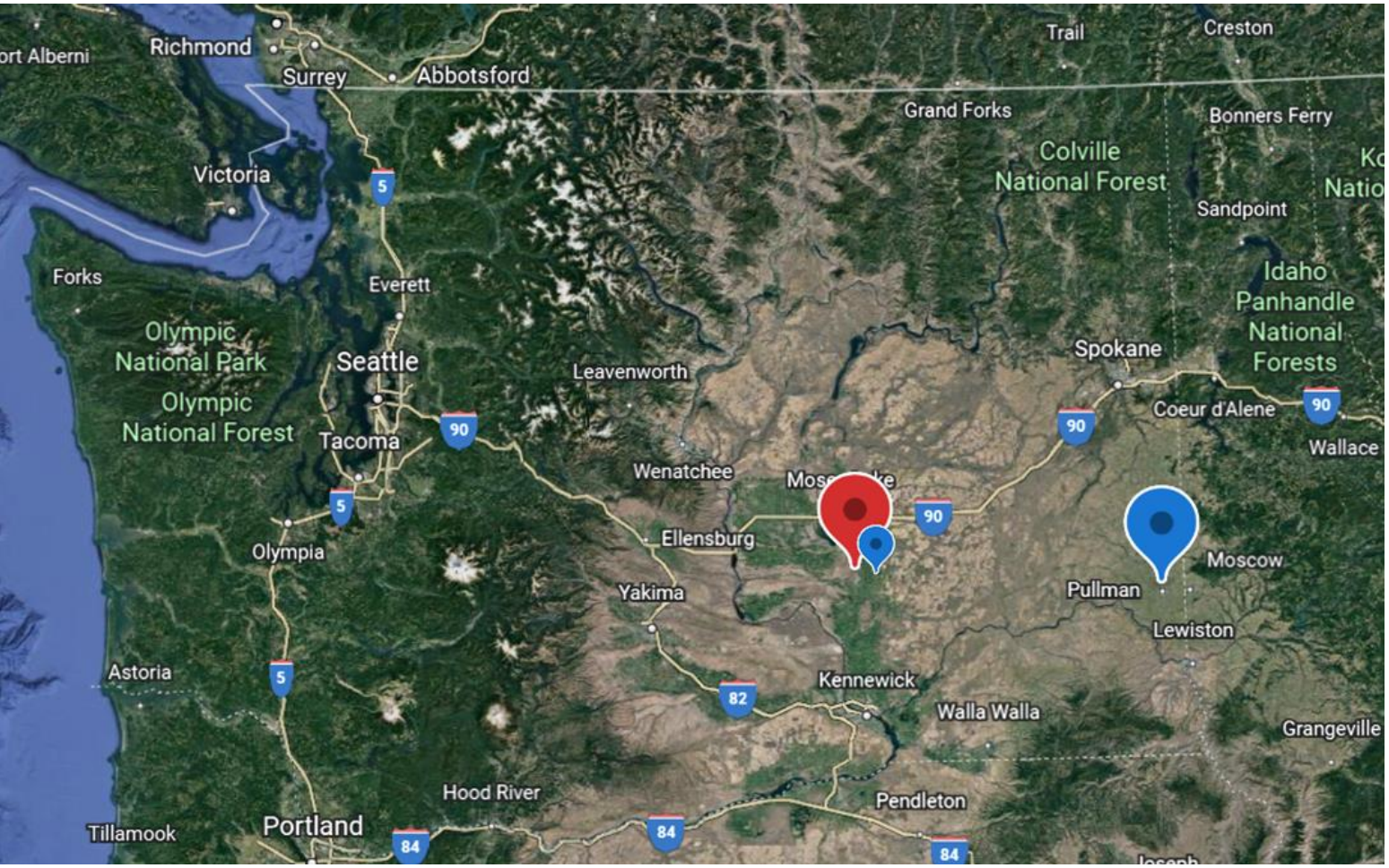
Improving Pollination Quality in Seed Crops

Riley Reed

Beeinformed.org

About me


Richmond
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Forests
Olympic
National Park
Seattle
Spokane
Leavenworth
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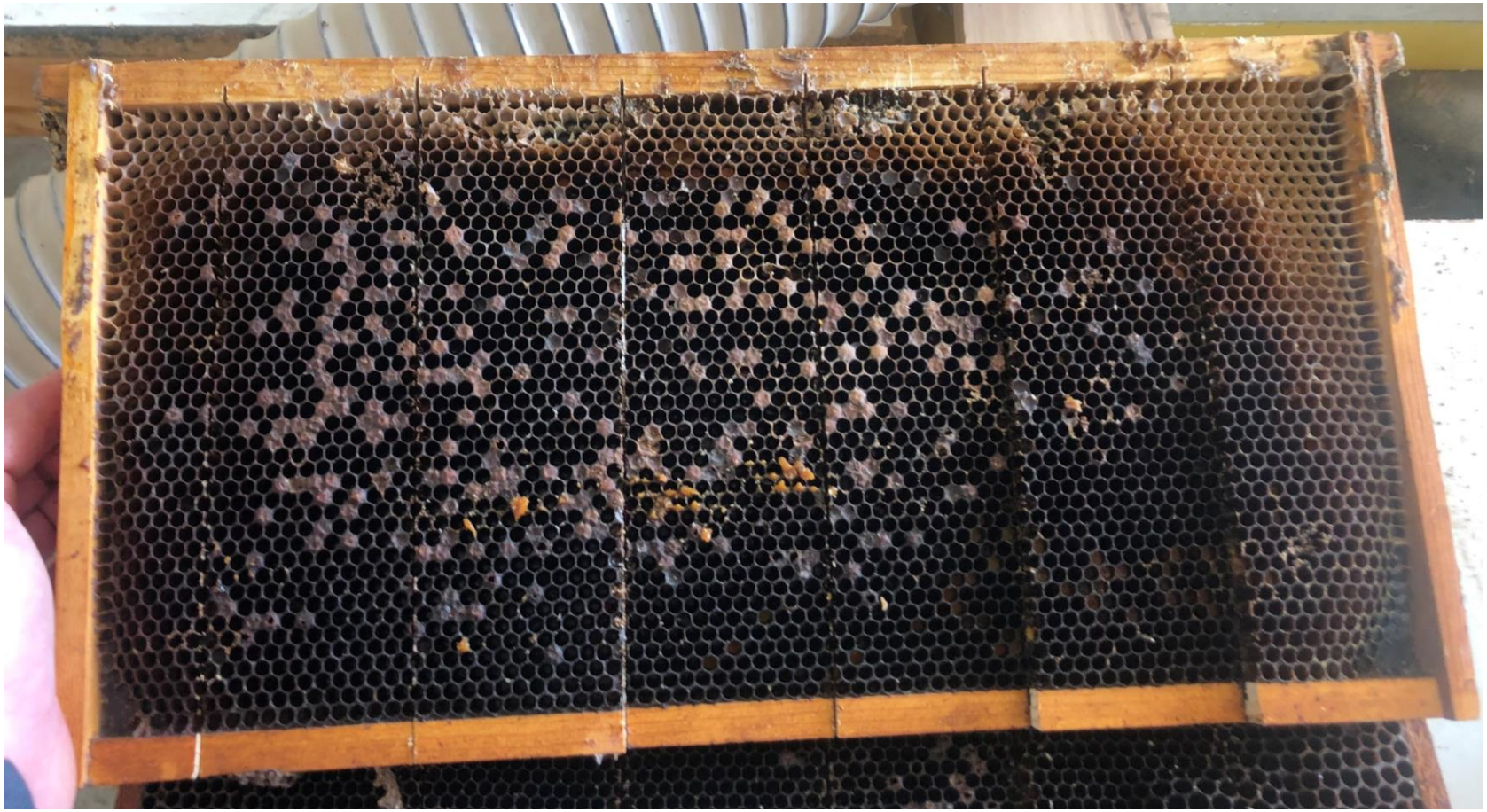
National Forest
Tacoma
Coeur d'Alene
Wallace
Wenatchee
Ellensburg
Olympia
Moscow
Yakima
Pullman
Lewiston
Astoria
Kennewick
Walla Walla
Grangeville
Hood River
Pendleton
Tillamook
Portland
5
90
82
84

A colony is alive, a hive is a box.

