

Damage type

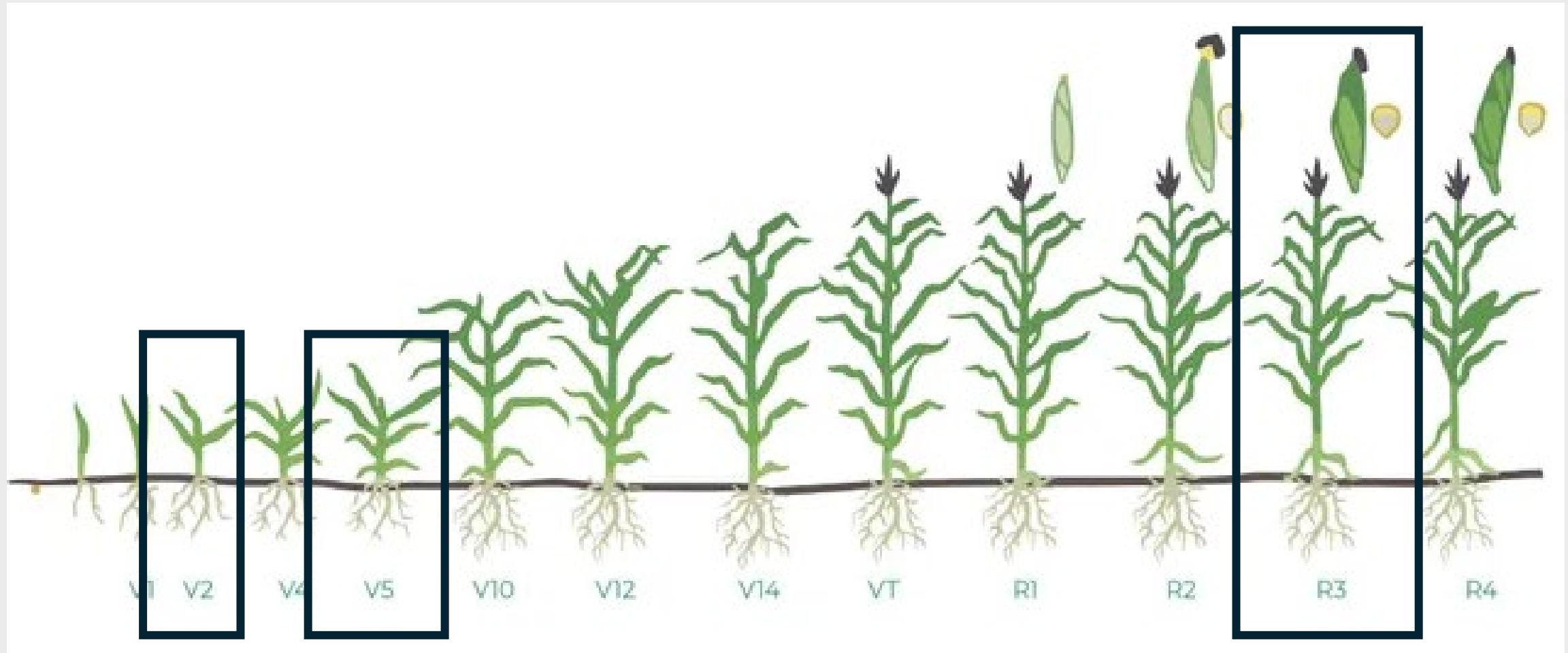
Sentinel prey

Slug counts

Pitfall (2022-2023)



