Integrating Research and Extension to Manage Pollinator Health

Lynn Adler

Dept of Biology, UMass

Research-Extension Liaison

Center for Food, Agriculture and the Environment

How did I get here?

1. A little bit about me

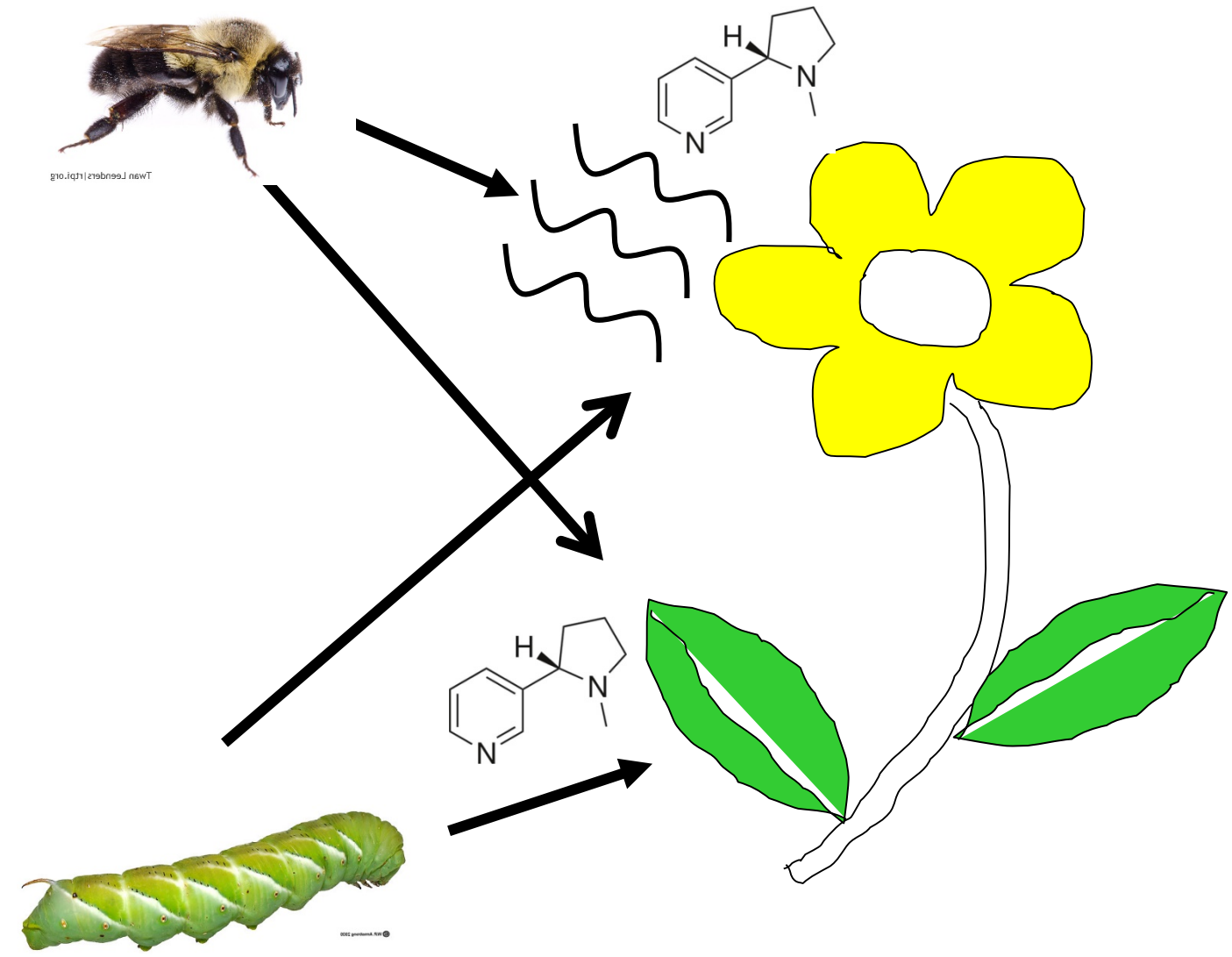
2. A little bit more about integrating research & extension

   A. Squash and perimeter trap cropping

   B. Flowers and bee health

I can do this for a job??

THE BIG PICTURE




COMMIT TO
VIRGINIA TECH!
THIS IS
VIRGINIA TECH

"We prize the synergy between basic and applied research."

Plants and bugs = lots of $

- 87 of 115 food crops depend on animal pollinators, contributing 35% of global food production.

- Pollination services valued at $24 billion in US.

- Invasive insects cost over $70 billion per year globally

- Insect crop losses estimated at 20%, or $470 billion globally

How did I get here?