Swarming

Frames



Supers

Pollen trap

Buzzingacrossamerica.com

beeequipmentaustralia.com

Supplemental feed

teeth.org.au/sugar

Breakdown

- Part one: Supplemental feeding
  - Chapter 1: Supplemental feeding in carrot seed
  - Chapter 2: Supplemental feeding in canola
  - Chapter 3: Supplemental feeding and colony health
- Part two: Hive space requirements
  - Chapter 4: Supering during carrot seed

Part 1: Supplemental Feeding

Why should I care?

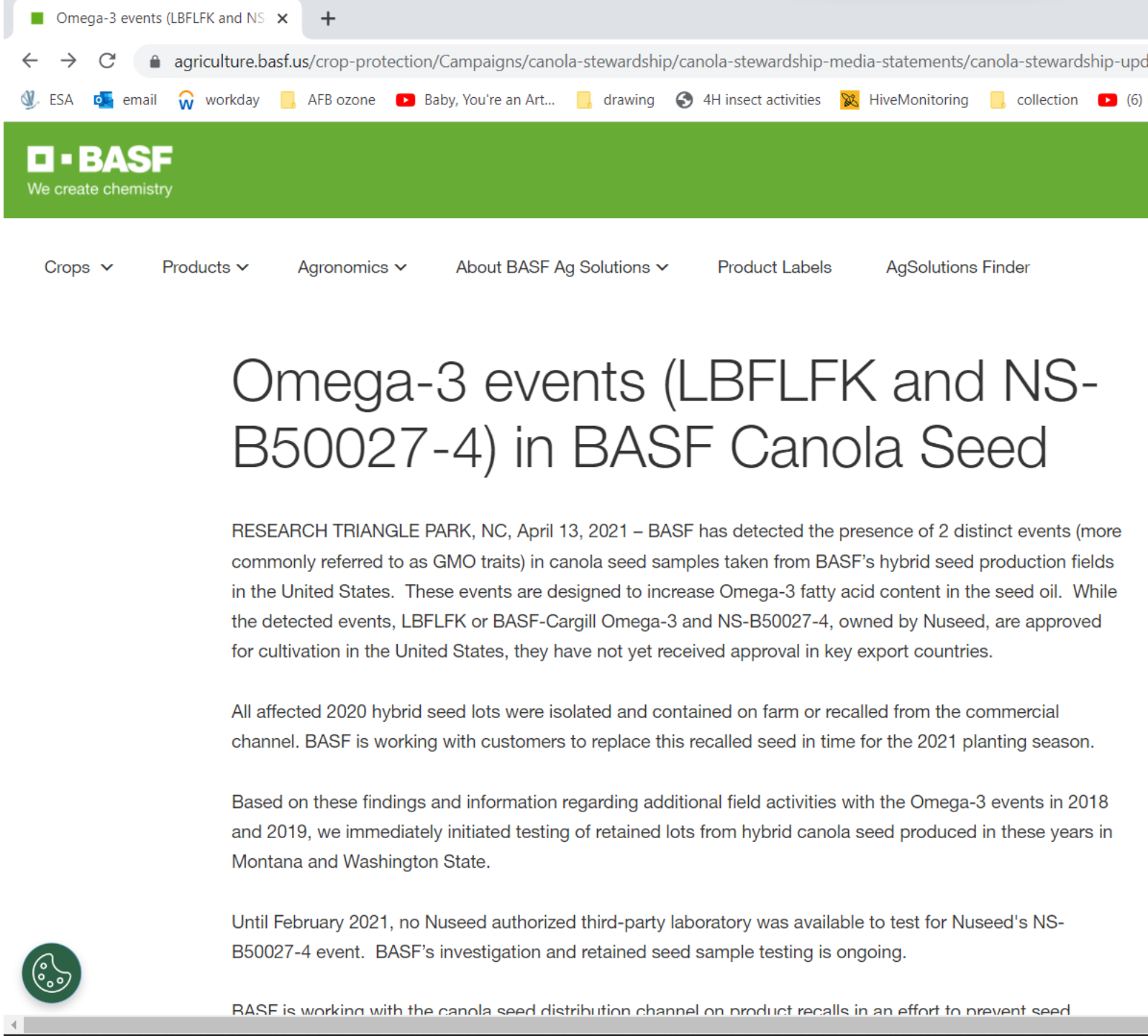
- ~1/3 of crops depend on or at least benefit from pollinators (Klein et al, 2007)
- Honey bees are the most widely used pollinator
- US vegetable seed is worth over $125,000,000 (USDA NASS 2019)
- US carrots are worth over $750,000,000 (USDA NASS 2019)

Pollen transfer between fields lowers seed purity.

