Enhancing Arthropod-Mediated Ecosystem Services by Alleviating Key Stressors in Specialty Crop Production

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What are **stressors** for beneficial arthropods providing *ecosystem services*?

1. **Insecticides**

- broad-spectrum (e.g., pyrethroids, neonicotinoids)
- prophylactic vs. reactionary (IPM using thresholds)

What are **stressors** for beneficial arthropods providing *ecosystem services*?

2. **Floral Resources**

- lack of pollen & nectar availability
- affects both pollination & biocontrol

What are **stressors** for beneficial arthropods providing *ecosystem services*?

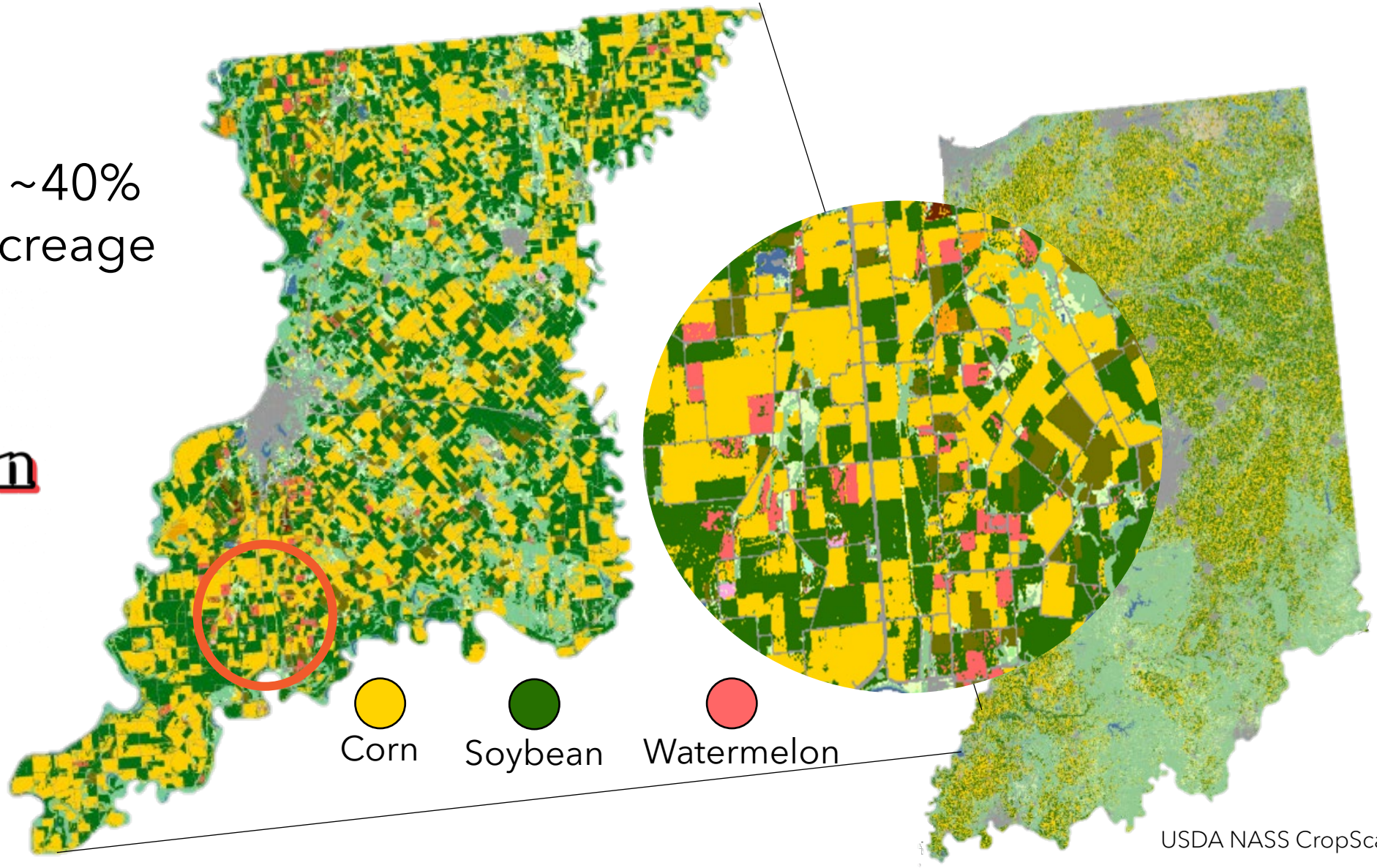
3. **Managed Species**

- specific to pollination
- honey bees (*Apis mellifera*) & bumble bees (*Bombus impatiens*)

cucurbits ideal system to test effects of stressors on arthropod-mediated ecosystem services

No, Indiana doesn't just grow corn!

- Knox County: ~40% watermelon acreage



USDA NASS CropScape

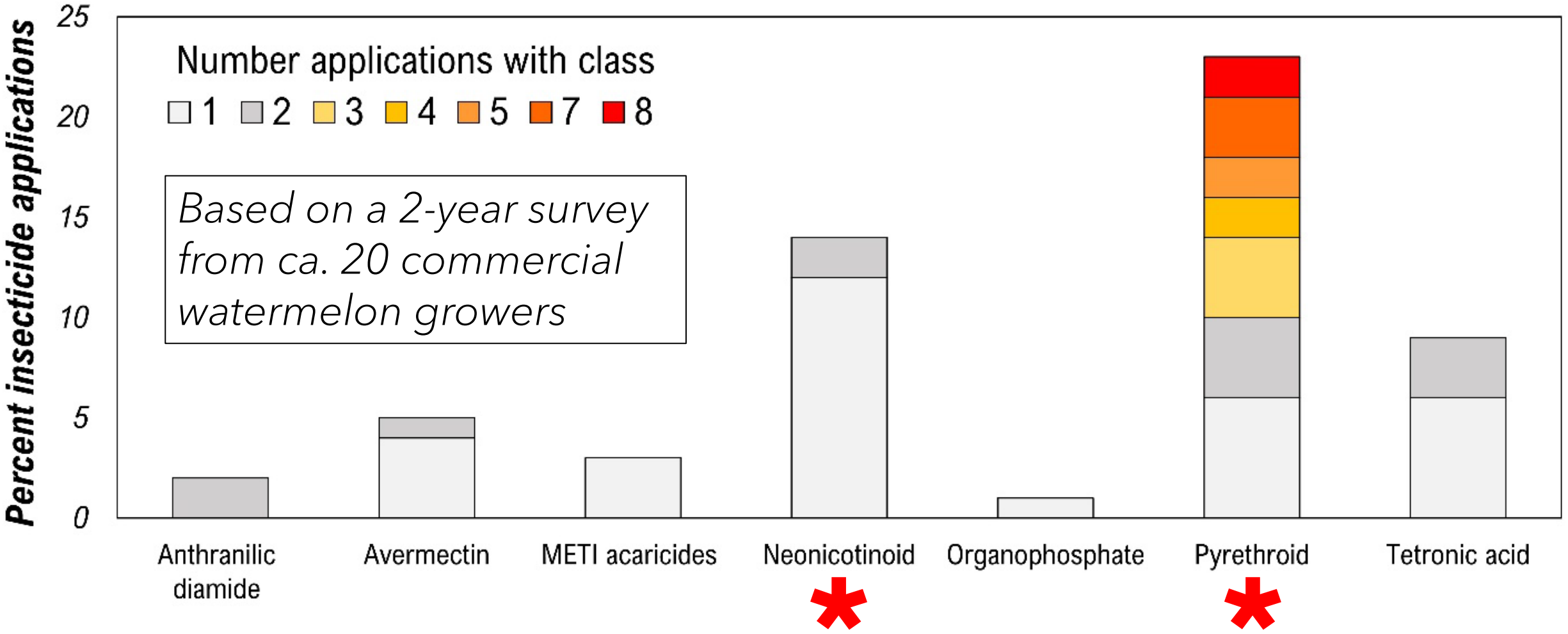
Seedless watermelon uses a **pollenizer**-based pollination system

Self-incompatible **agronomic mule**: pollen from diploid (2N) ‘pollenizer’ moves to crop (4N), tetraploid watermelon), resulting in a triploid (3N) fruit

Growers supplement with **managed bees**

All use honey bees; *some* also use bumble bees

A “standard” approach to **insecticide use** for insect pests on watermelon in Indiana