Corn growth stages



Hypothesis



Background

Project layout

Slugs

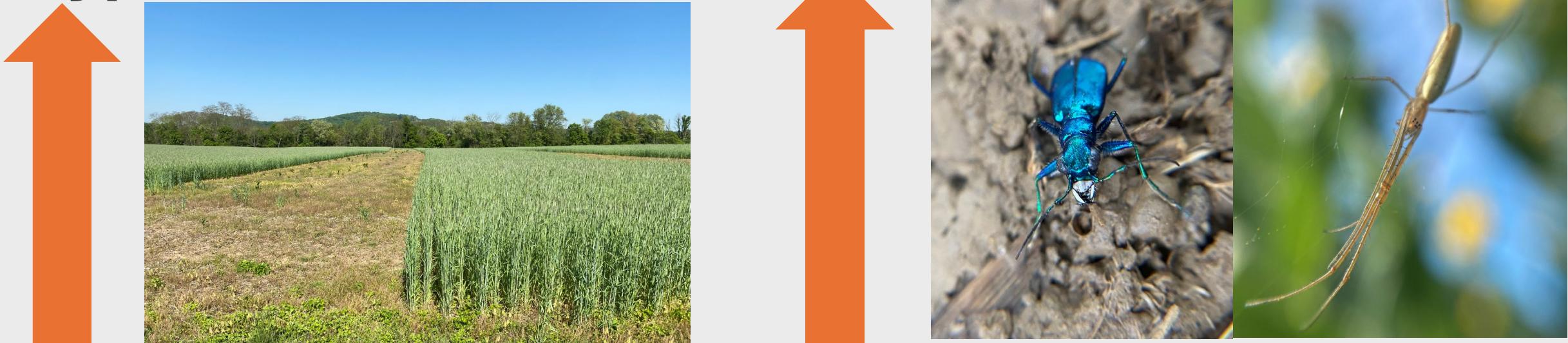
Predation

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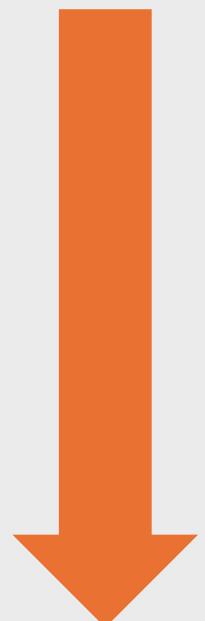
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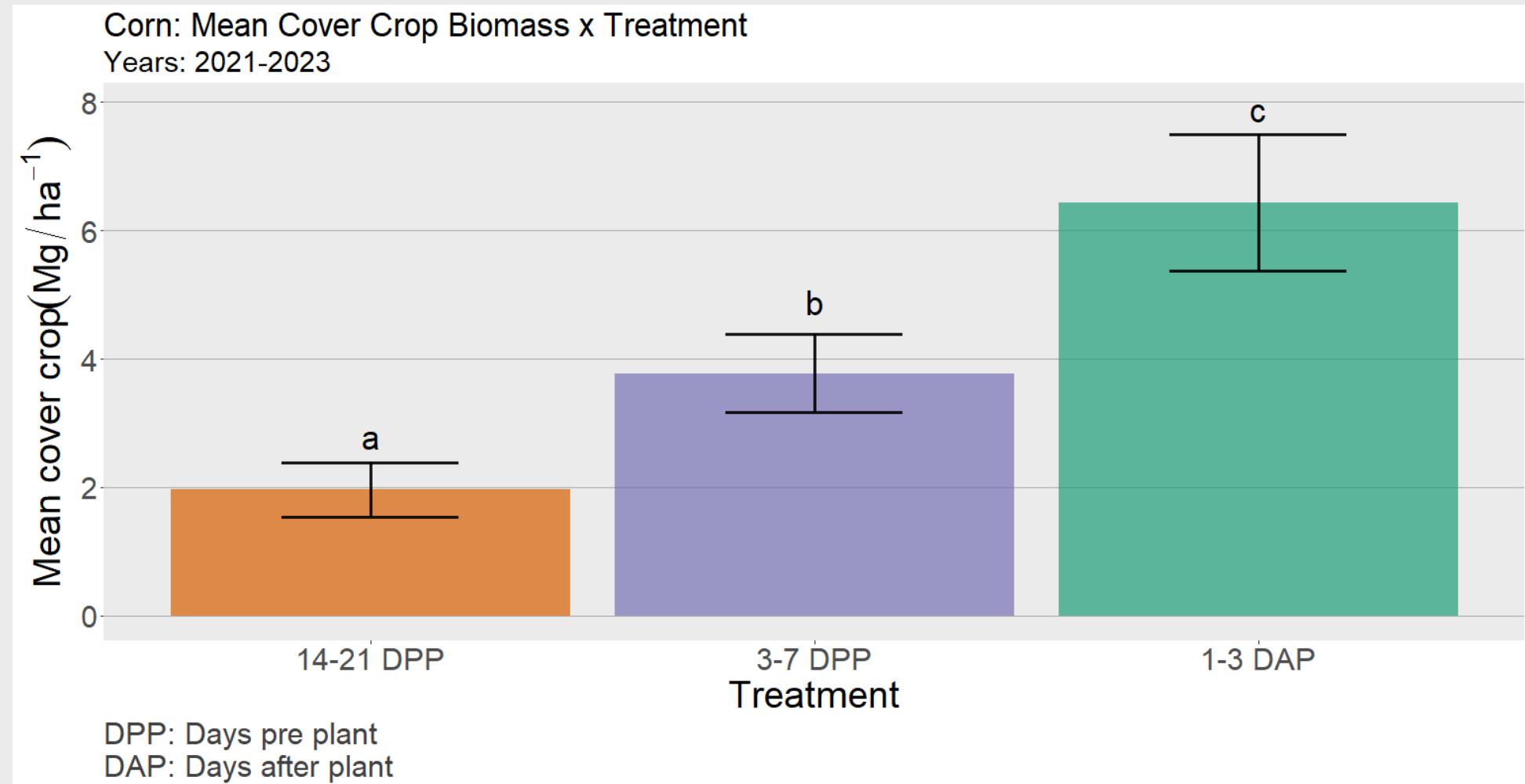
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More cover crop biomass with later termination