1. A little bit about me

2. A little bit more about integrating research & extension

   A. Squash and perimeter trap cropping

   B. Flowers and bee health

Economic Importance of Cucurbit Crops in Massachusetts

* Collaboration with Ruth Hazzard & Andy Cavanagh

- 40% of MA vegetable crop acreage
- > $5 million for the state
- Butternut squash is a key crop for fall & winter sales

Striped Cucumber Beetles (*Acalymma vittatum*)

- Most important insect pest in cucurbit crops in the Northeast
- Primary target of insecticide applications used by growers in New England
- Vectors deadly bacterial disease

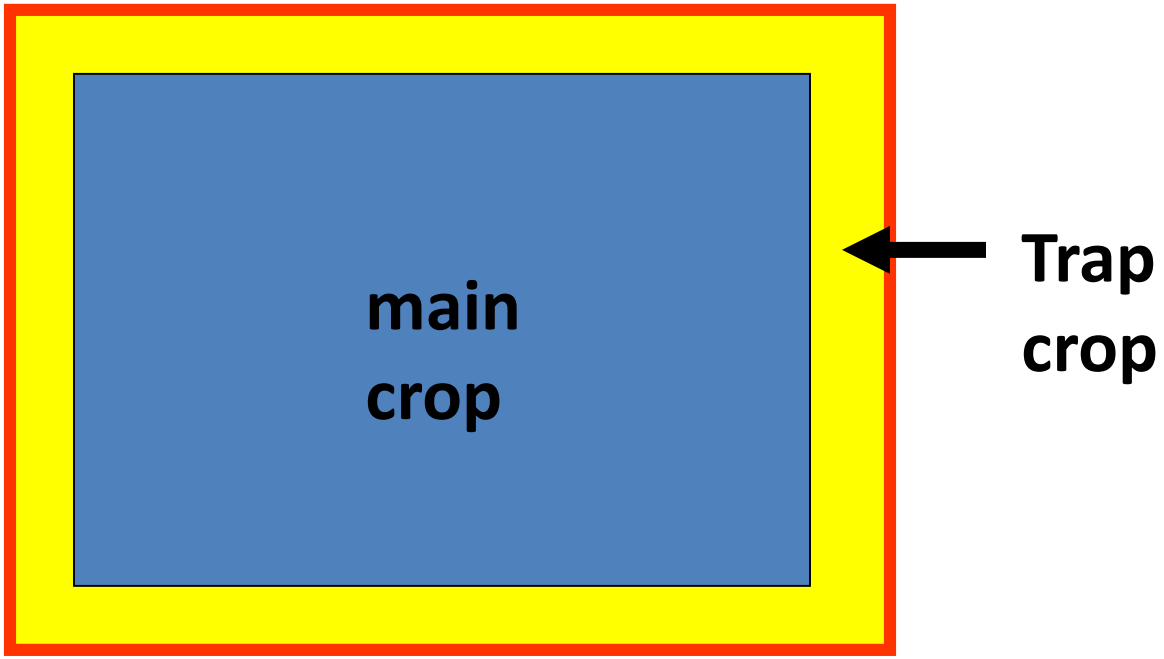
General Research Objectives

- To design, test, and evaluate an effective, low cost, and environmentally responsible system for control of striped cucumber beetles on butternut squash

(thank you,
Ruth Hazzard!)