← **rye** isn't a great pollinator resource

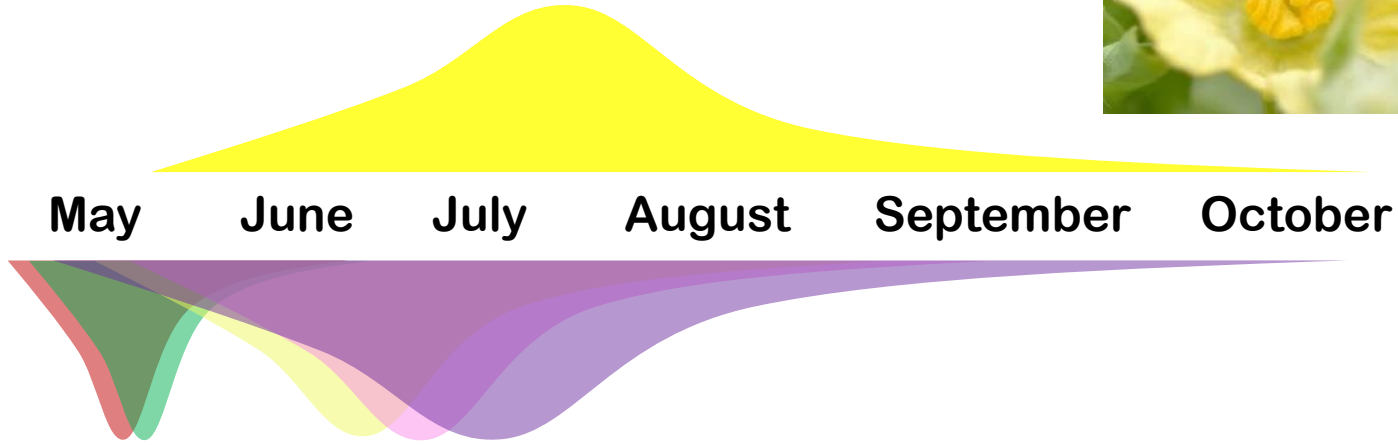
Can we improve pollination with a **flowering cover crop**?

Zeus Mateos Fierro

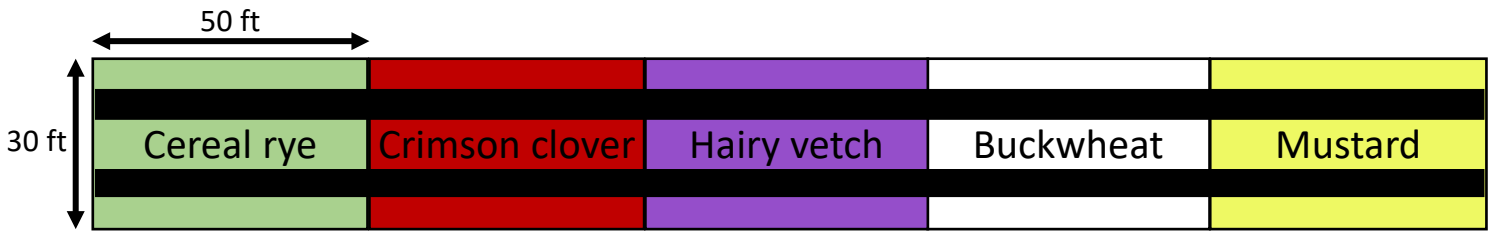
Cover crops have different **bloom times**

Cover crops flower *before* or *during* watermelon bloom

Competition between visits to cover crop and watermelon flowers?



Field trial design: **2023**



5 treatments with 15 total plot reps across 3 research farms:

1. cereal rye (control)
2. crimson clover
3. hairy vetch
4. buckwheat
5. mustard

No managed bees were used
No insecticides were applied

Pollinator surveys

Abundance & diversity

- transects May to August
- cover crop visitors
- watermelon visitors

Watermelon **pollinator diversity**

Apis mellifera

Large bees

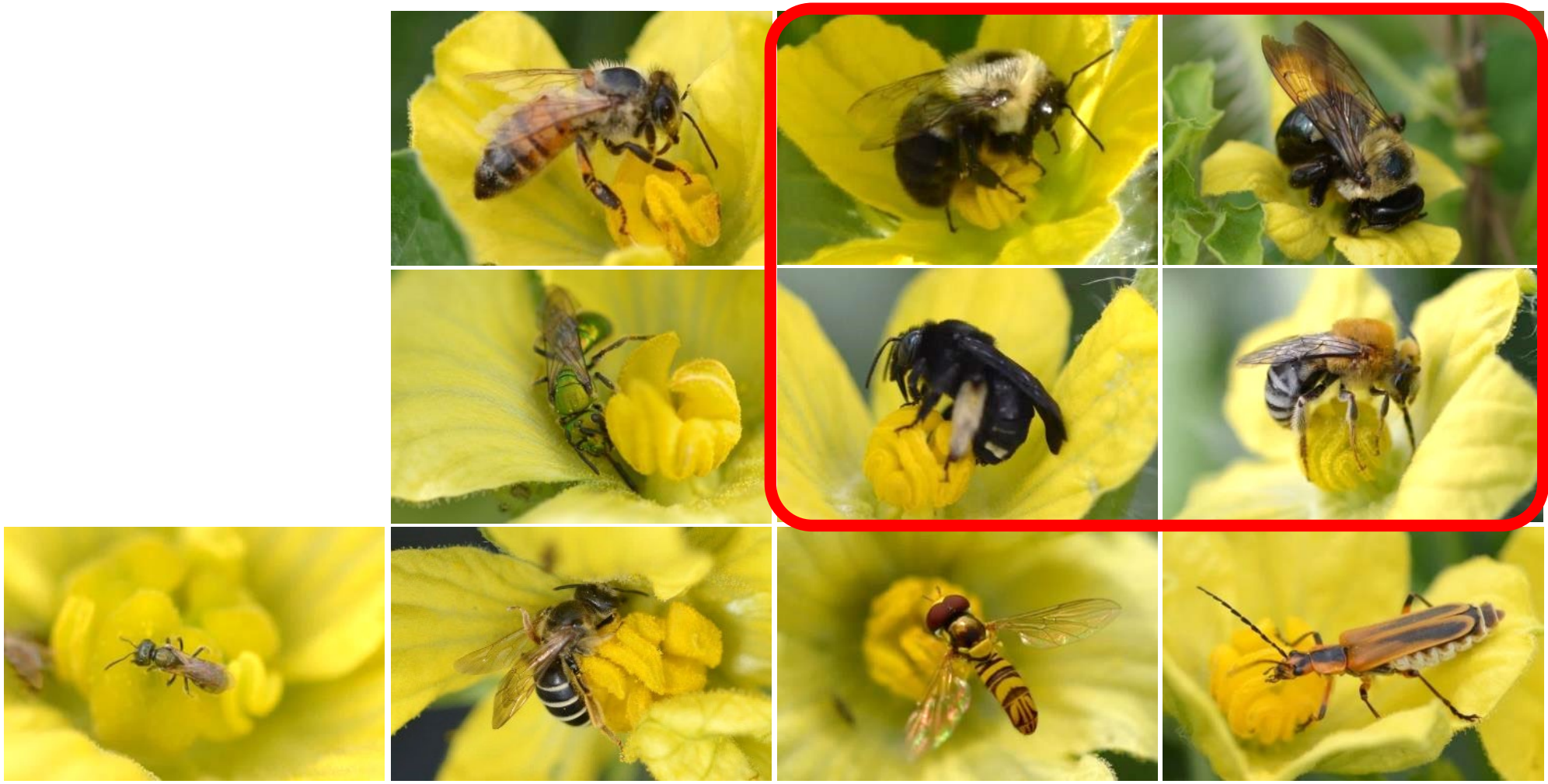
- *Bombus*
- *Xylocopa*
- *Eucera*
- *Melissodes*