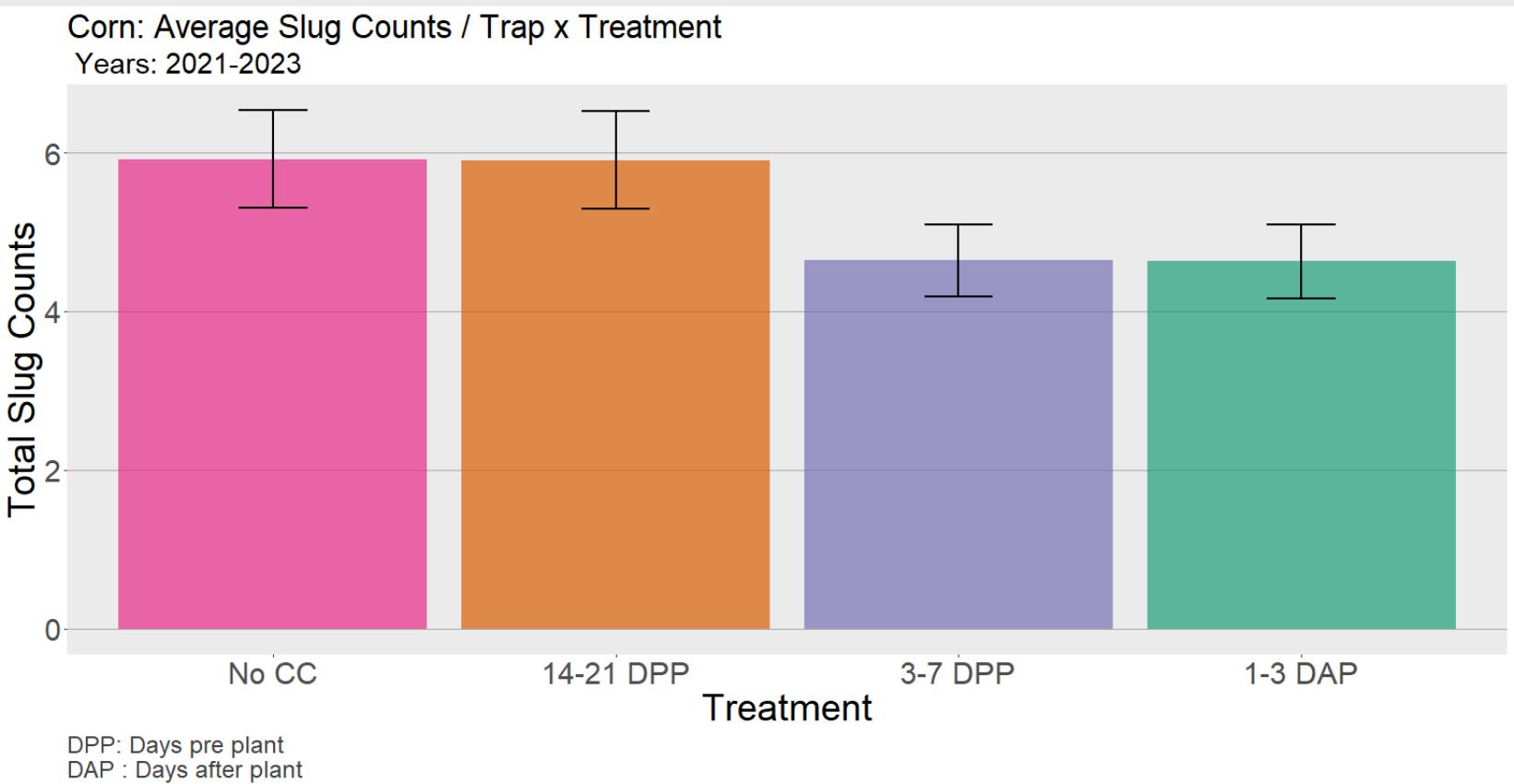


Slug populations are driven by precipitation

Conditional R² : 0.813

Marginal R²: 0.002

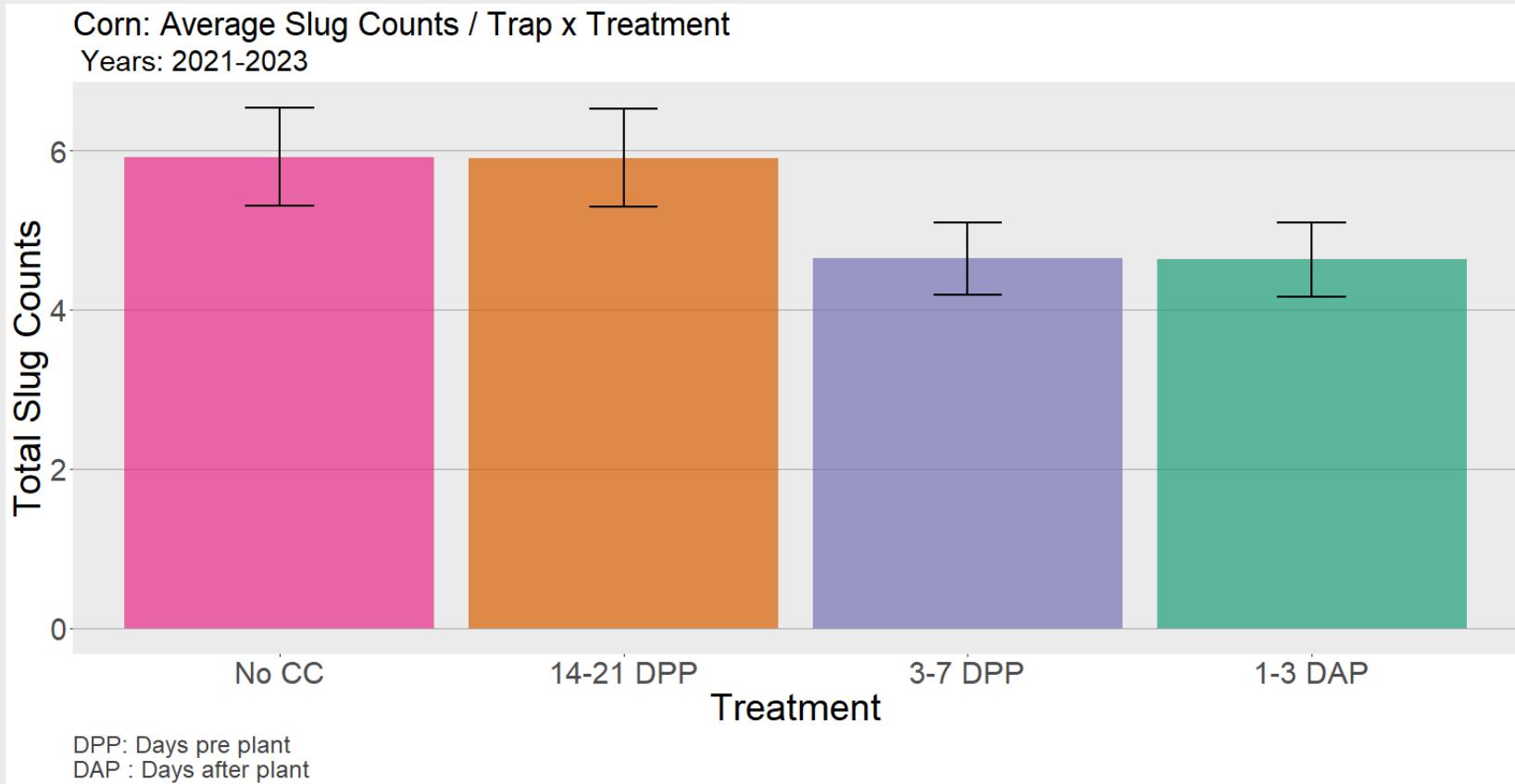
Random R² = 0.811



Slug populations are driven by precipitation

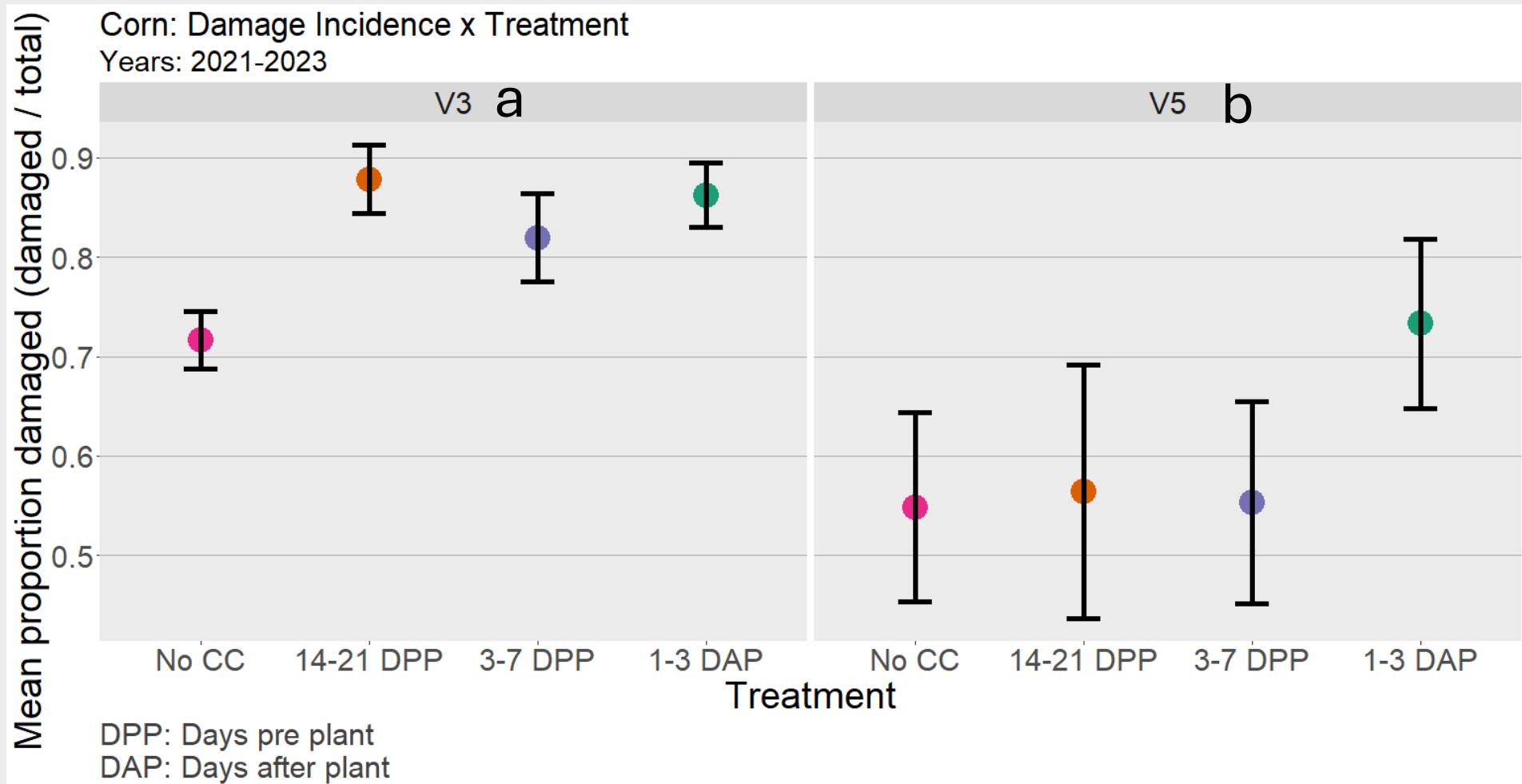
Without precipitation