Benedict Vanheems
growveg.com

almanac.com/plant
/carrots

Transgenic Crops

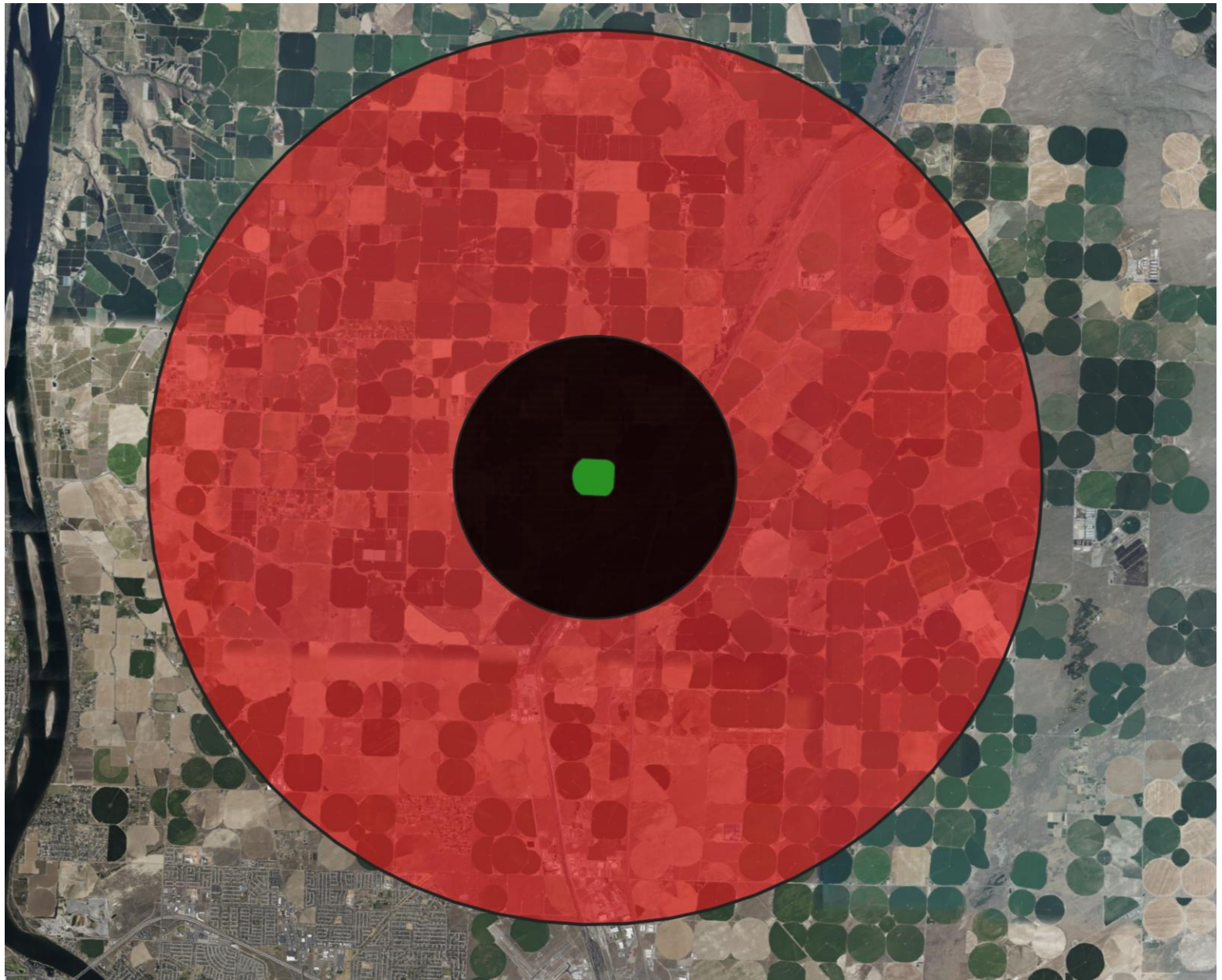


Hines 2021

Honey bees can fly up to 9 kilometers.

Optimal Foraging Theory
2-3km

Geometric Framework
Up to 9.5km



Monocultures and hybrid production decrease food resources.

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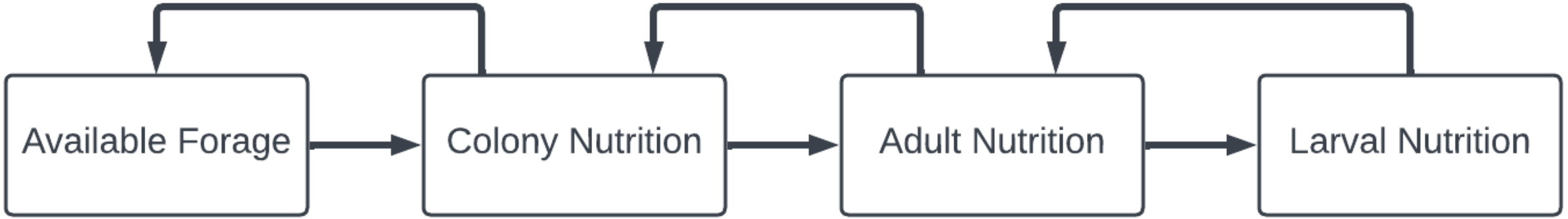
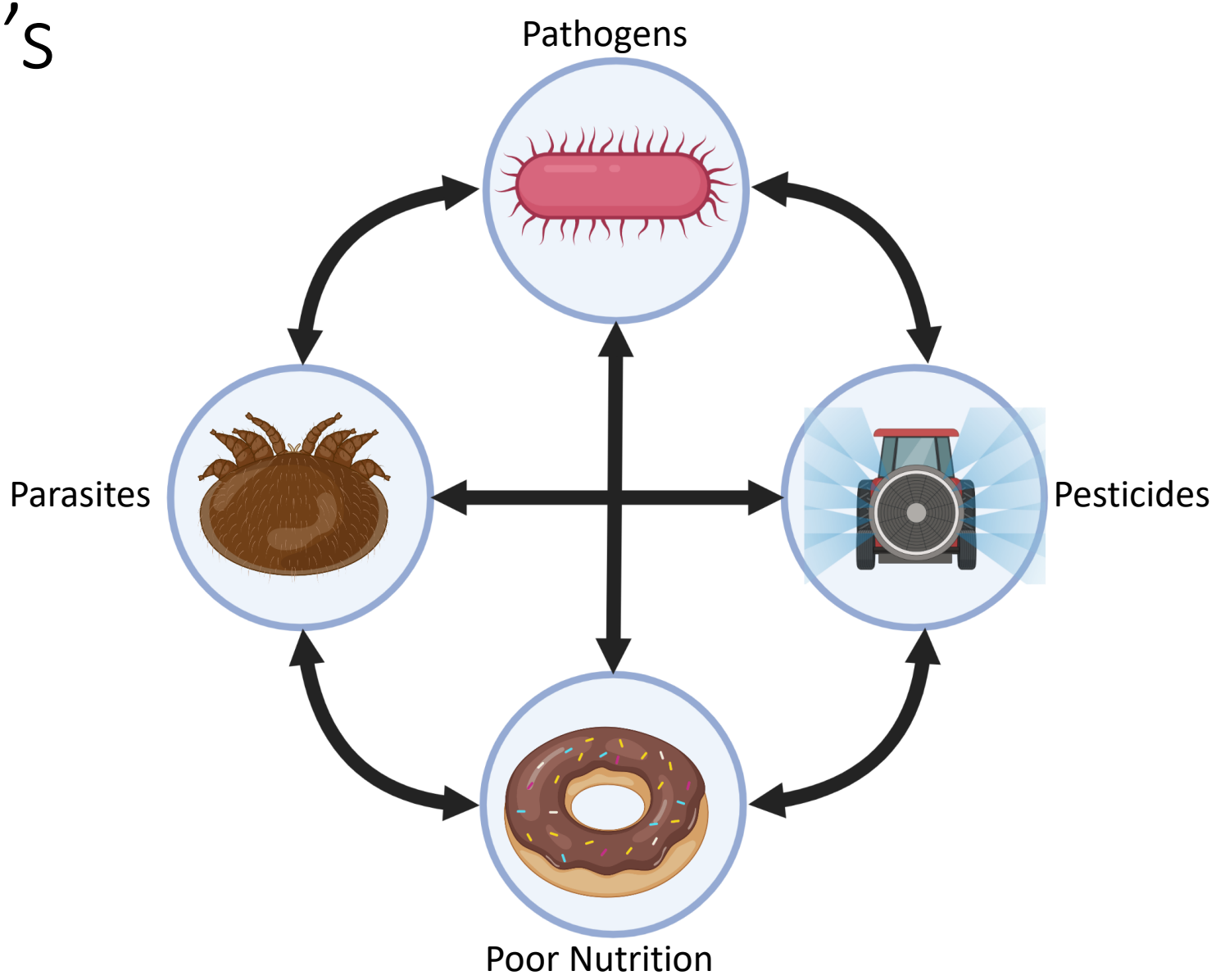
Poor nutrition is not immediately evident, but the effects can be long lasting