Small bees

- Augochlorini
- *Lasioglossum*
- *Halictus*

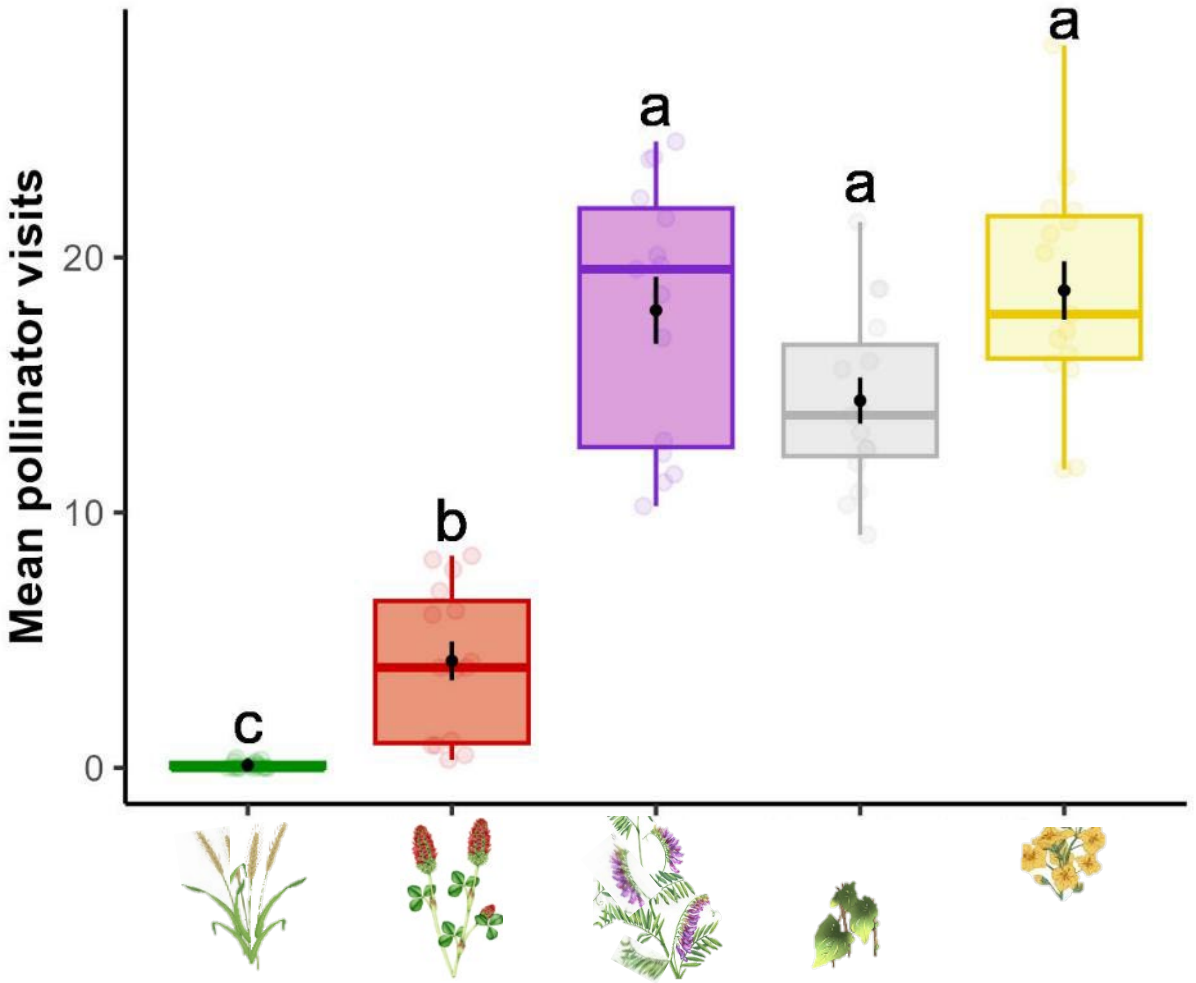
Syrphidae

Cantharidae



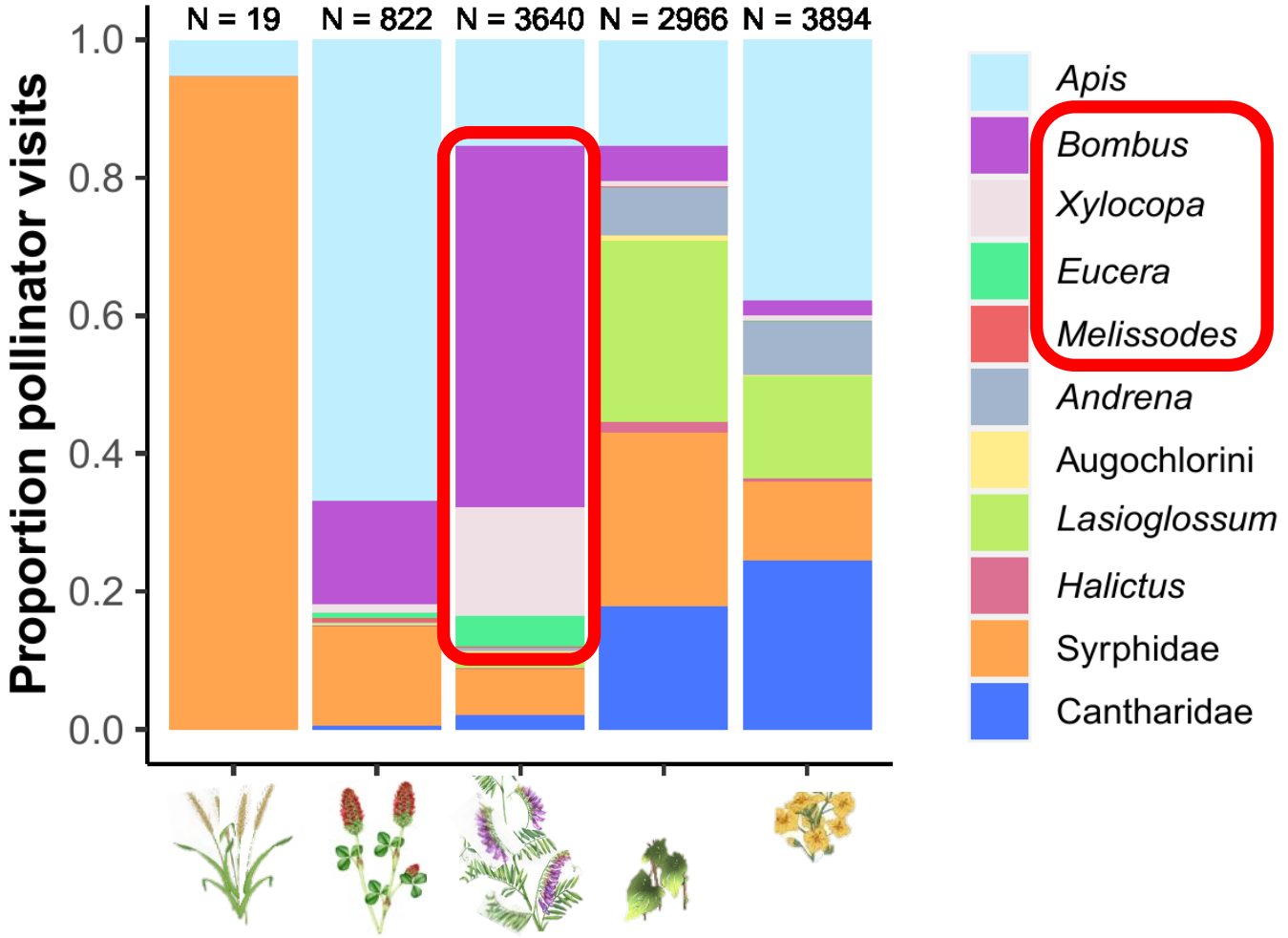
Flowering cover crops attract more bees

Lowest pollinator visits to the **rye** cover crop flowers



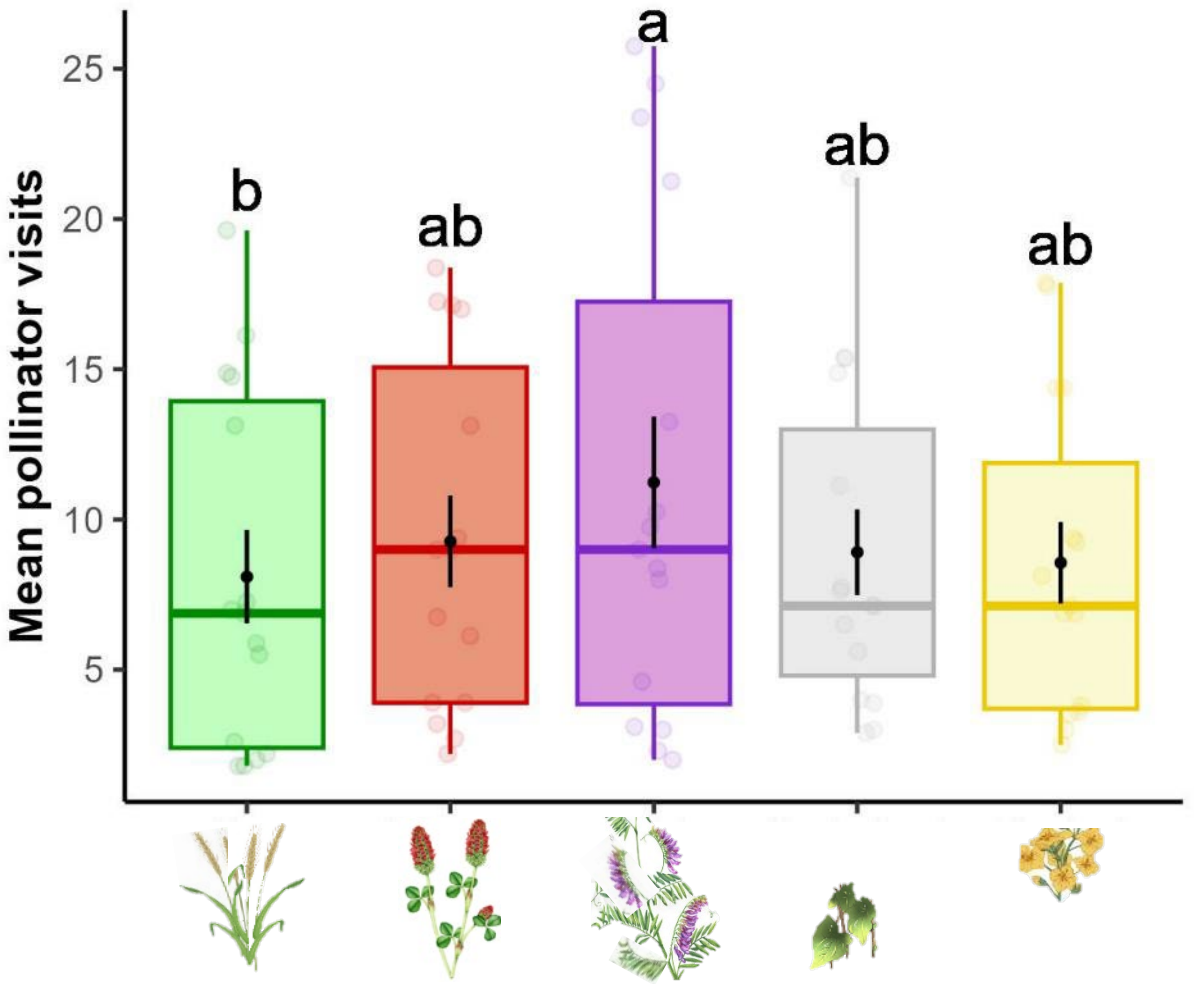