Conditional R²: 0.035
Marginal R²: 0.007
Random R²: 0.028

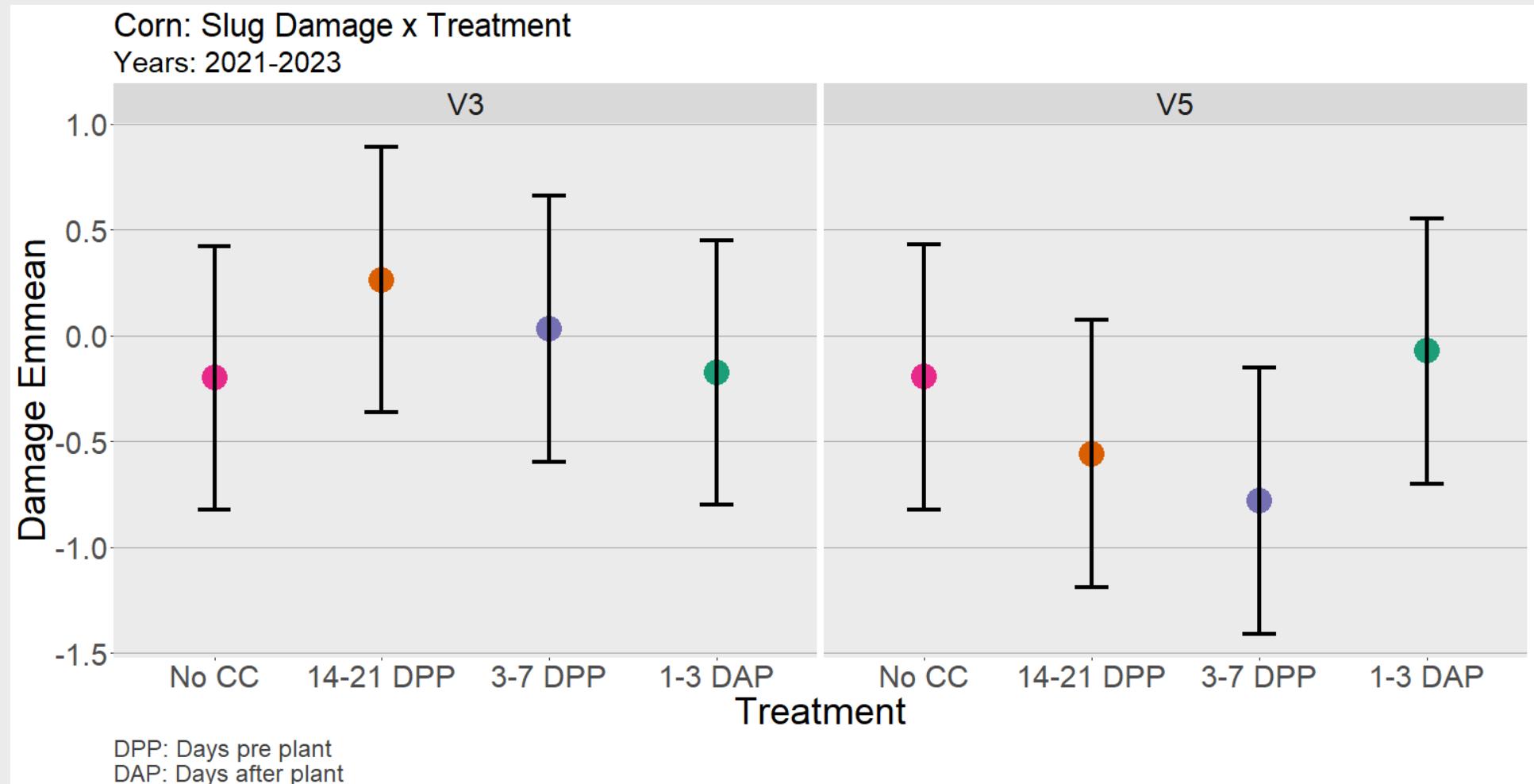


`glmer(proportion_damaged ~ treatment*growth_stage + (1|year/block/plotid/growth_stage), family = binomial)`

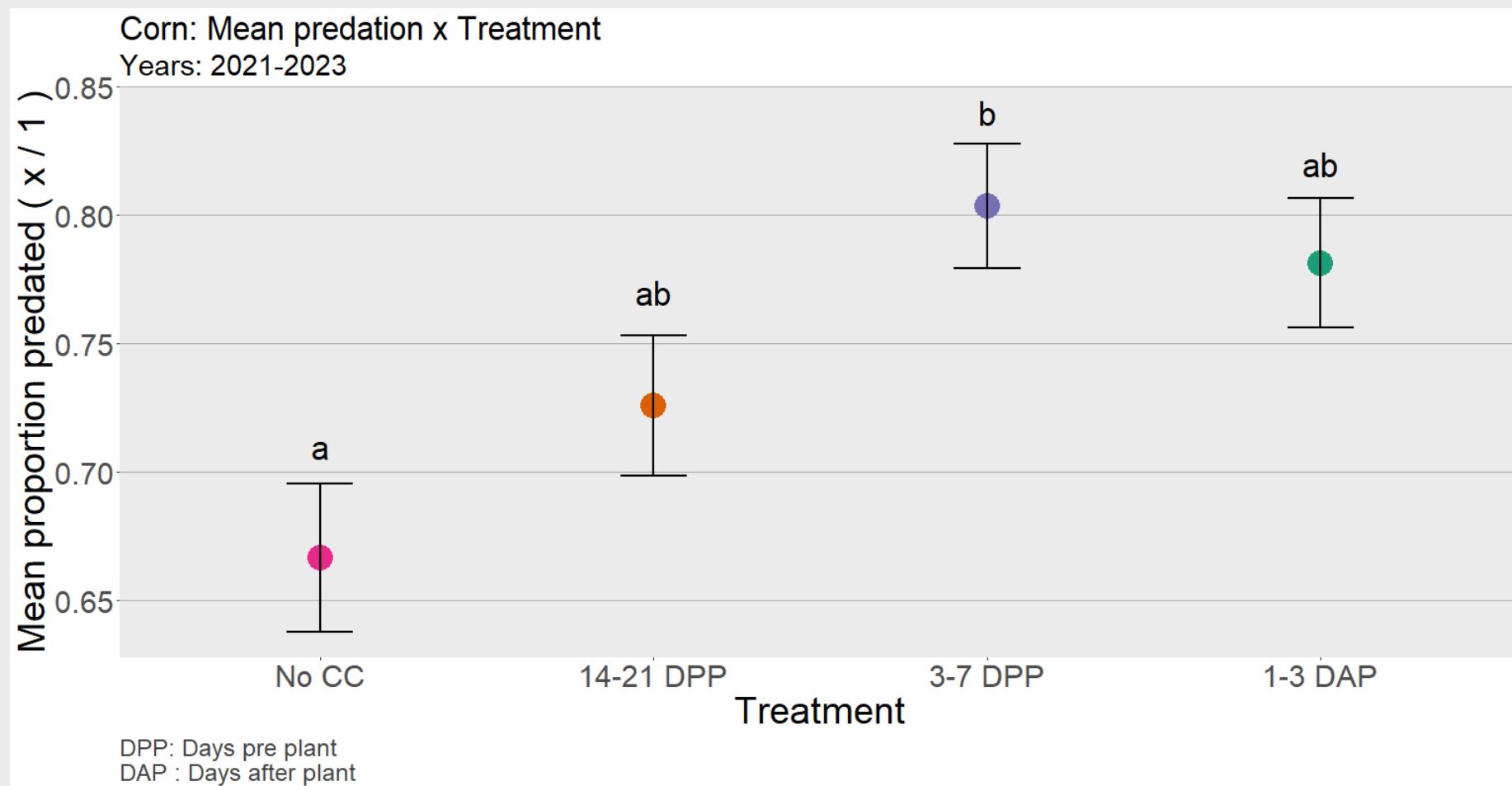
No treatment differences in total damage