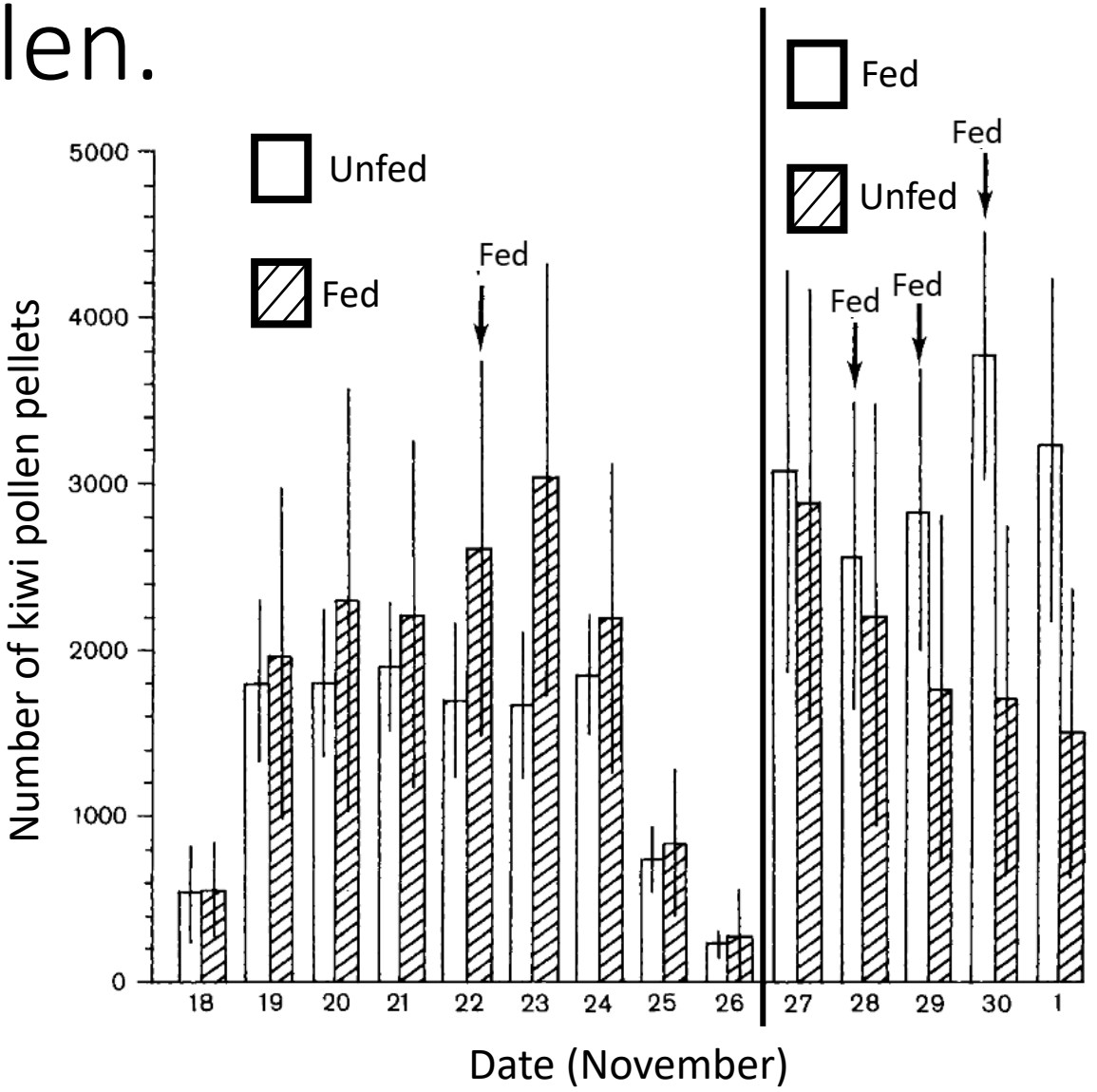


The 4 P's



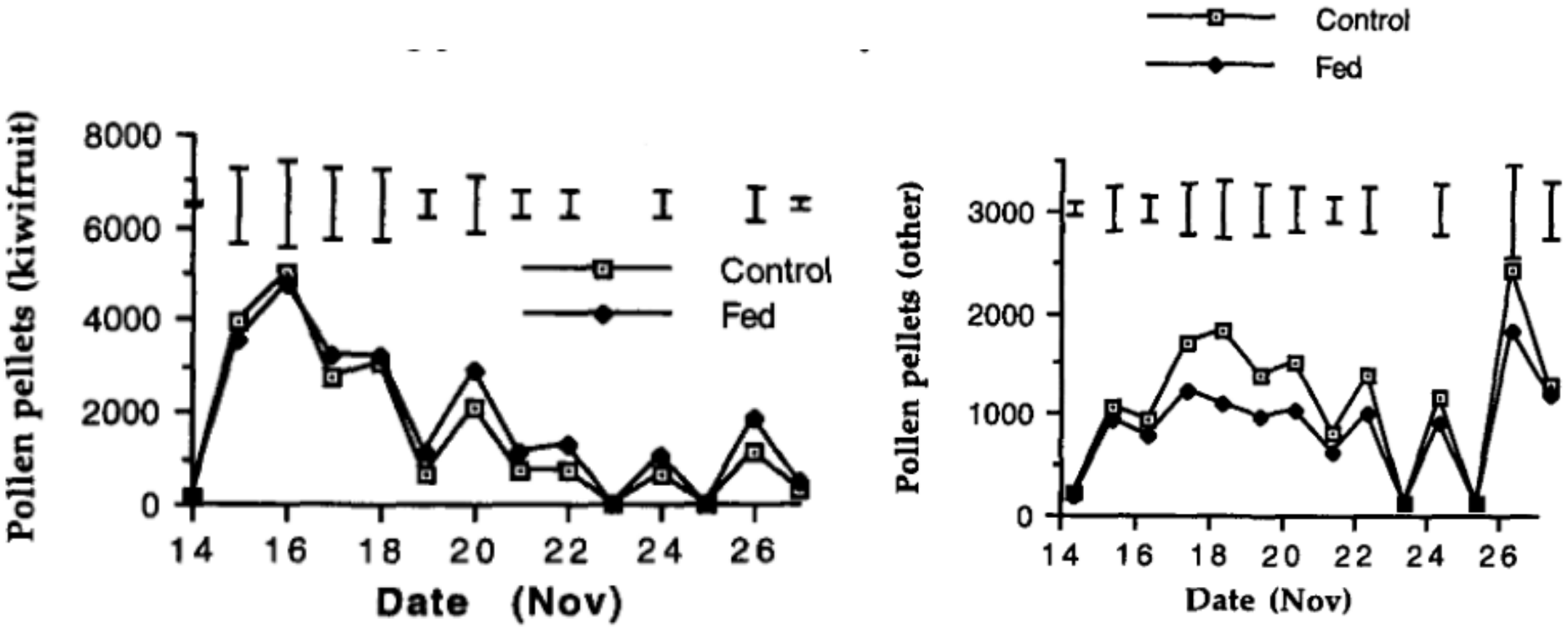
Created with BioRender.com

Feeding sugar syrup increased the collection of kiwi pollen.



Goodwin, 1986

Feeding pollen substitute decreased the collection of other pollen other plants.