Flowering cover crops increase diversity

Lowest pollinator diversity
visiting **rye** cover crop flowers



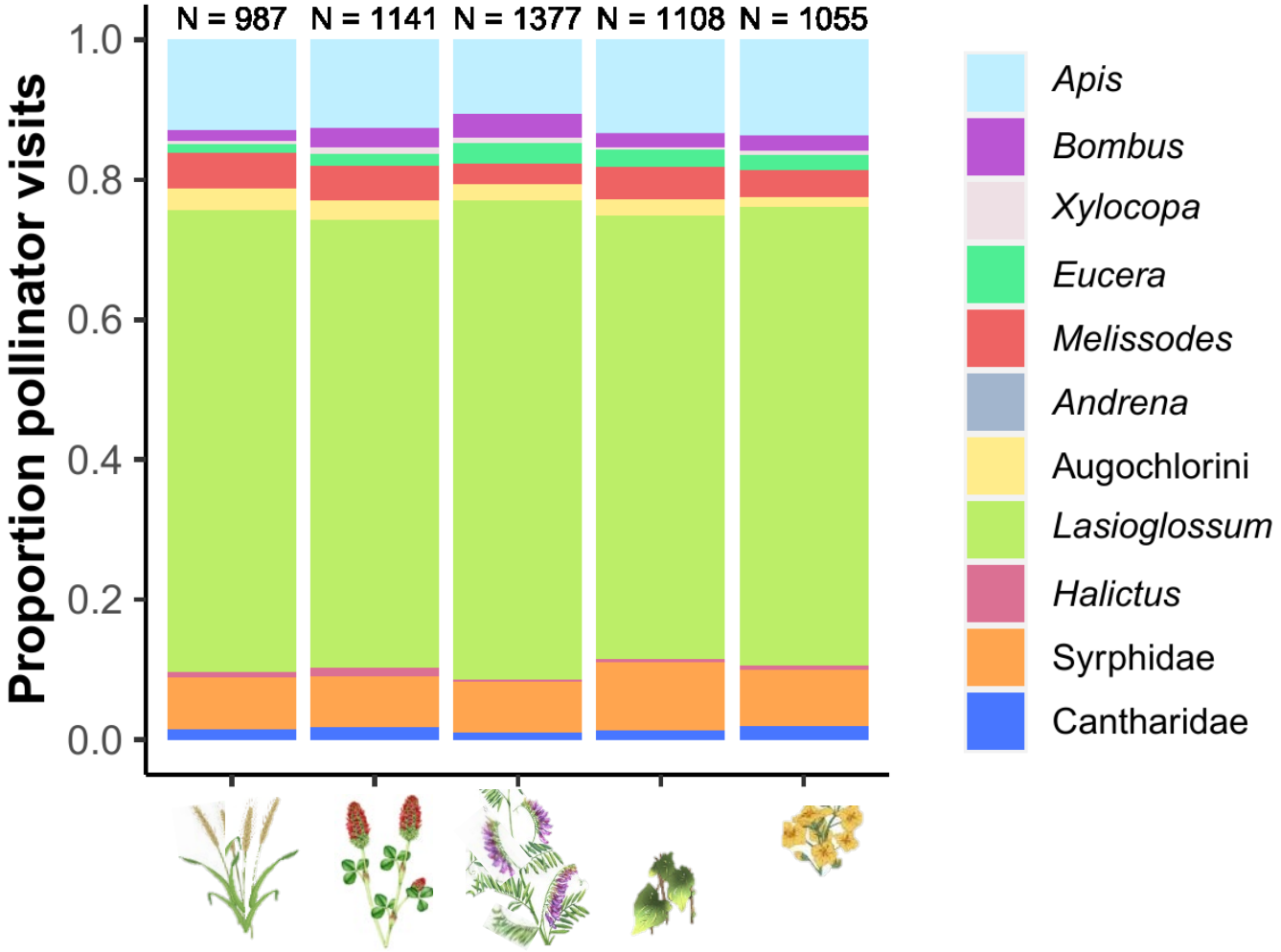
Vetch "spillover" to watermelon

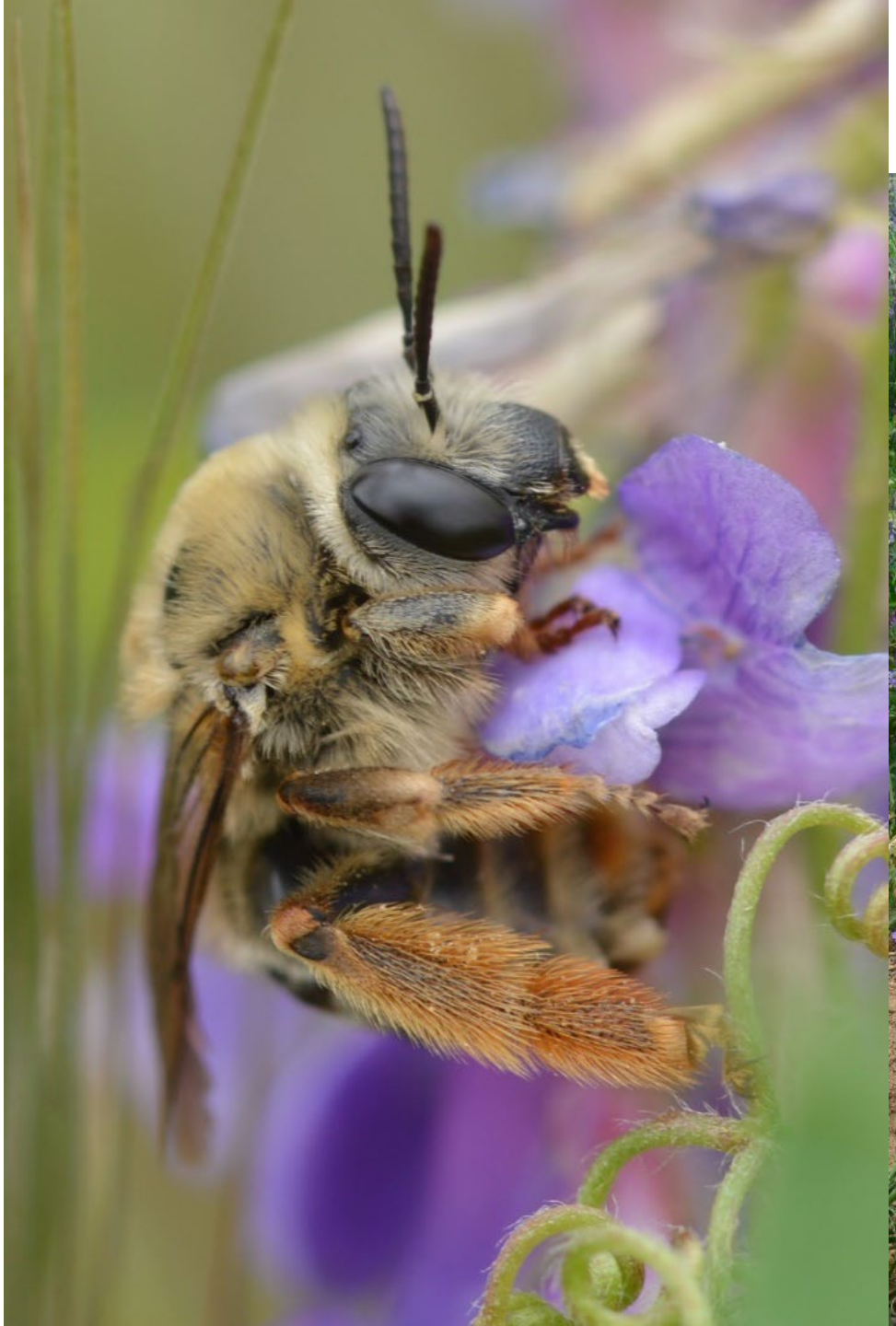
More pollinators visiting watermelon flowers in the **vetch** plot