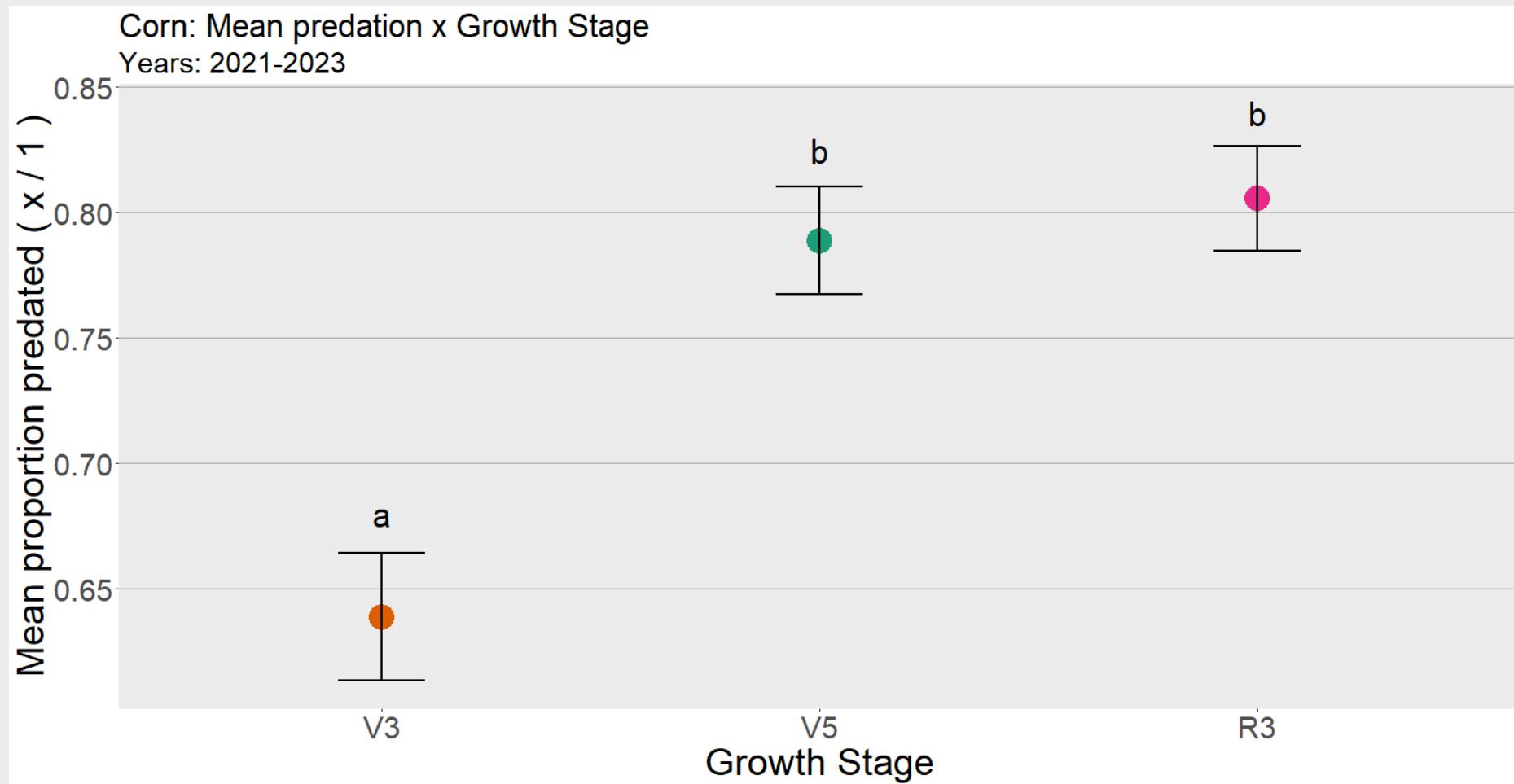
No differences in slug damage



Predators eat more prey with more cover crop



Predators eat later in the season

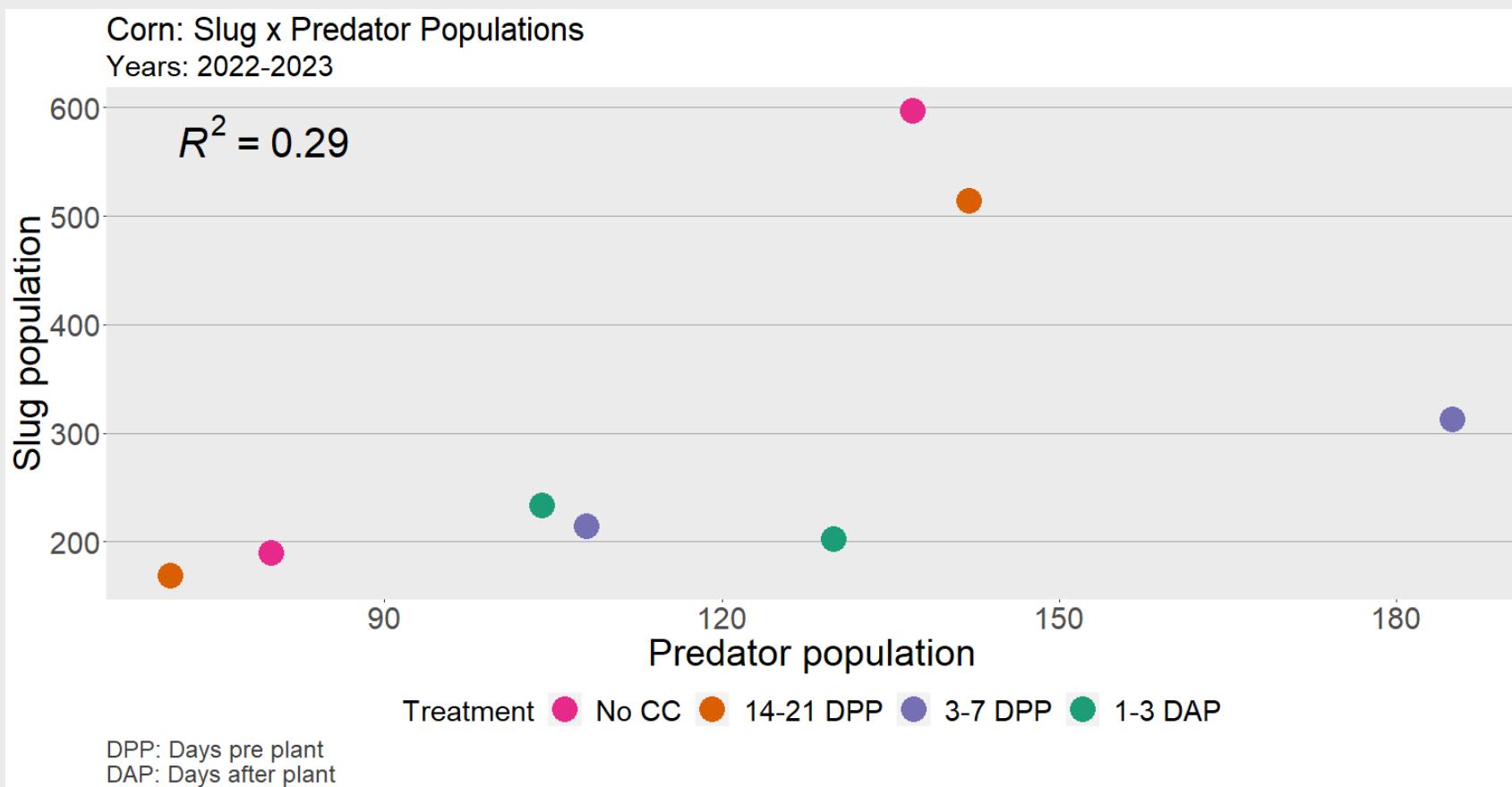


Inverse relationship of predators x slugs

Corn

Predators:

Spiders, Carabids,
Staphylinids,
Formicids, Ensifera,
etc.