Goodwin et al., 1994

Going forward, two different cropping systems will be used.

uky.edu/ccd/production/crop-resources/gffof/canola

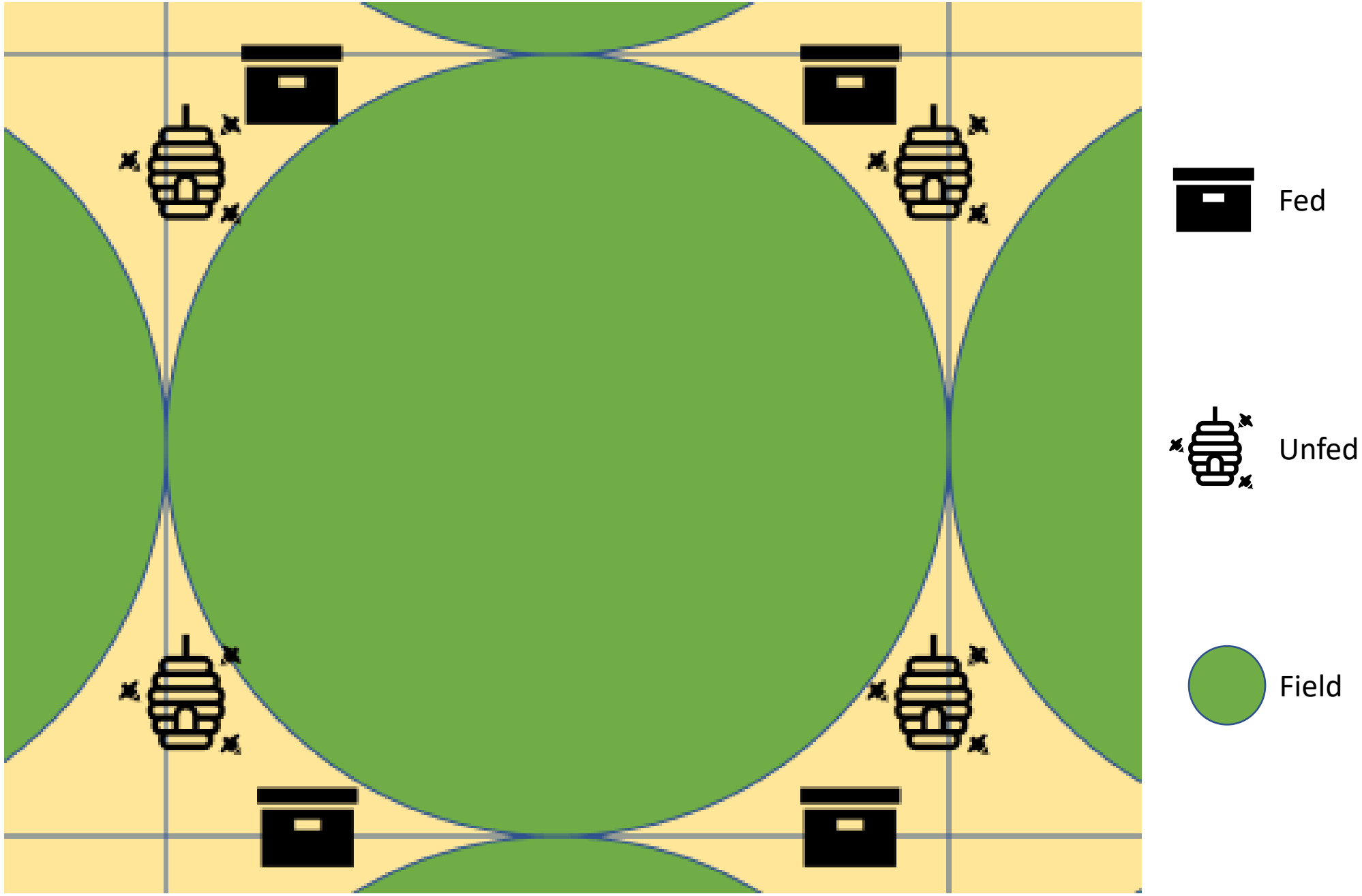
almanac.com/plant/carrots

Goals

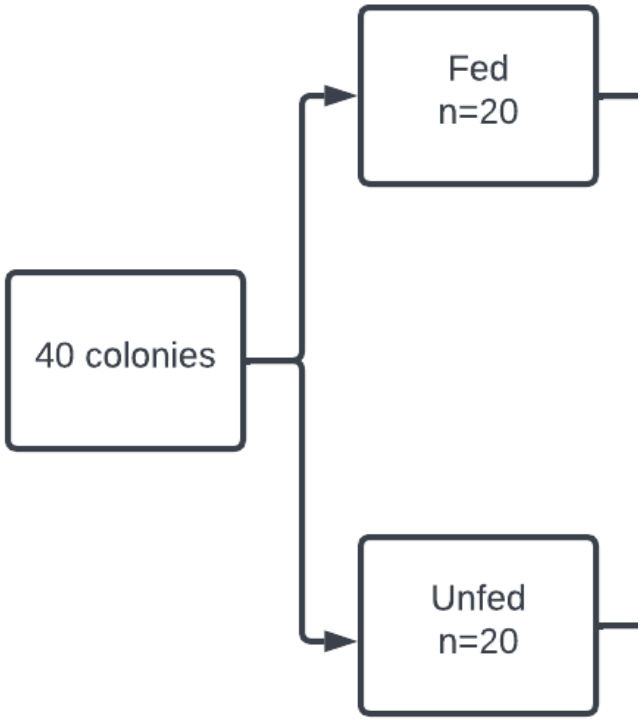
- Improved isolation between fields
- Decreased risk of transgene escape
- Healthier, more valuable, colonies

Chapter 1: Carrot seed

Hypothesis 1 : Providing supplemental in-hive feeding will increase the number of foragers working in the field without impacting overall foraging activity.


Fed
Unfed
Field

How does feeding impact foraging behavior?



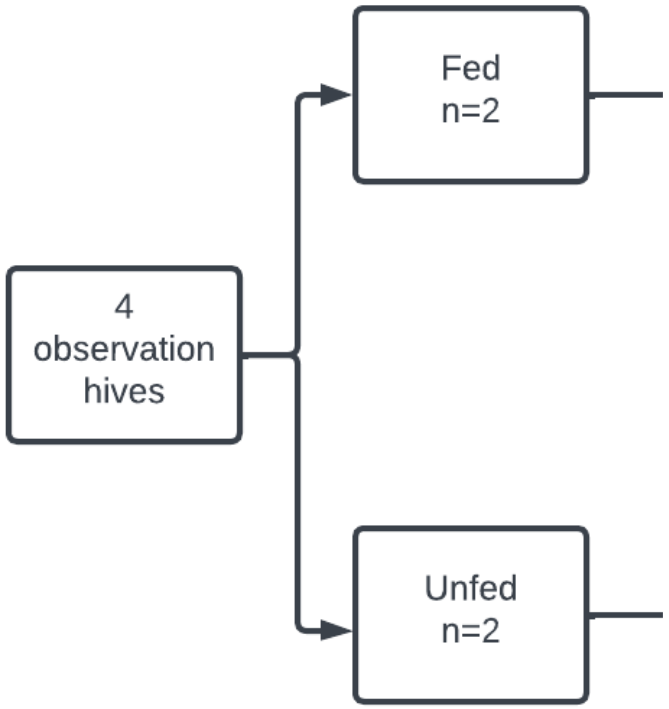
The waggle dance is used to communicate the location and quality of a resource