…but no major shifts in diversity

Pollinator communities consistent between watermelon plots





2023 ➡ 2024

Field Design

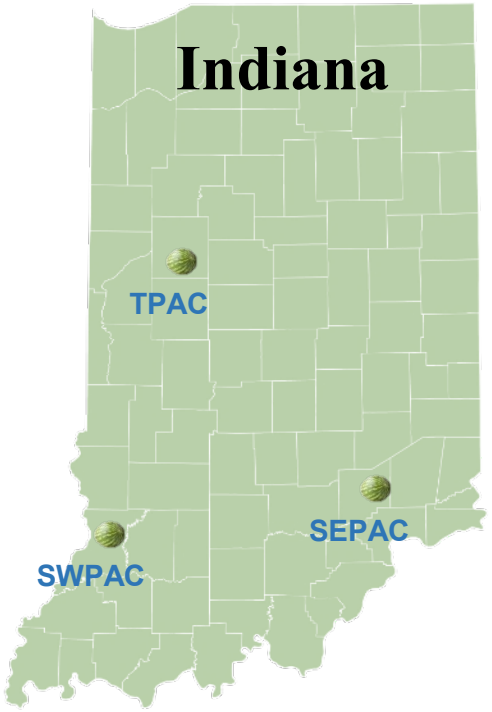
Two fields per location

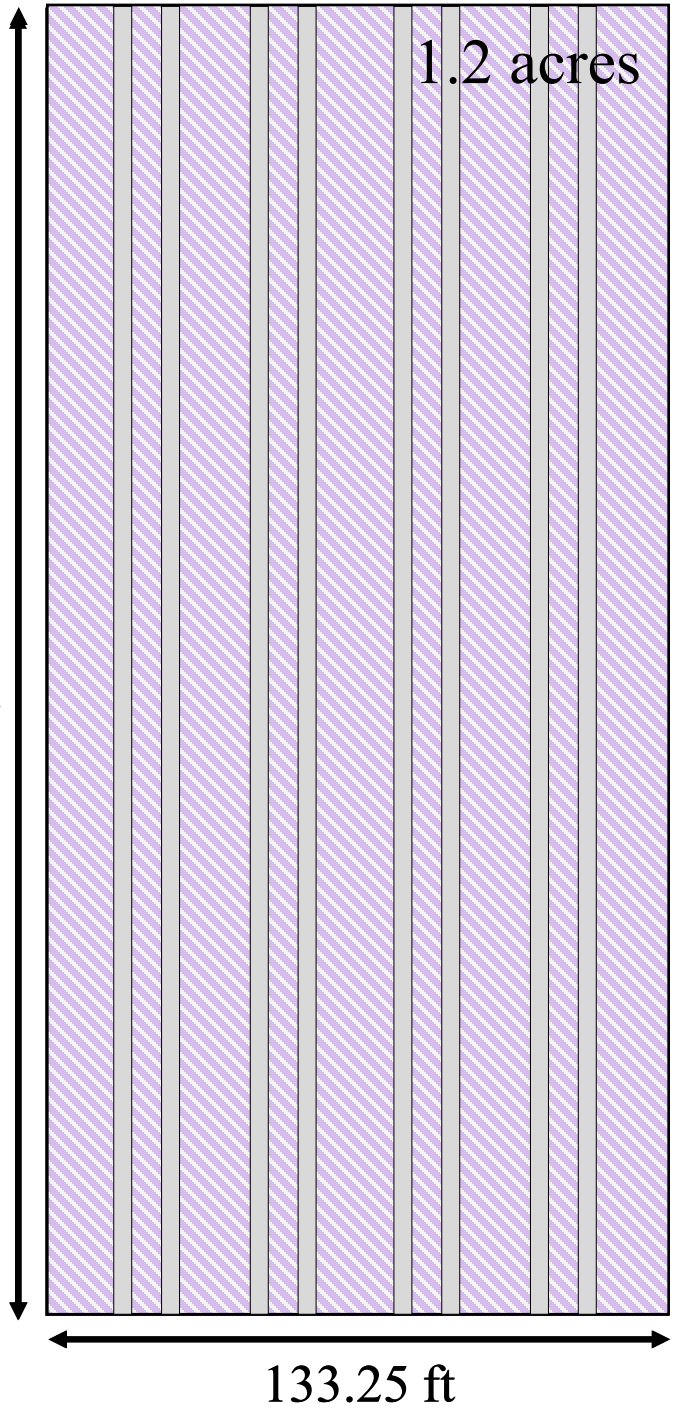
1. Conventional management

- Rye cover
- Calendar insecticide applications
- Managed bumble bees

2. Ecological intensification

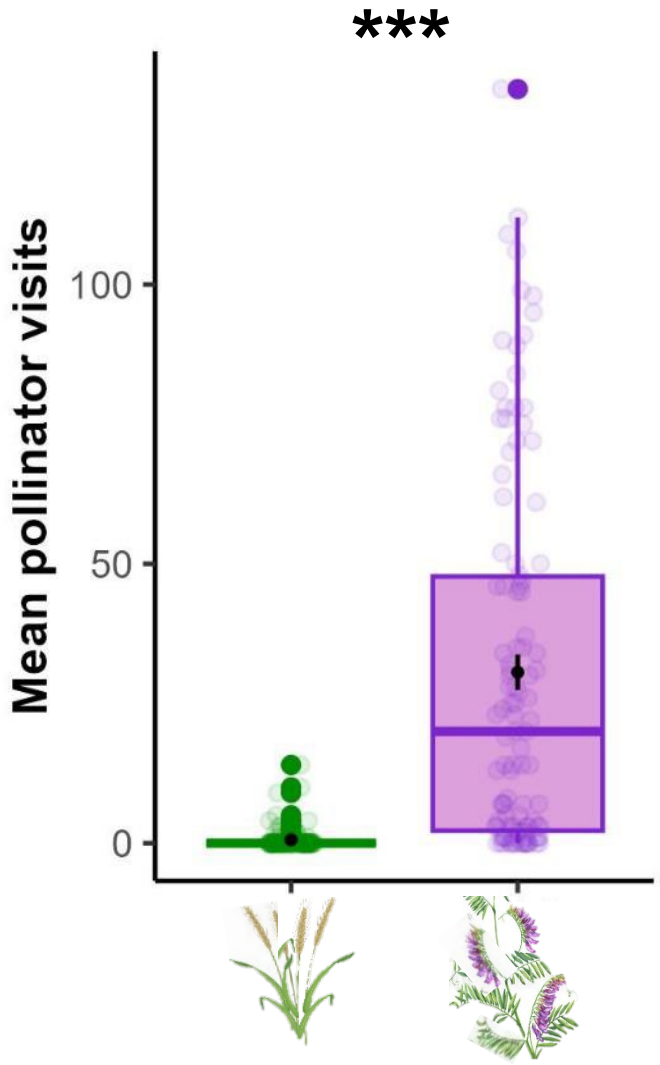
- Vetch cover
- Threshold-based recommendations
- Rely on wild bees