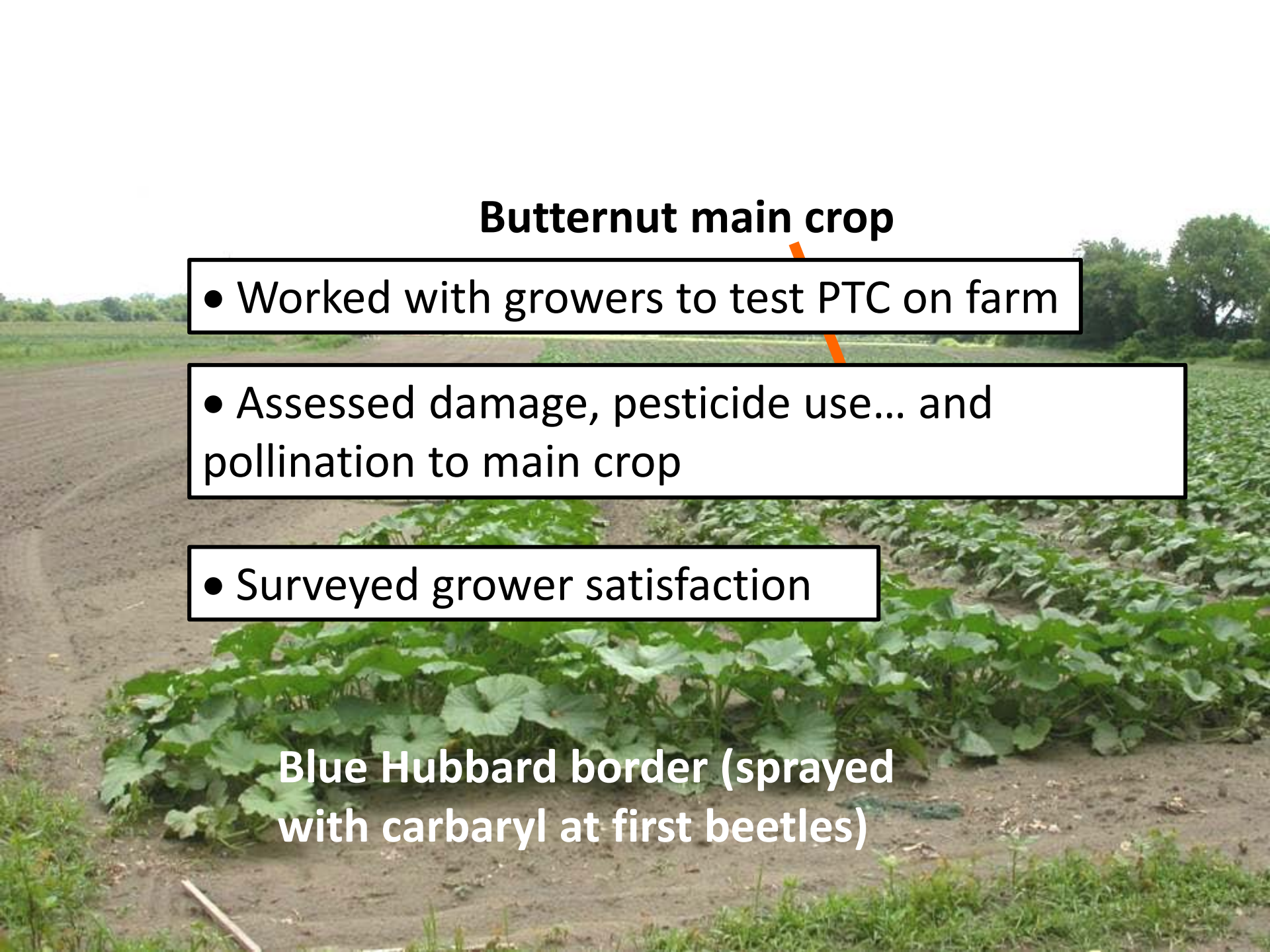
Perimeter Trap Cropping: the concept

Plant a crop preferred by the beetles around the entire main crop, so that it encircles it like a castle wall



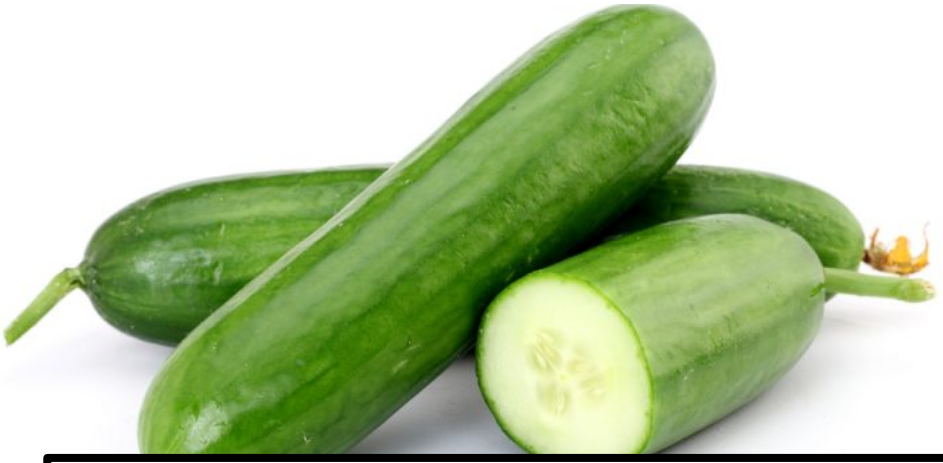
Overwintering sites

Beetles move in from field edges


Butternut main crop
• Worked with growers to test PTC on farm
• Assessed damage, pesticide use… and pollination to main crop
• Surveyed grower satisfaction
Blue Hubbard border (sprayed with carbaryl at first beetles)

Major results

- PTC reduced pesticide use by 90%
- 100% of surveyed growers found the PTC system to be good or excellent overall
- Six out of seven growers said they would certainly use PTC again
- PTC did not affect pollination



What do these crops have in common?

How did I get here?

1. A little bit about me

2. A little bit more about integrating research & extension

   A. Squash and perimeter trap cropping

   B. Flowers and bee health

Your breakfast with bees

Your breakfast without bees

Scientific American April 2009

Value of crops in US that depend on pollination: >$18.9 billion

$217 billion worldwide

Source: Scientific American '09; M. Spivak, UMinn

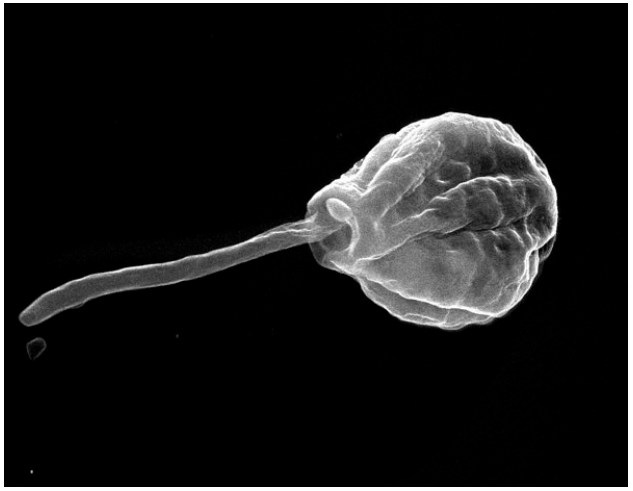
Today's Question

Can pollen quality affect bee disease?

The Players

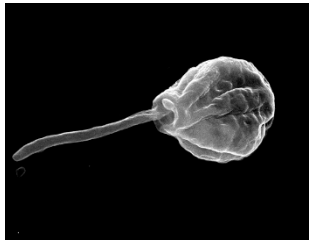
- *Bombus impatiens*, common Eastern bumble bee
- commercially reared
- not in decline

http://www.discoverlife.org/20/q?search=Bombus+impatiens

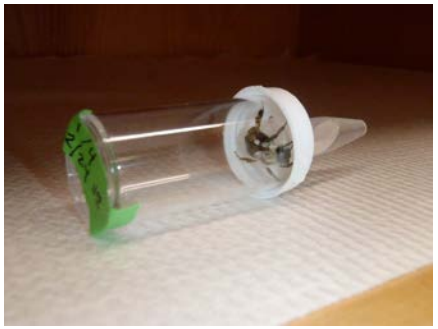


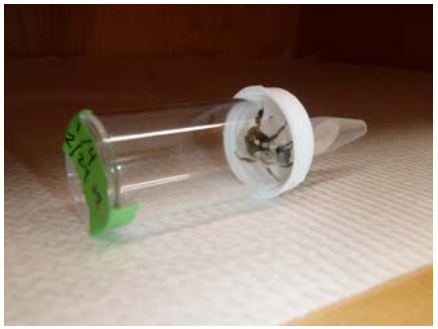
- Often infected by *Crithidia*, a gut pathogen transmitted in feces