Waggle Dance Game:
https://askabiologist.asu.edu/bee-dance-game/how-to-play.html

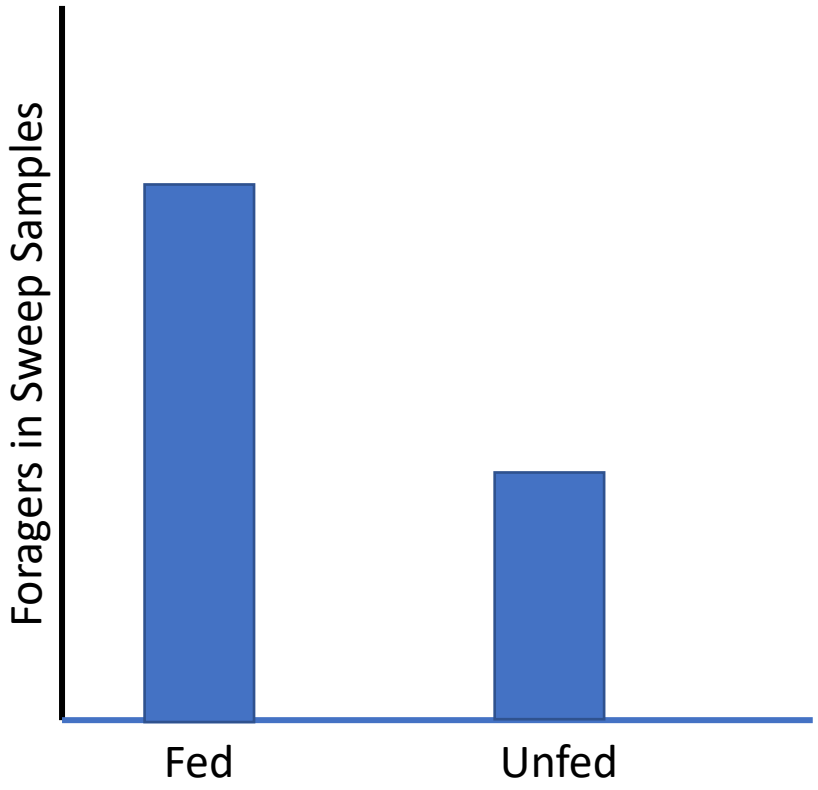
Observation hives allow to observe the inner workings of a hive