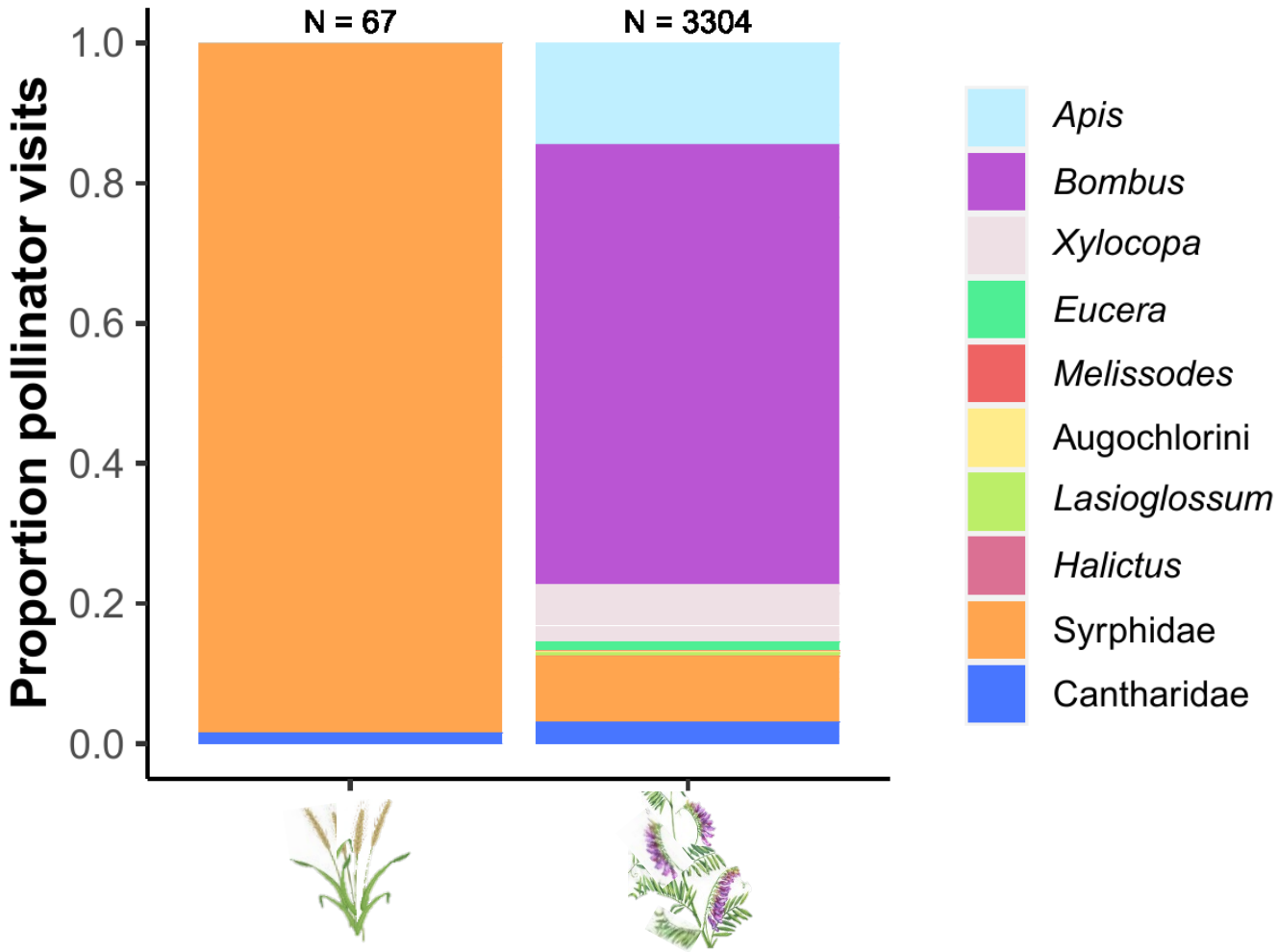
Vetch *still* more **attractive** than rye

More pollinator visits to cover crop flowers in the vetch plot



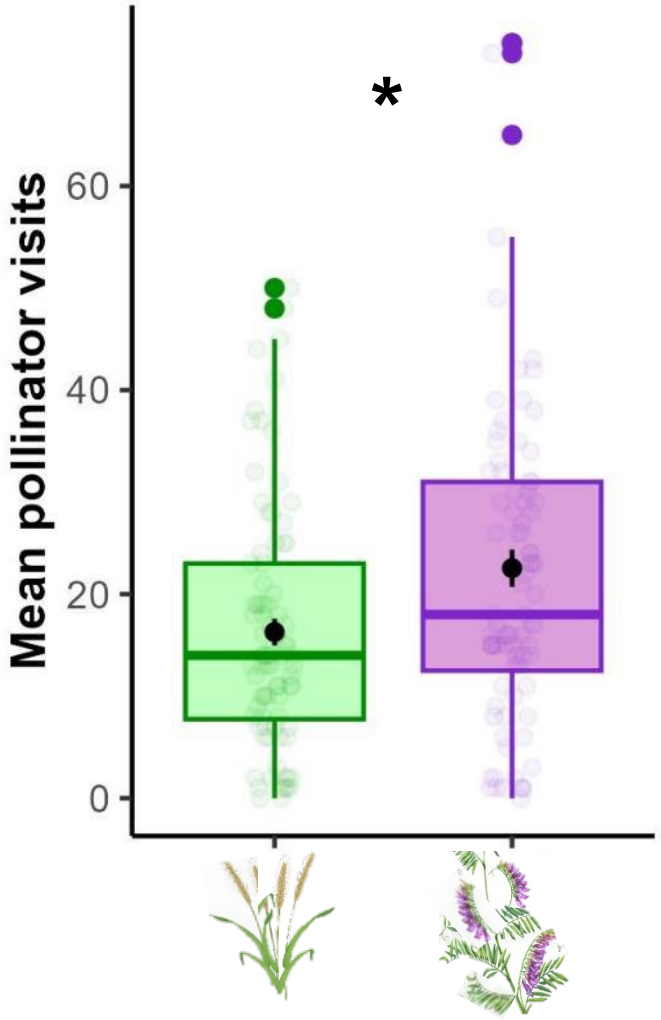
Vetch bees *still* more **diverse** than rye

Lowest pollinator diversity visiting **rye** cover crop flowers



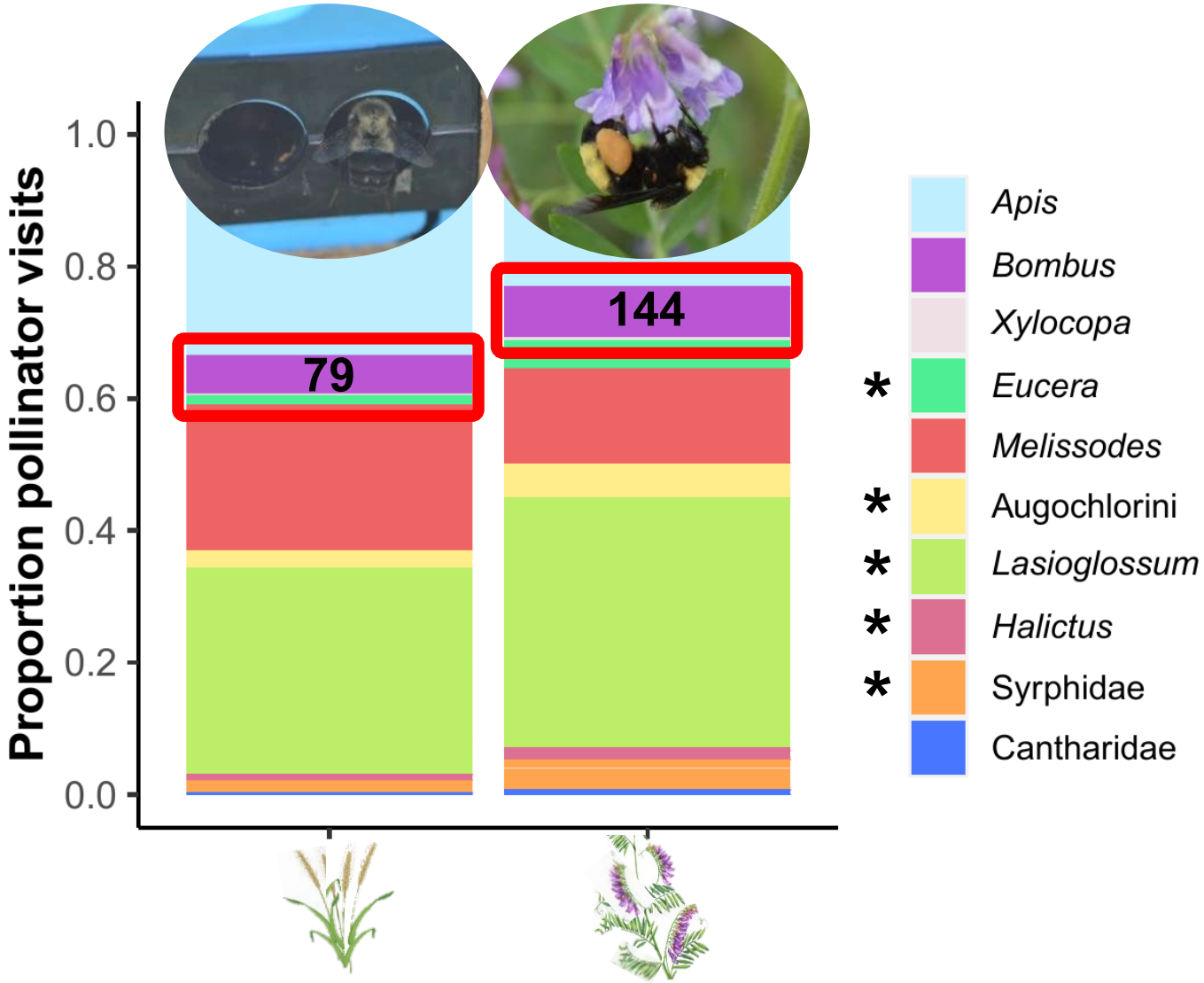
Vetch fields had higher pollination *despite* not stocking bees!