Methods

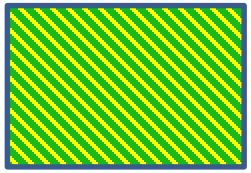


Inoculate all bees with *Crithidia*



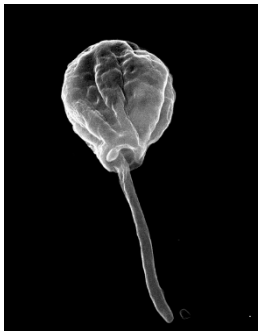


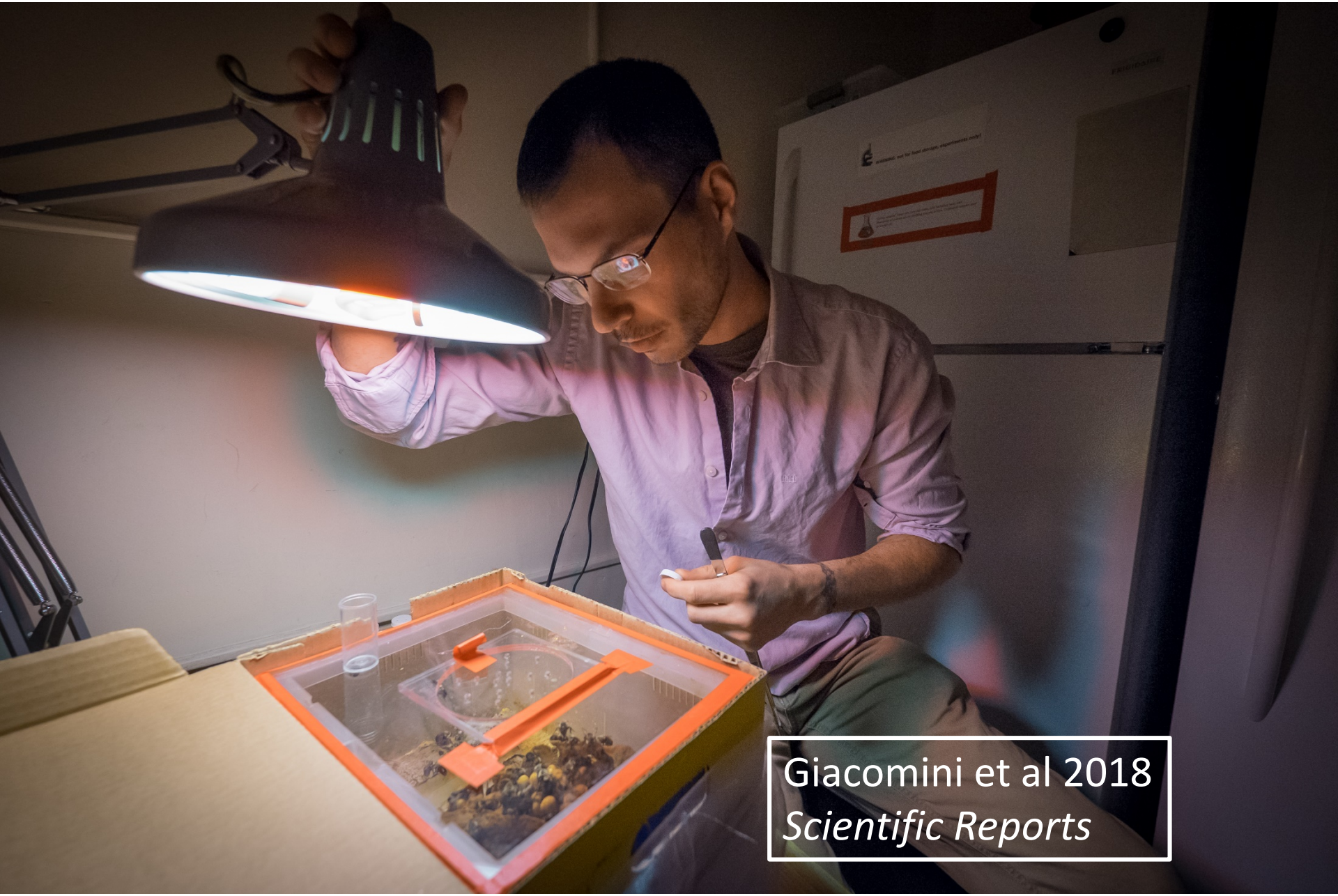