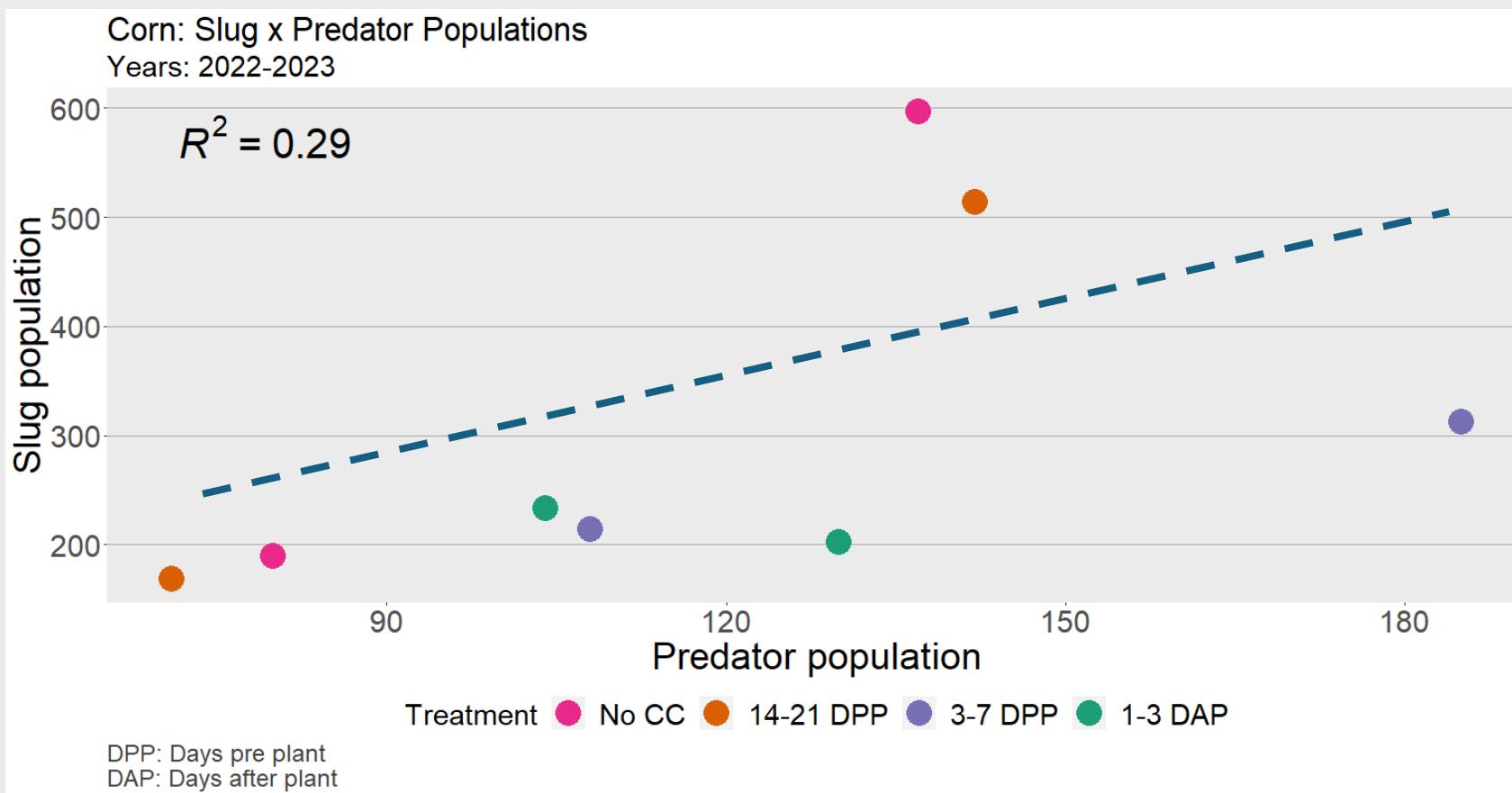
Inverse relationship of predators x slugs

Corn

Predators:

Spiders, Carabids,
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etc.