Ecological intensification outperformed **conventional system** for crop pollination



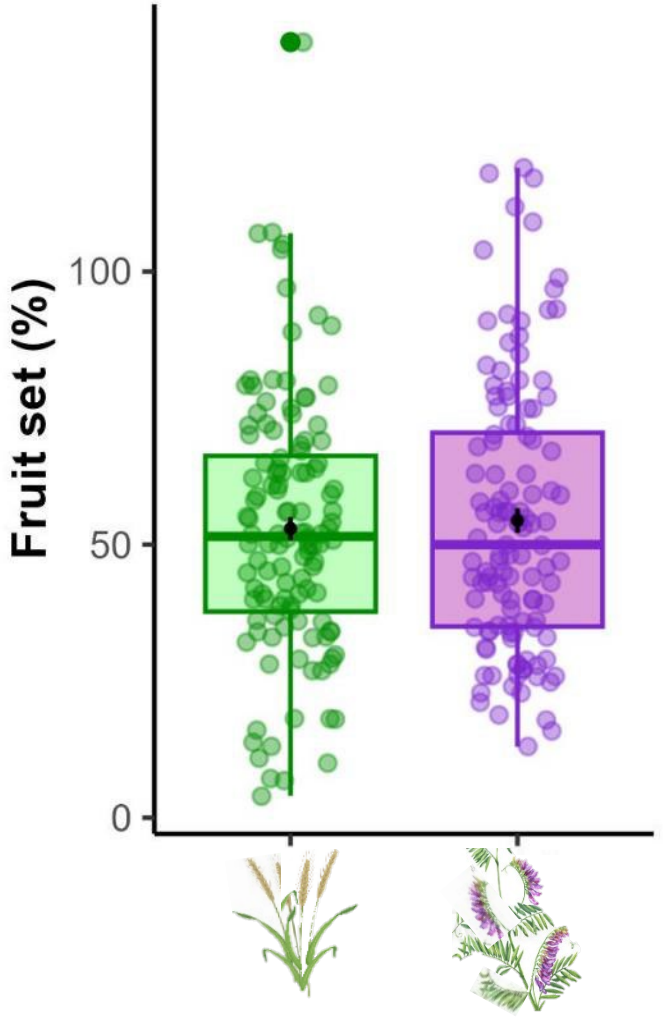
Still comparable bee diversity in crop

Pollinator diversity was **consistent** between plots in watermelons

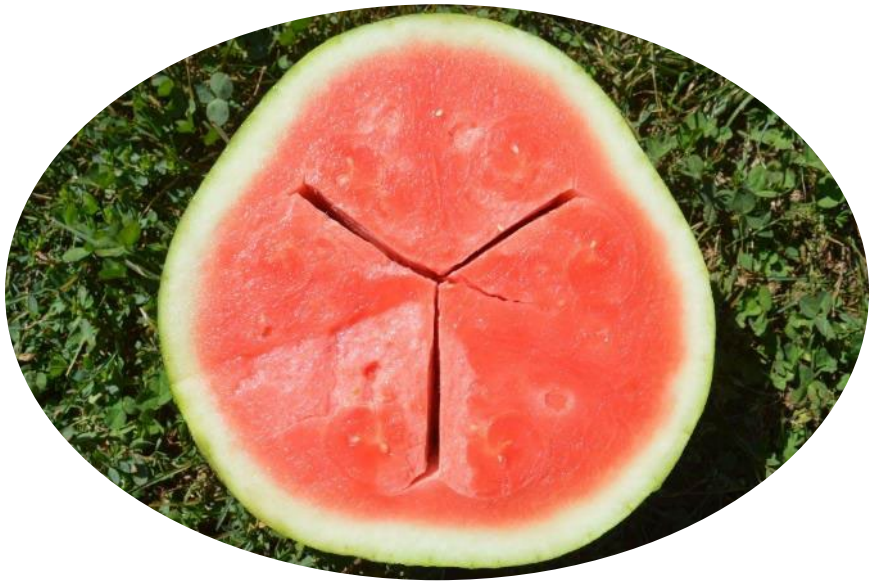


Same yields between the two systems!

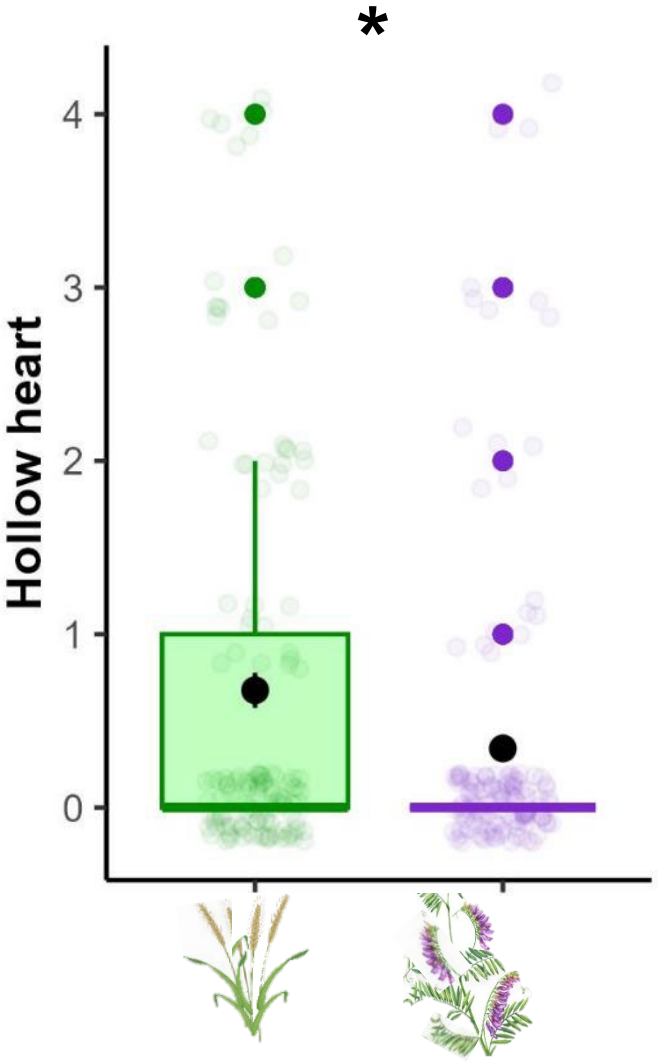
No differences in # of melons harvested or fruit weight