Randomly assign to treatments



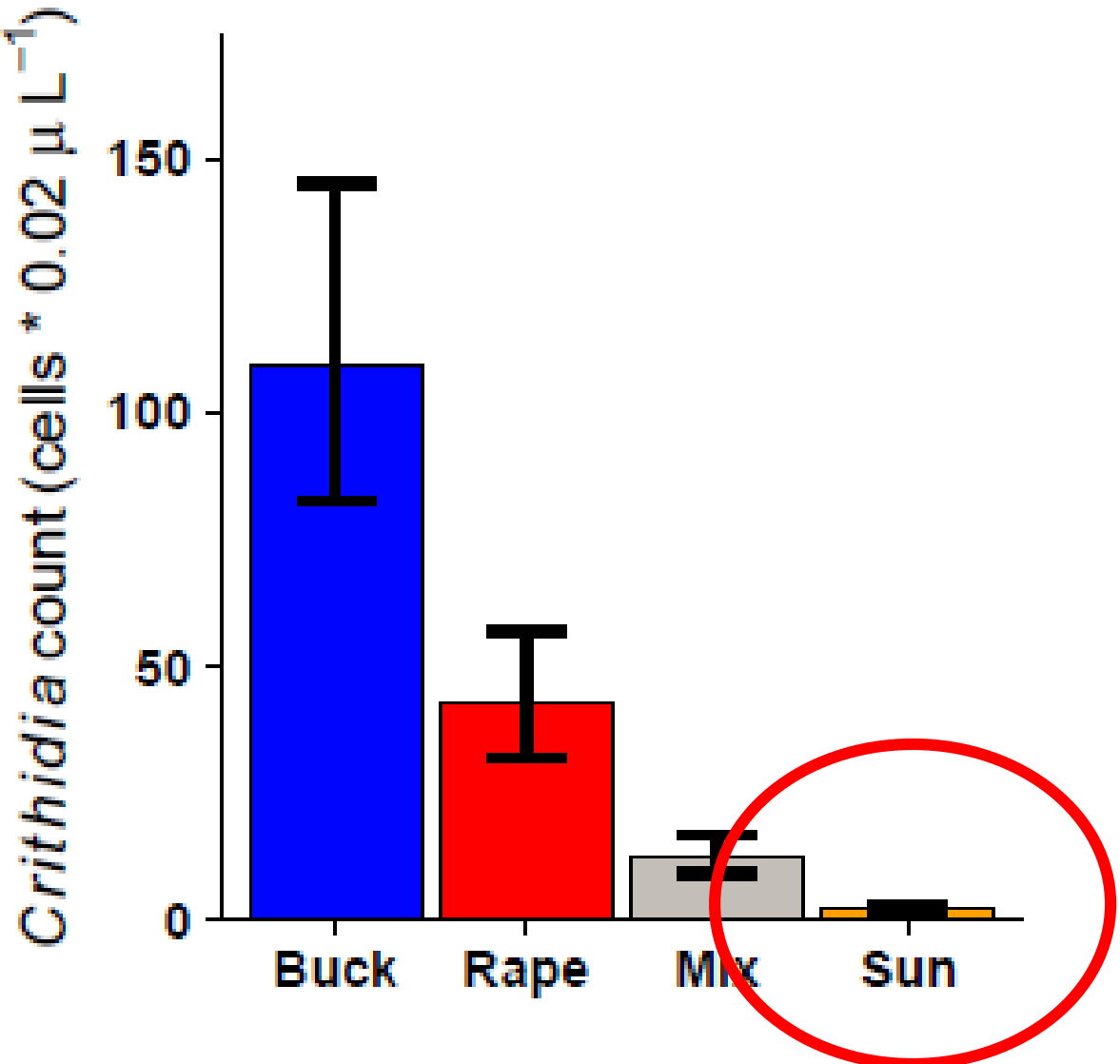
7 days

Dissect and count *Crithidia*



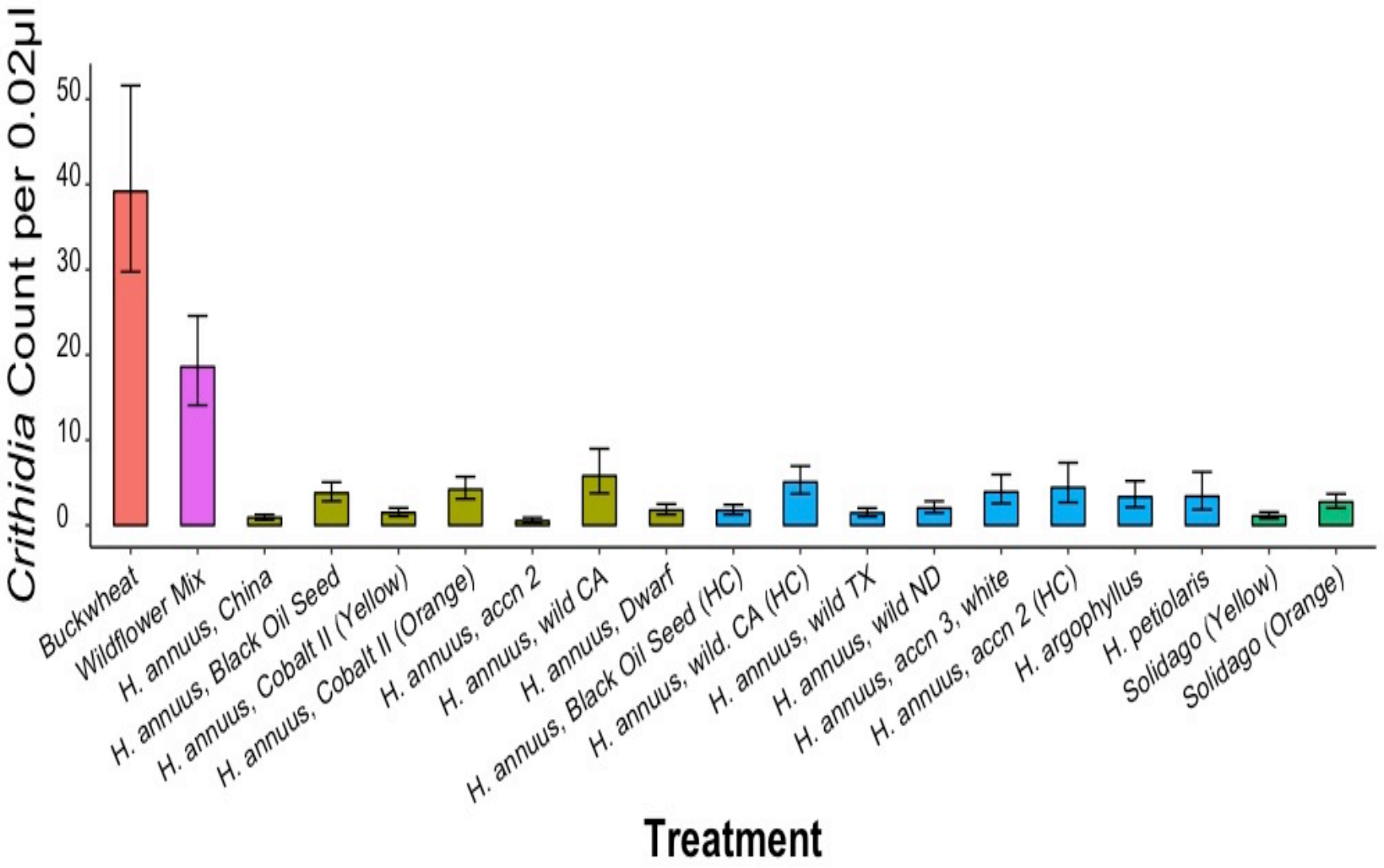