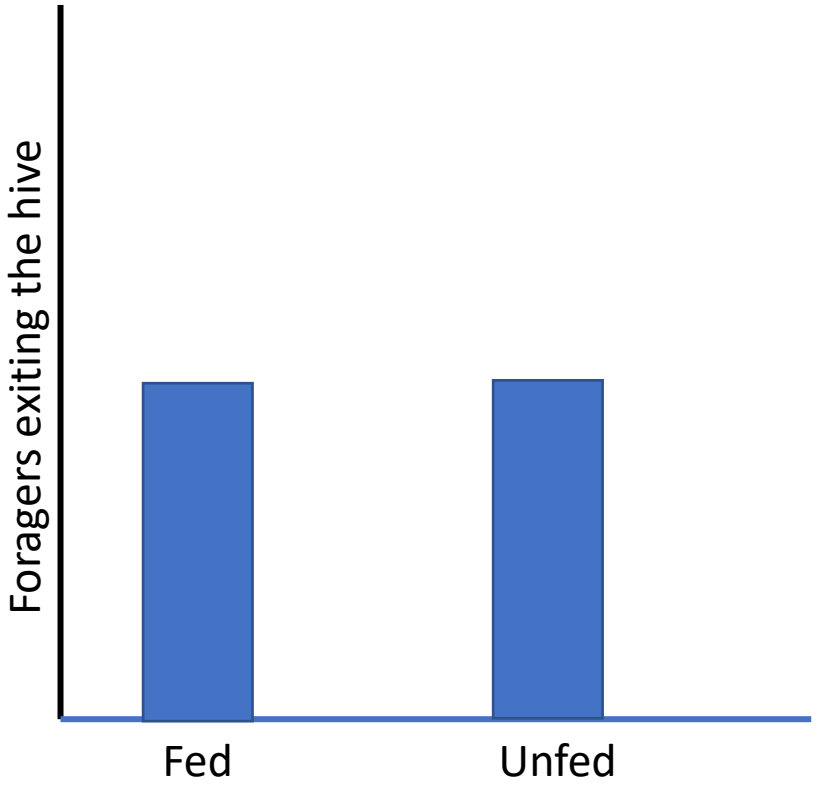
https://www.beelistener.co.uk/

Waggle dances can also be used to decode foraging behavior



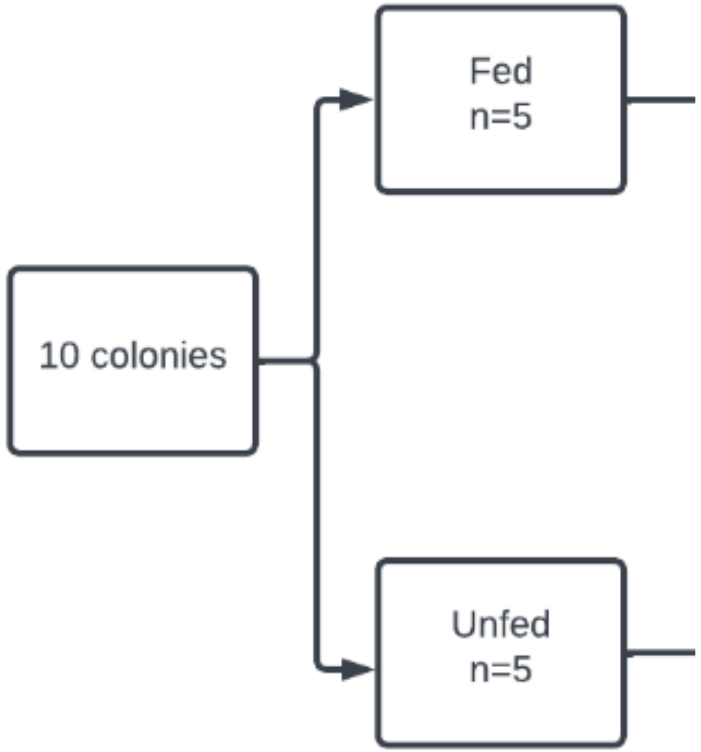
Expected results

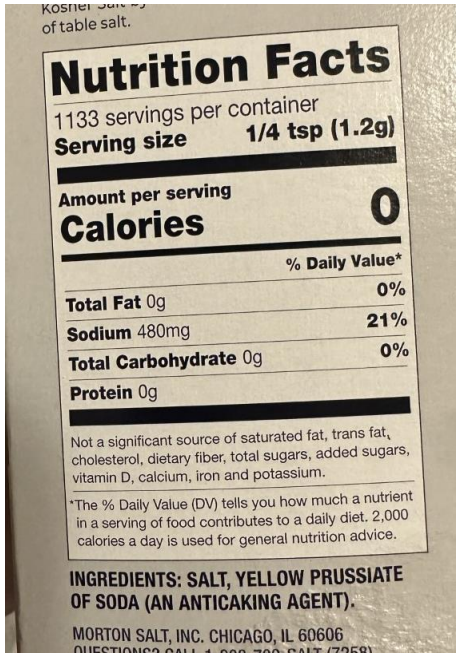




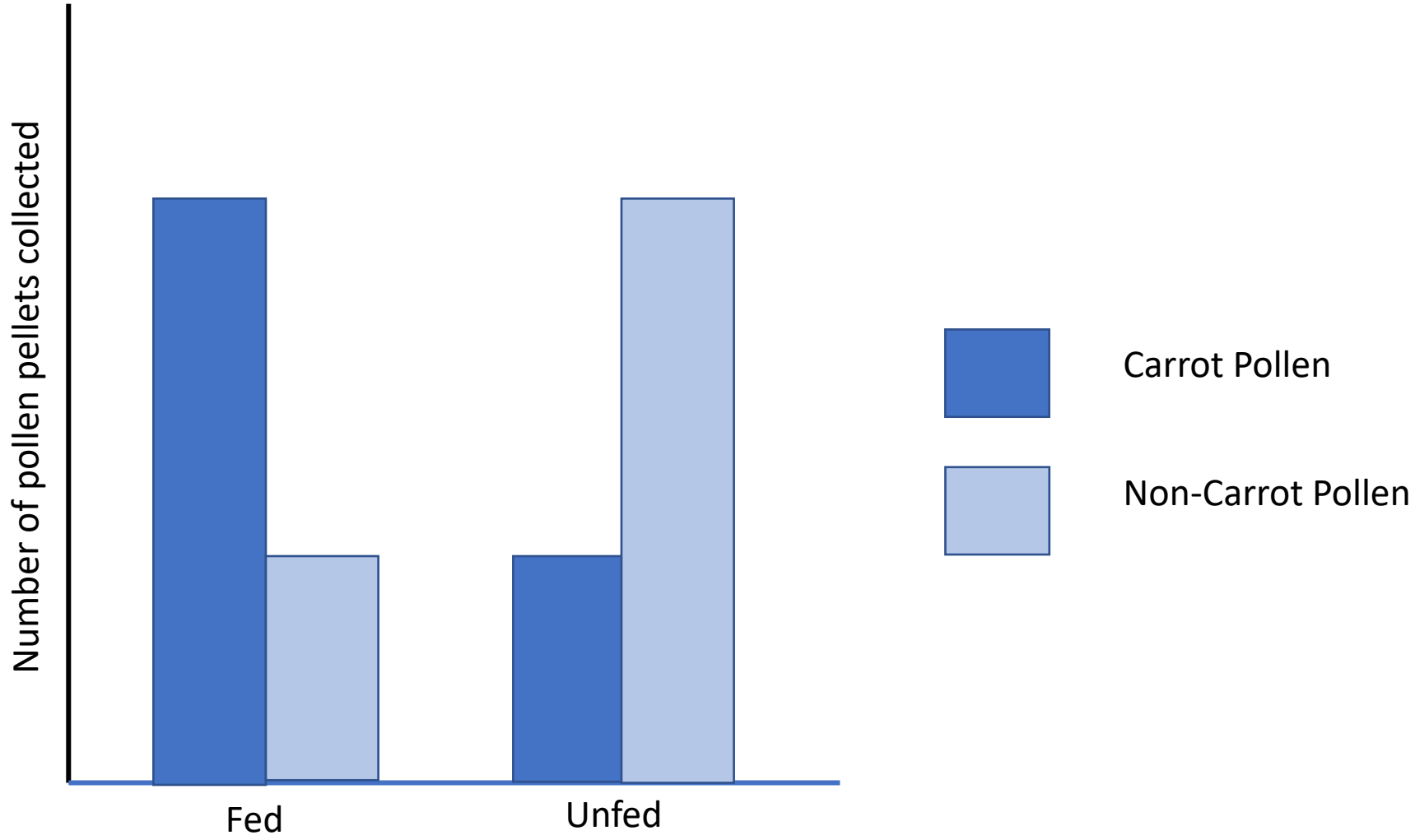
Hypothesis 2 : Providing supplemental in-hive feeding will decrease the amount of non-carrot pollen collected.

How does feeding impact pollen collection?



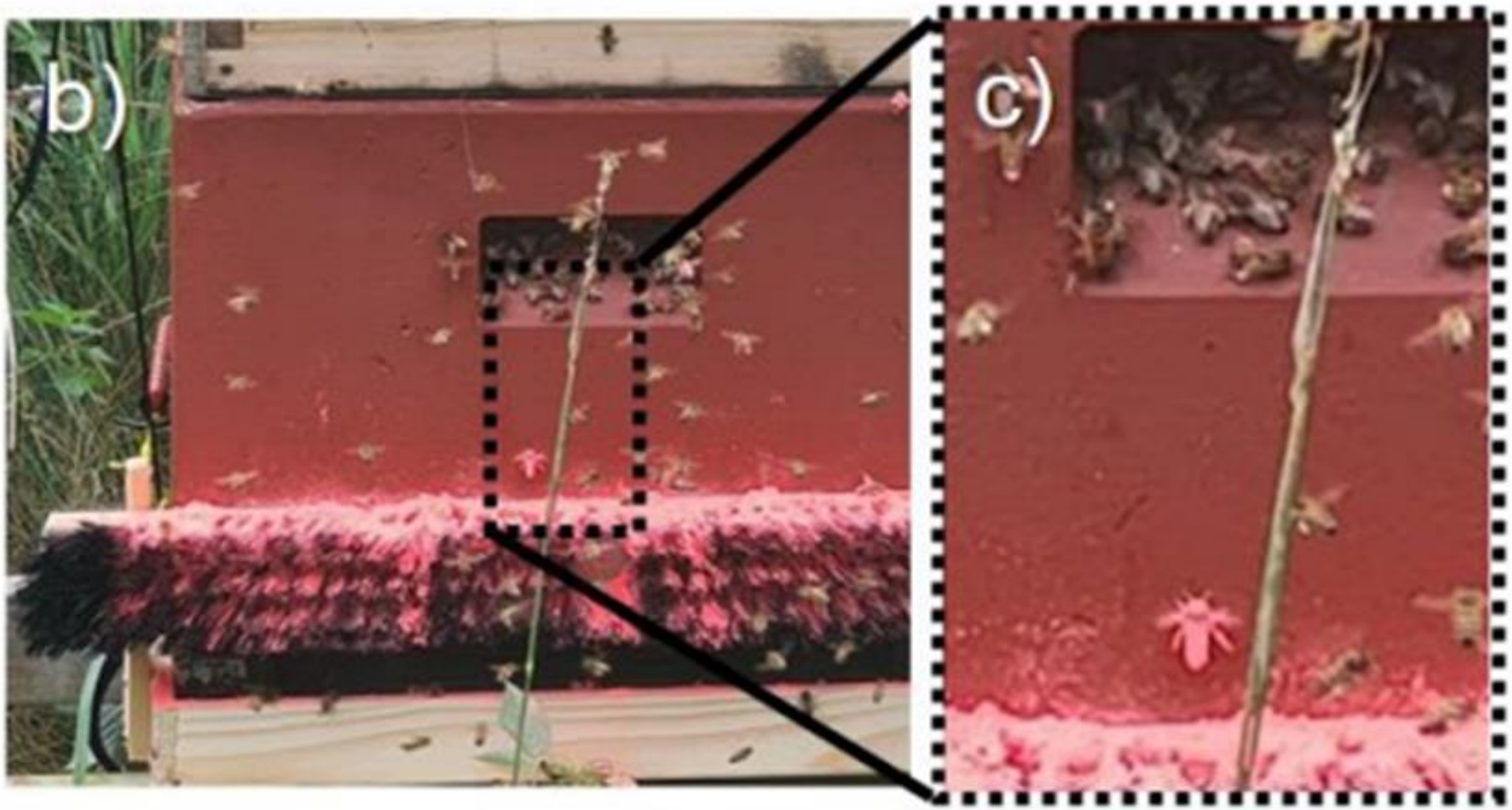


Expected results



Summer 2022

Colored powders were removed too quickly.