Lower hollow heart in vetch plots

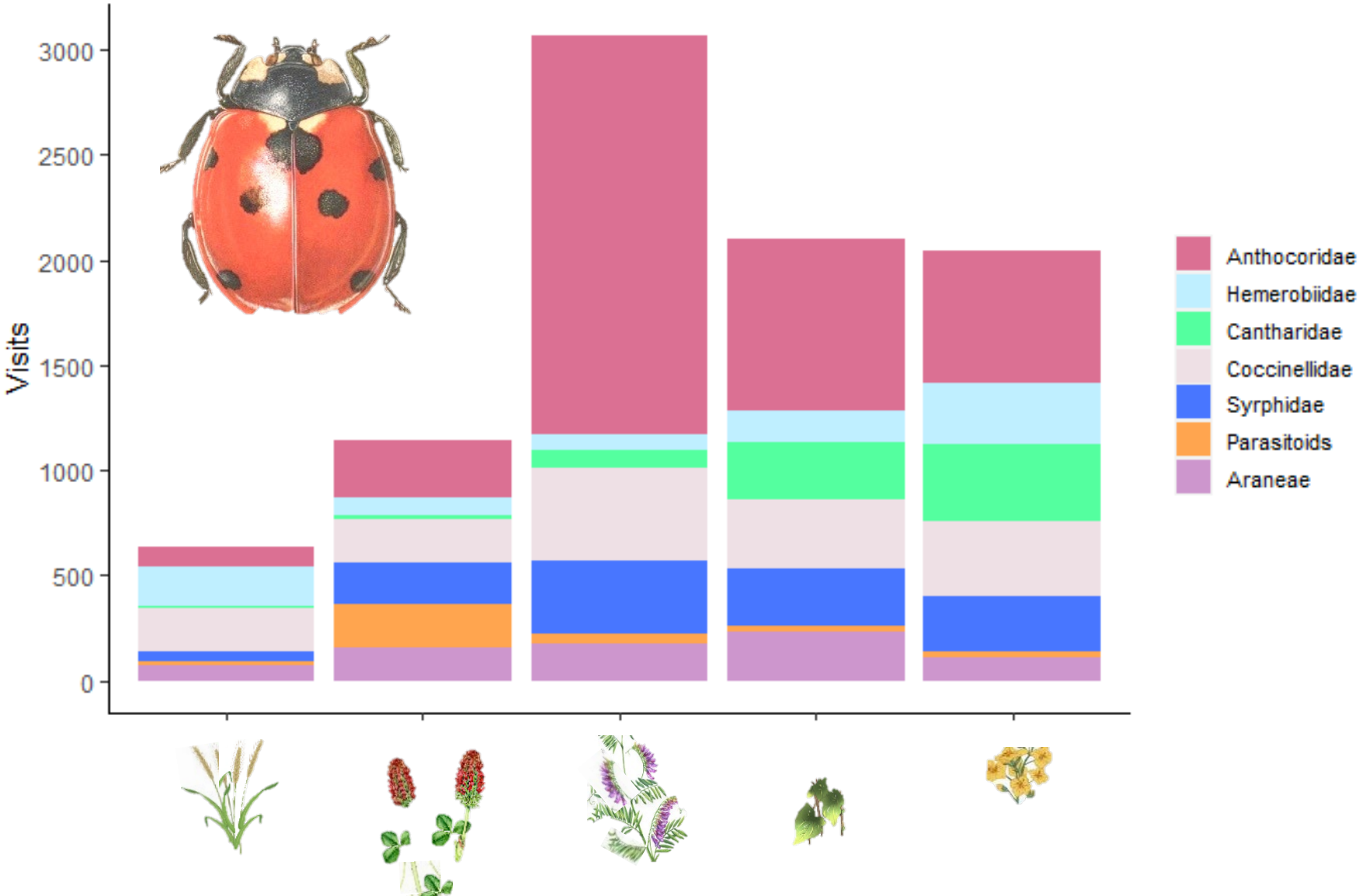


Hollow heart disorder is a crop quality characteristic <u>associated with poor pollination</u>



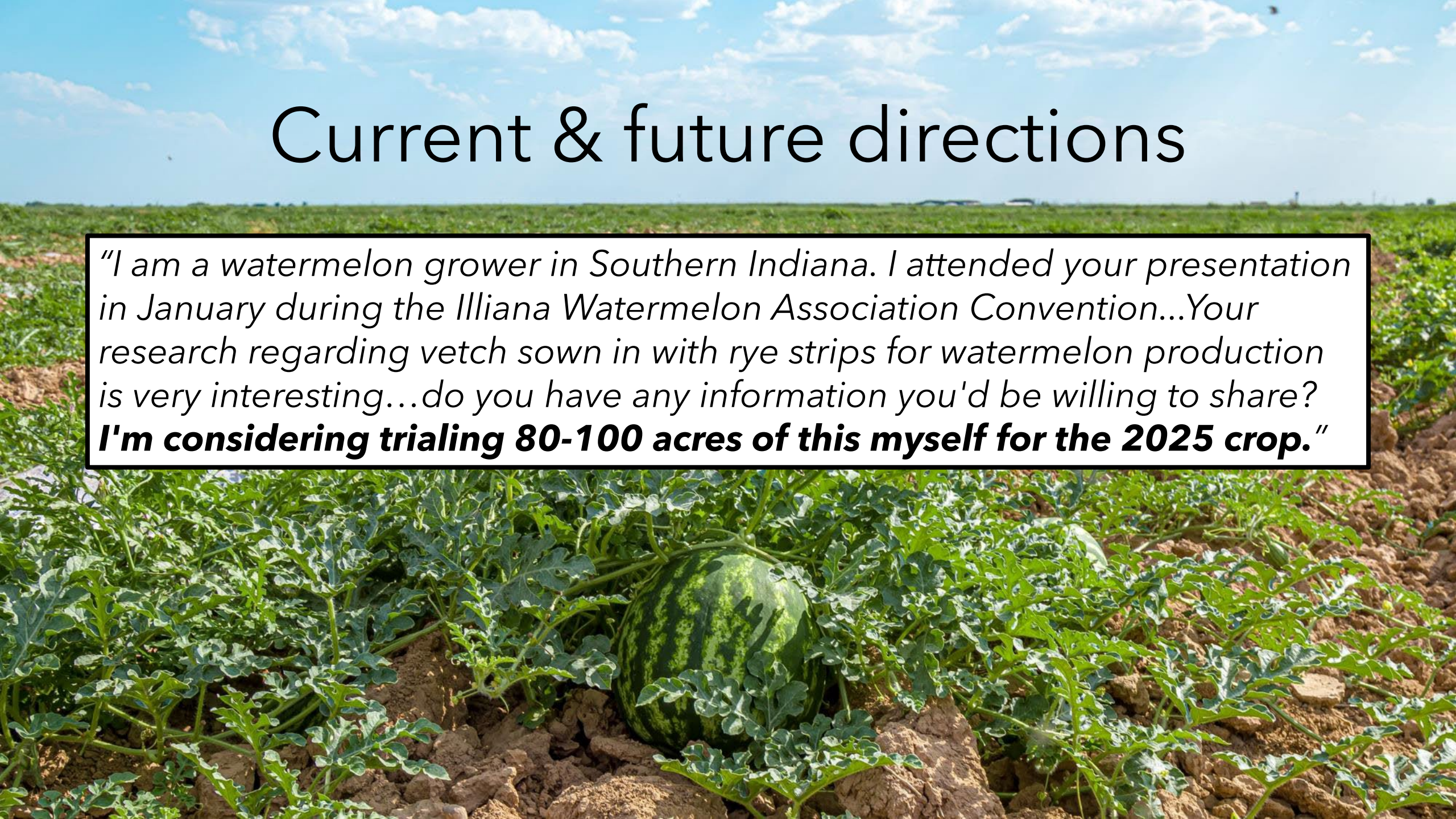
Current & future directions

We also have lots of data on **biocontrol**! But I'm almost certainly out of time…



Current & future directions

"I am a watermelon grower in Southern Indiana. I attended your presentation in January during the Illiana Watermelon Association Convention...Your research regarding vetch sown in with rye strips for watermelon production is very interesting…do you have any information you'd be willing to share? ***I'm considering trialing 80-100 acres of this myself for the 2025 crop.***"



Acknowledgements

Thank you!

- **USDA**
  - Grant # 2022-67019-36365

- **Farm managers**
  - Chloe Henscheid - TPAC
  - Dennis Nowaskie - SWPAC
  - Joel Wahlman - SEPAC

- **Technicians, students & staff**
  - Allie Film, Dominic Marazita, Elizabeth Lopez, Estefany Ronquillo, Stephany Bautista, Ella Stroh, Angelika Thompson, Silas Buchanan, Jewel Yeager, Dan Bauerle, Steven Rieker, Owen Grider, Max Maschino