Giacomini et al 2018
Scientific Reports

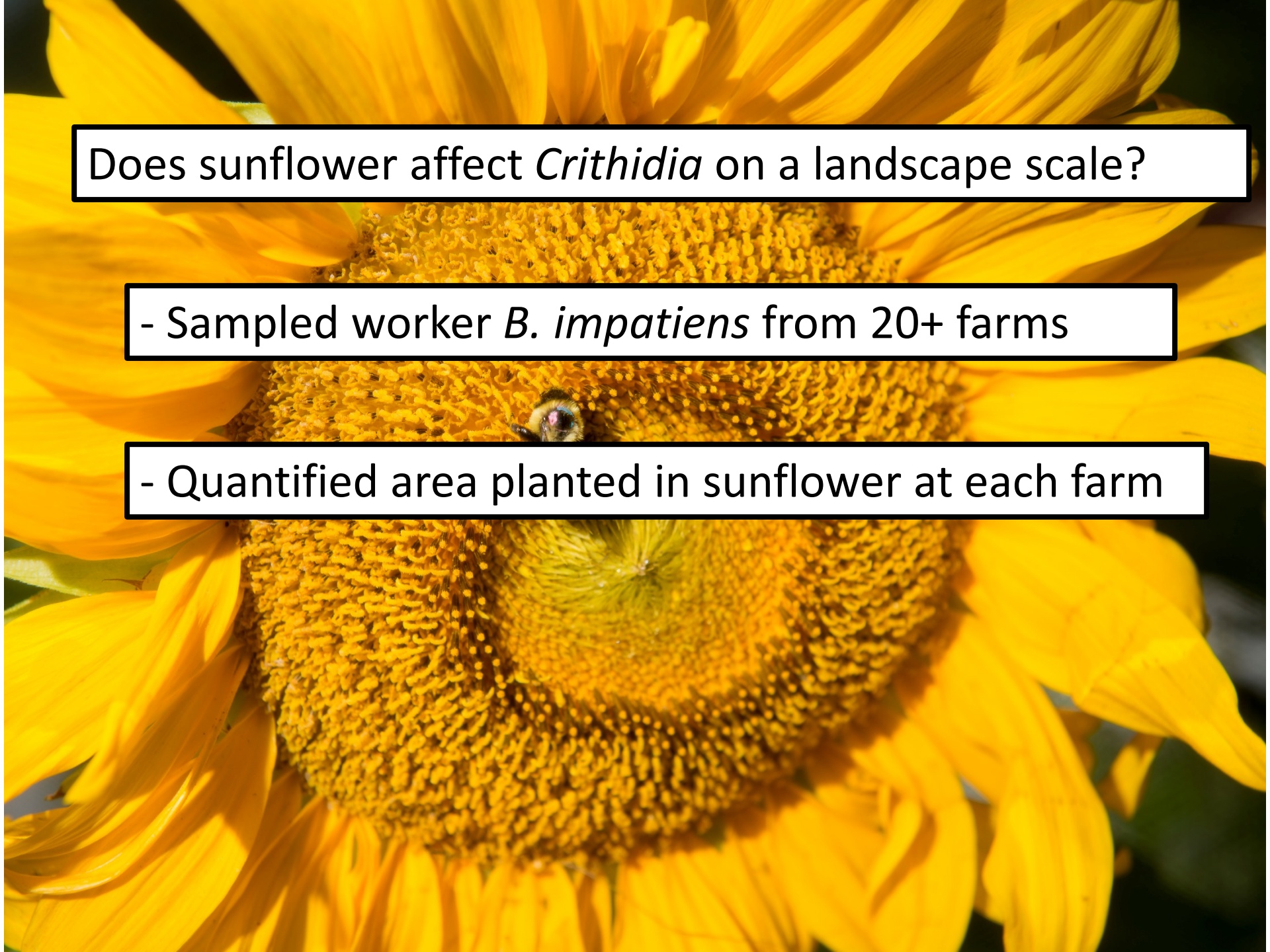
Bees fed sunflower pollen had dramatically lower *Crithidia* loads.