Trending **increase**
in slugs with an
increase in
predators

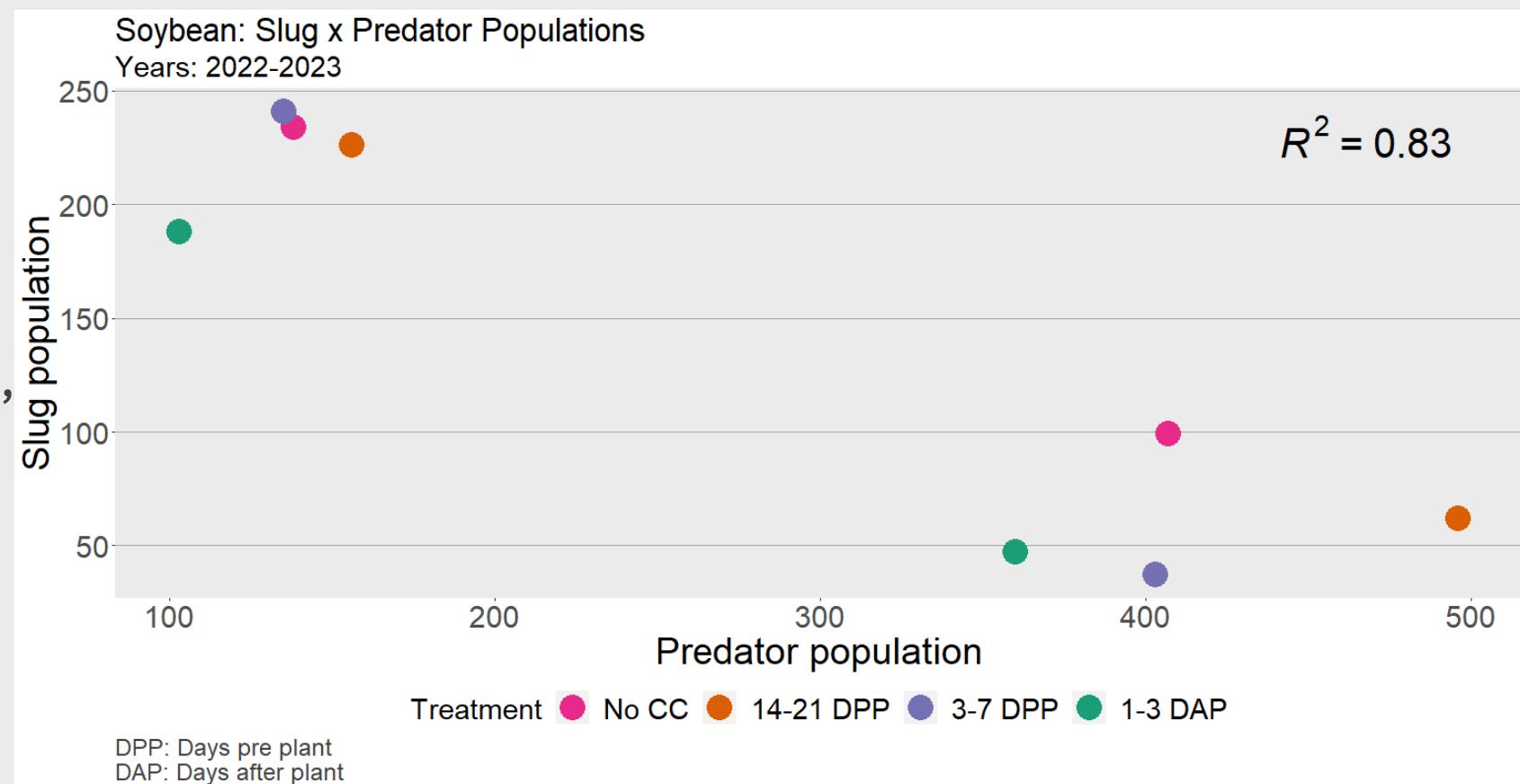


Predicted relationship of predators x slugs

Soybean

Predators:

Spiders, Carabids,
Staphylinids,
Formicids, Ensifera,
etc.



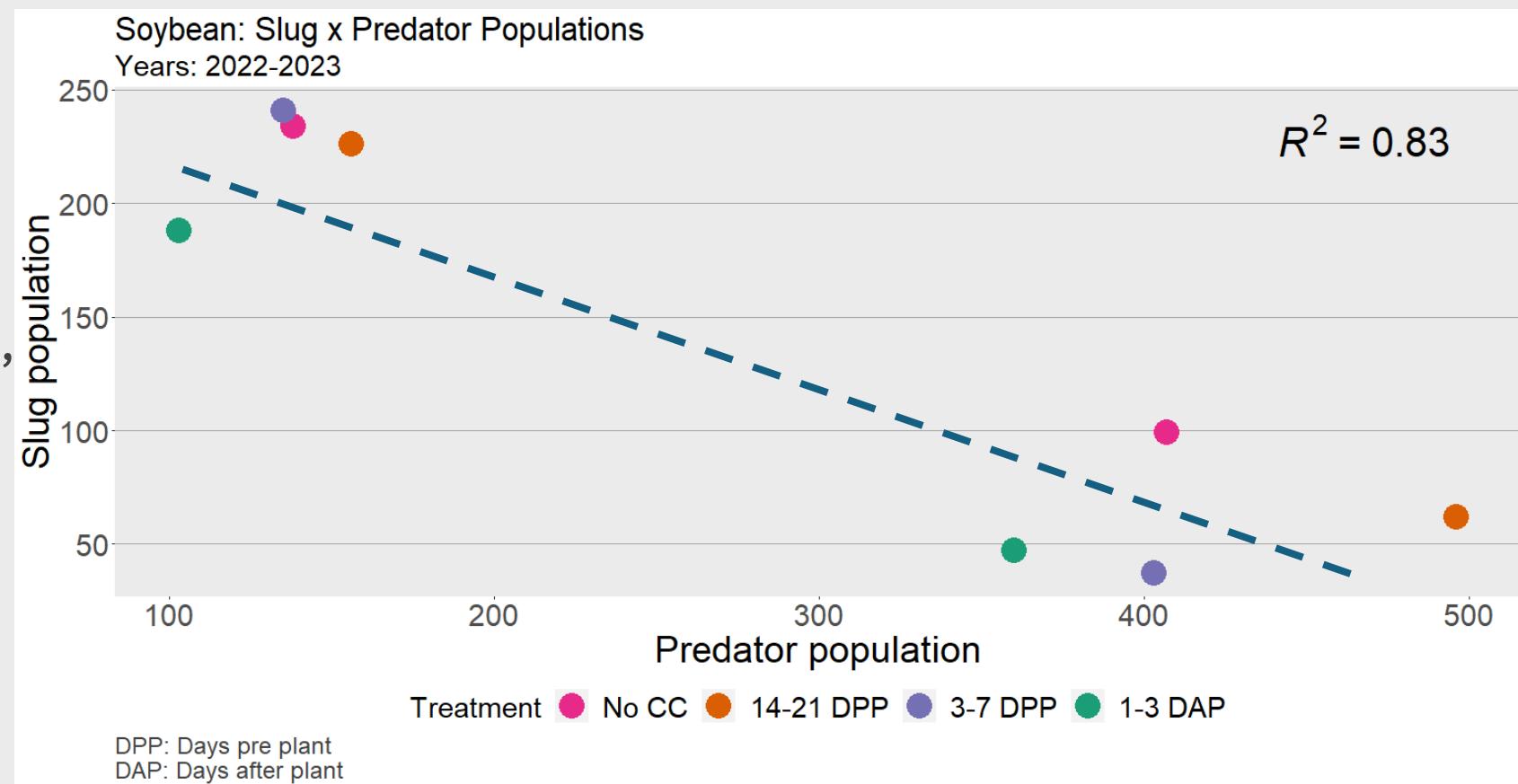
Predicted relationship of predators x slugs