Do different sunflower cultivars/species/ relatives all have medicinal pollen?

Many different sunflowers are medicinal.



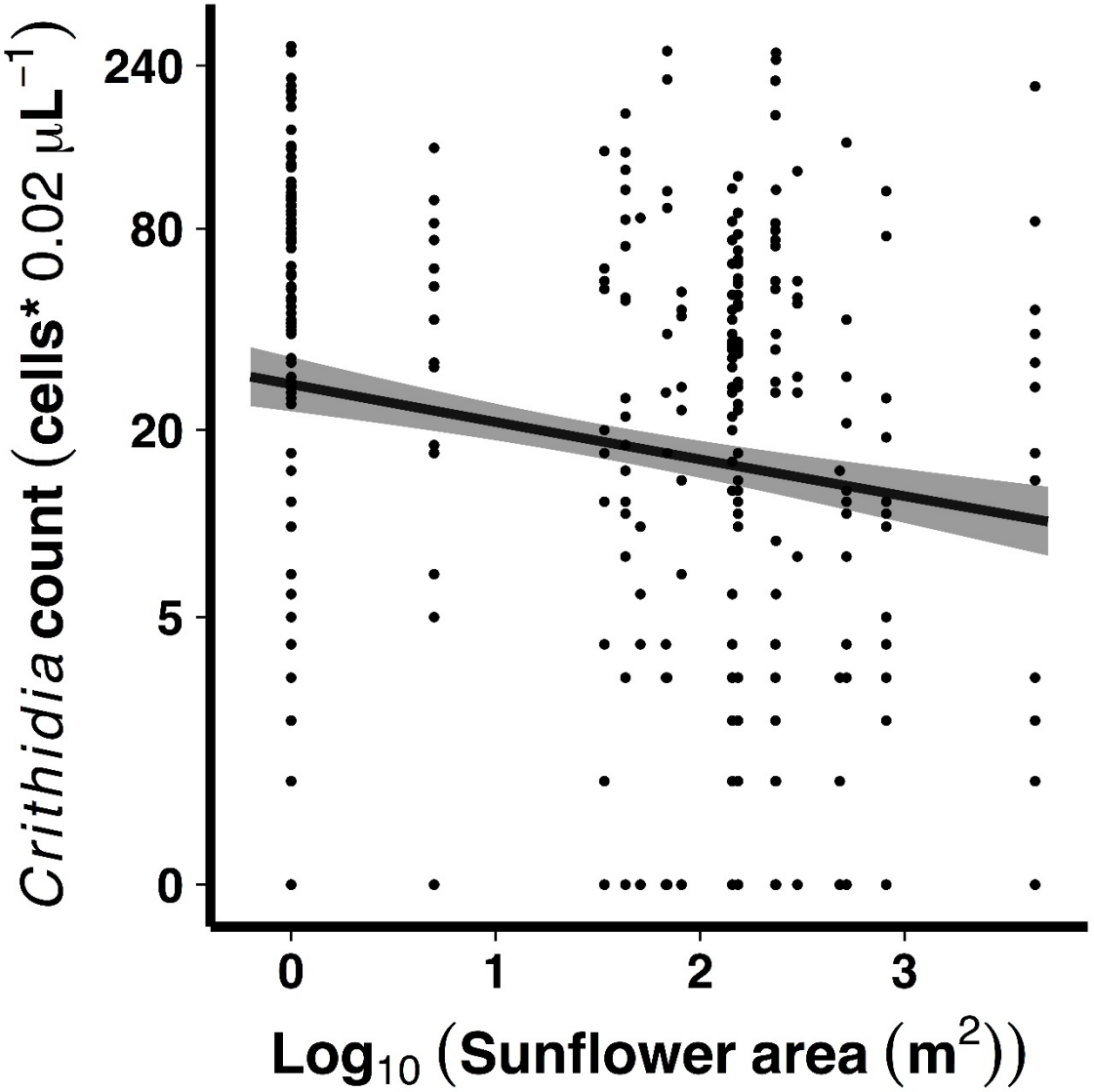


Does sunflower affect *Crithidia* on a landscape scale?