Soybean

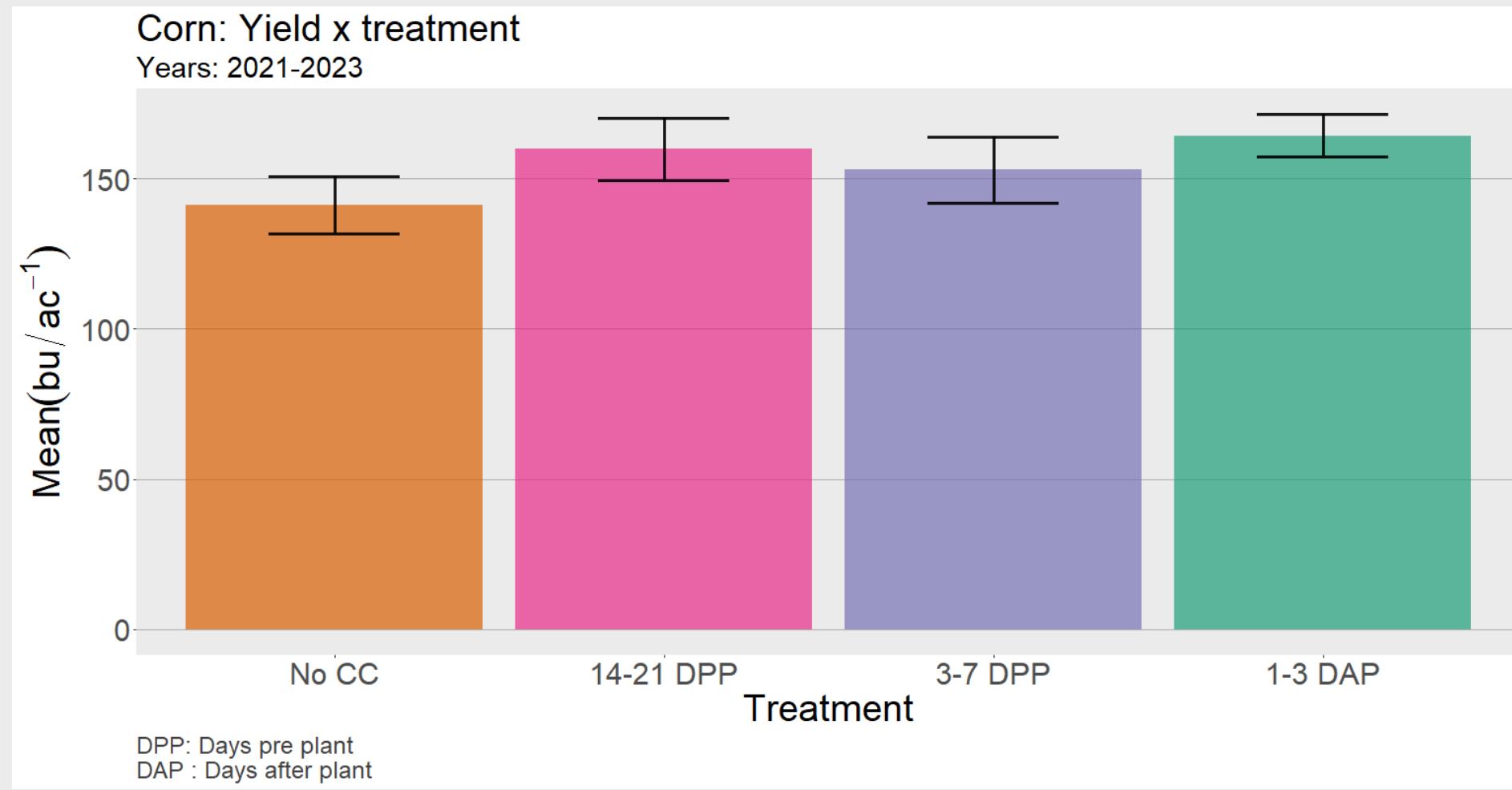
Predators:

Spiders, Carabids,
Staphylinids,
Formicids, Ensifera,
etc.

Trending **decrease**
in slugs with an
increase in
predators



No differences in yield x treatment



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Conclusions

No differences in slug counts by treatment or year

Driven by precipitation

Sentinel prey

More prey consumption later in the season

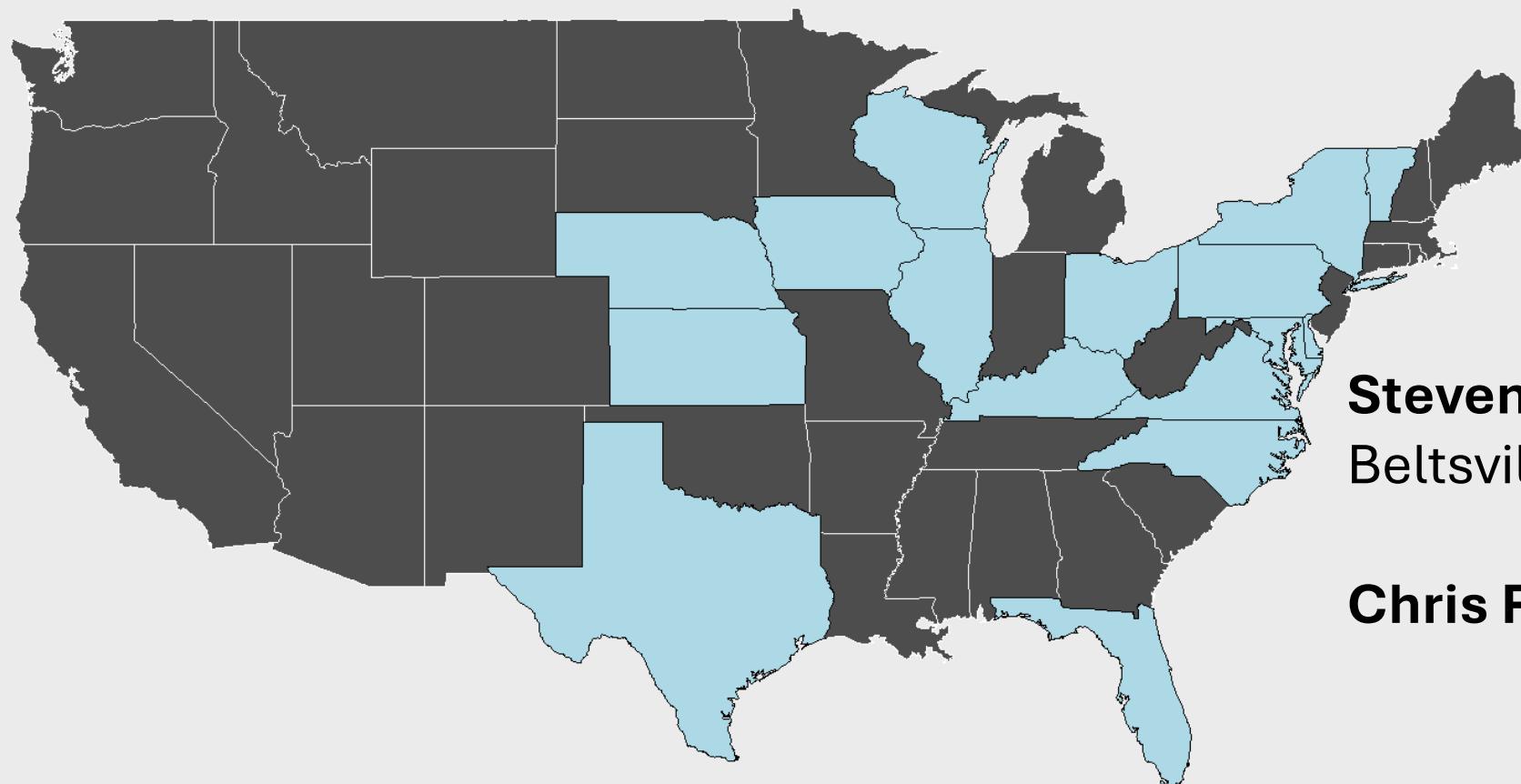
Predators

Corn *trending* an **increase** in slugs with an increase in predators

Soybeans *trending* a **decrease** in slugs with an increase in predators

No treatment differences in yield

Project replicates



Steven Mirsky: USDA –
Beltsville, MD

Chris Reberg-Horton: NCSU

Future Directions



Synthesize across 16 state replicates

Not all with slugs

Analyze regional affects of cover crop termination timing

Conduct one/several more seasons to tease out trends in regressions

Add a leguminous cover crop to the mix

Acknowledgments

Precision Sustainable Ag

Tooker lab

Wallace Lab

Sara Hermann

Tosh Mazzone



PennState
College of
Agricultural Sciences



Questions?