- Sampled worker *B. impatiens* from 20+ farms

- Quantified area planted in sunflower at each farm

Crithidia infection decreases with sunflower area on farms

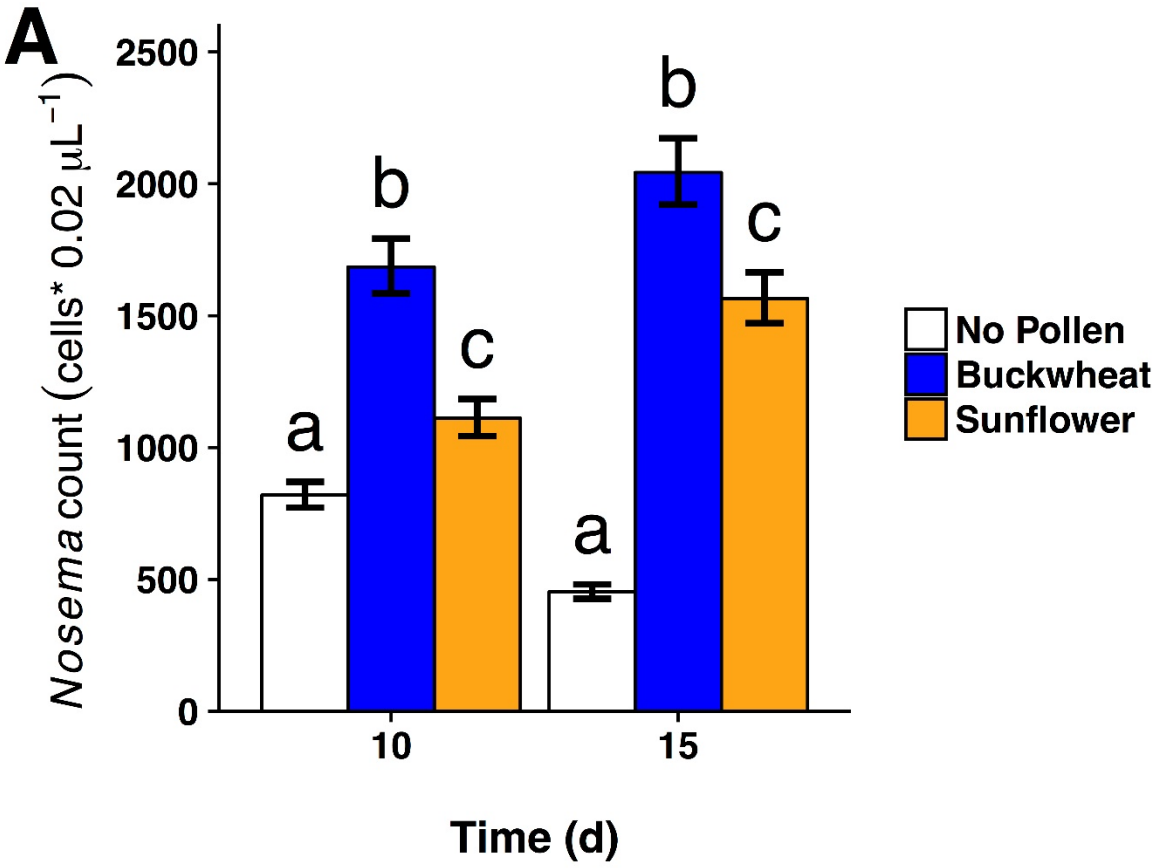


What about other bee/pathogen species?

- Honey bees and *Nosema*

- Inoculated and fed no pollen, sunflower or buckwheat pollen

Sunflower pollen reduced *Nosema* but also survival.



Conclusions

1. Sunflower pollen dramatically and consistently reduced *Crithidia* in bumble bees.

2. Bees from farms with more sunflower had lower *Crithidia* infection.

3. Many kinds of sunflower may be medicinal.

4. Sunflower pollen may also reduce *Nosema* in honey bees, but at a cost.

Potential medicinal applications?

Next steps (NIFA Pollinator Health grant)

1. Evaluate benefits and costs of sunflower pollen supplements on bee colonies (*Bombus* and *Apis*).

2. Assess impacts of sunflower pollen supplements on bee pathogens in the field.

3. Determine the degree to which sunflower plantings affect bee health.

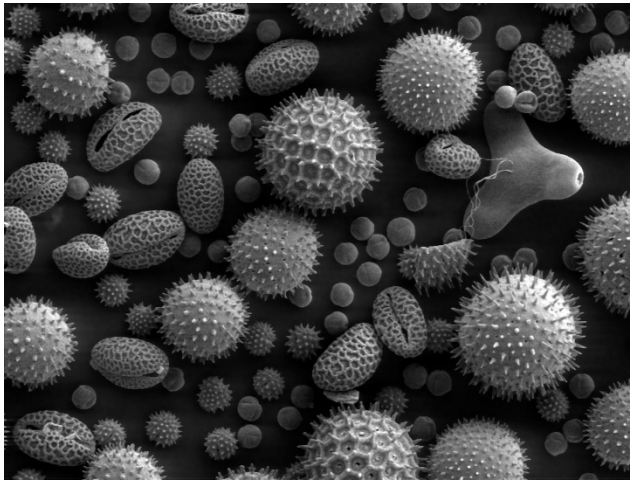
4. Large extension component; working with beekeepers and growers.

Hannah Whitehead
UMass Honeybee
Extension Educator

What we'd like to do (NIFA proposal)

HOW does sunflower pollen reduce bee disease?

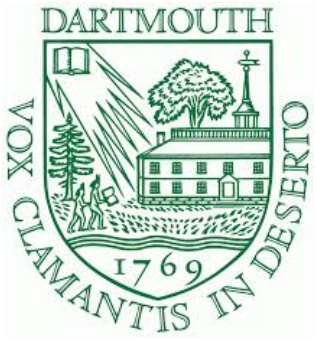
- Pollen defensive chemistry?
- Nutritional chemistry?
- Spikes?



- Bee immune system?
- Gene regulation?
- Gut microbiome?
- Gut transit time?

Thanks to....

United States Department of Agriculture
National Institute of Food and Agriculture



Collaborators

Becky Irwin
Ruth Hazzard
Scott McArt
Jay Evans
Phil Stevenson
Steve Ellner
Dennis Van Engelsdorp

Student Researchers

George LoCascio
Evan Palmer-Young
Alison Fowler
Andy Cavanagh
Jonathan Giacomini
Jess Leslie
River Pasquale
Eugene Amponsah

Thank you!

Photo by J. Giacomini