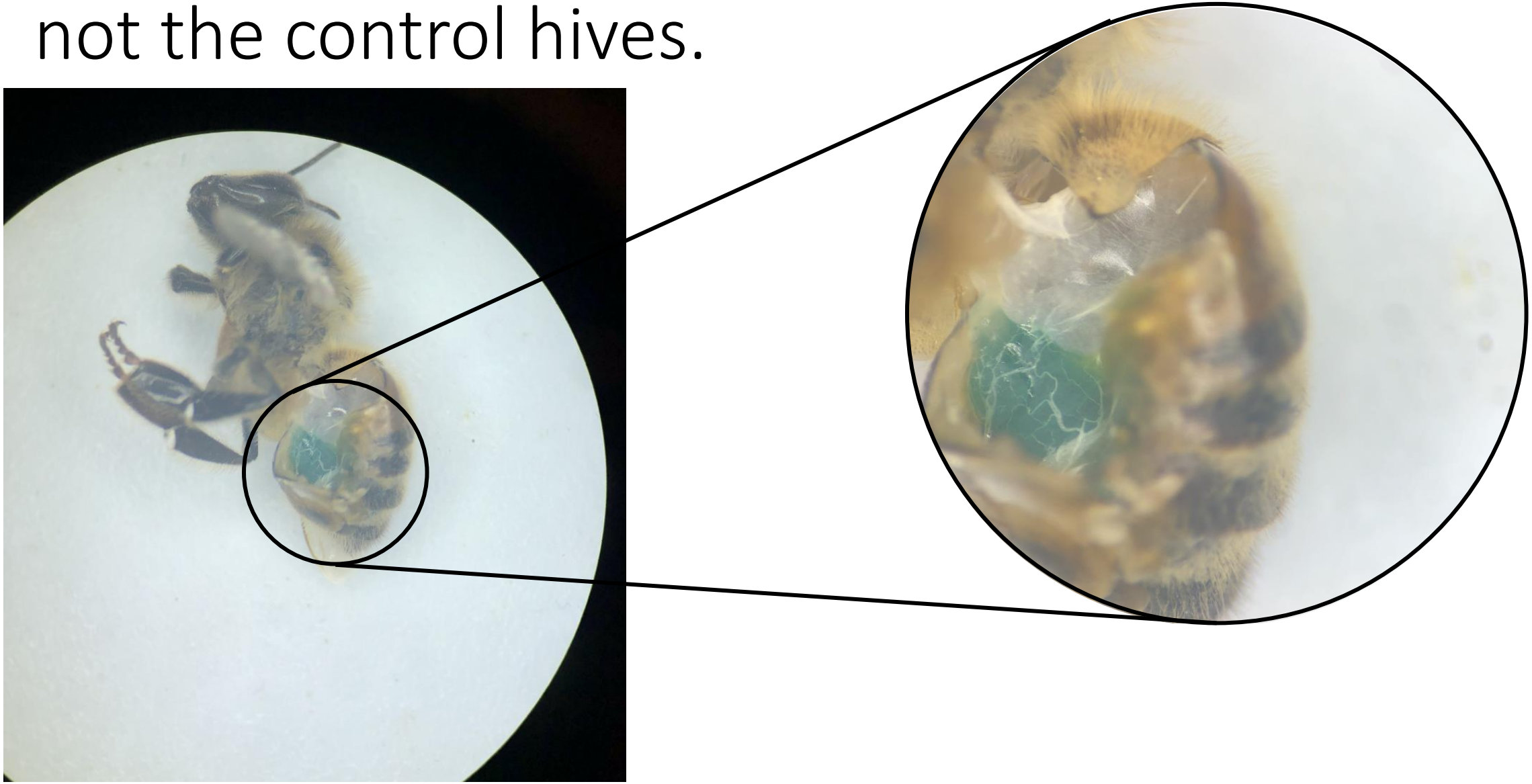


Månefjord et al. 2022

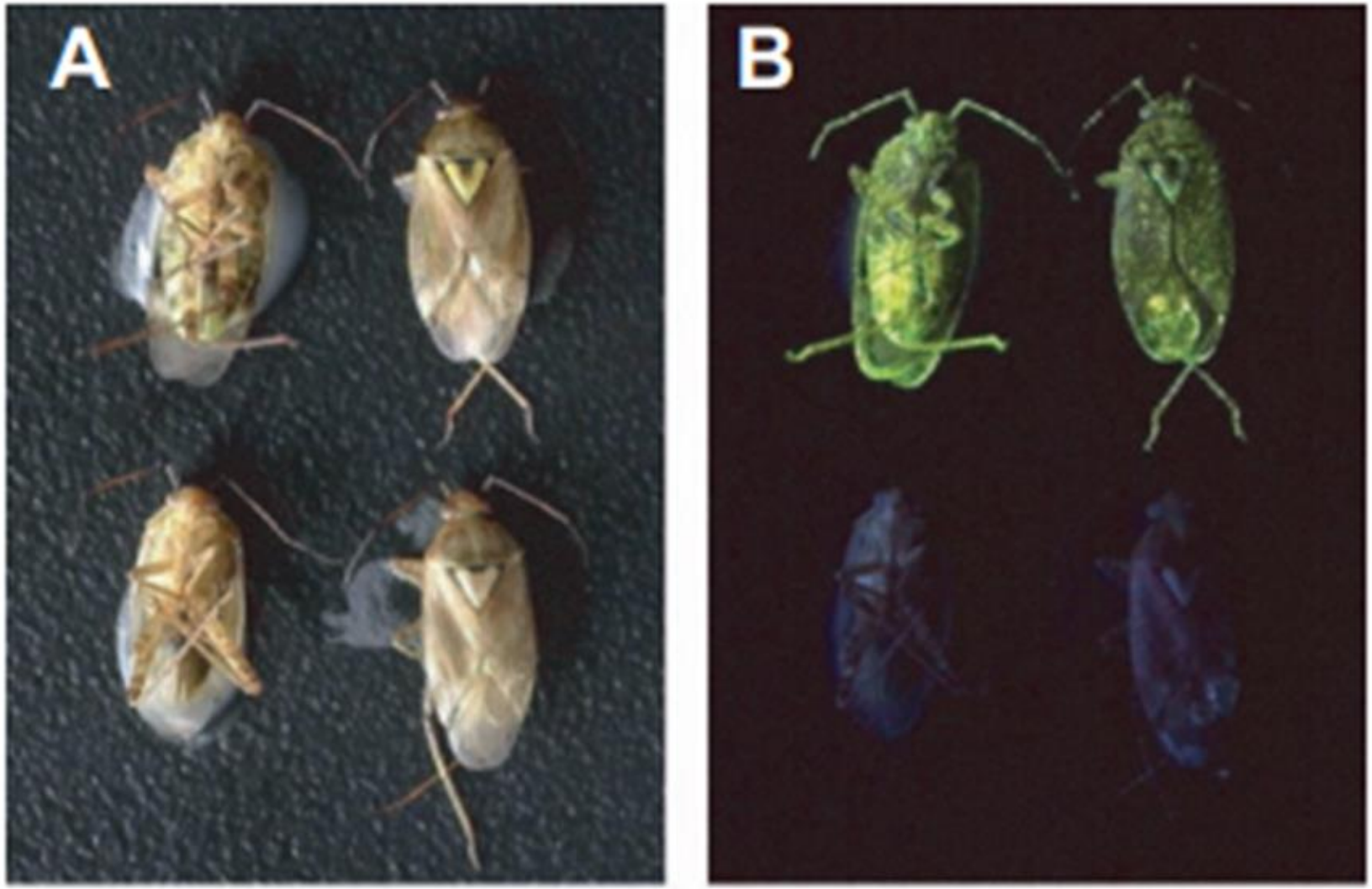
Hand painting requires to much time to mark a sufficient number of foragers.

Spray paint was either cleaned off or lethal to the bees.

Food coloring works for bees being fed but not the control hives.



Fluorophores have not been tested in honey bees but work very well in other insects.



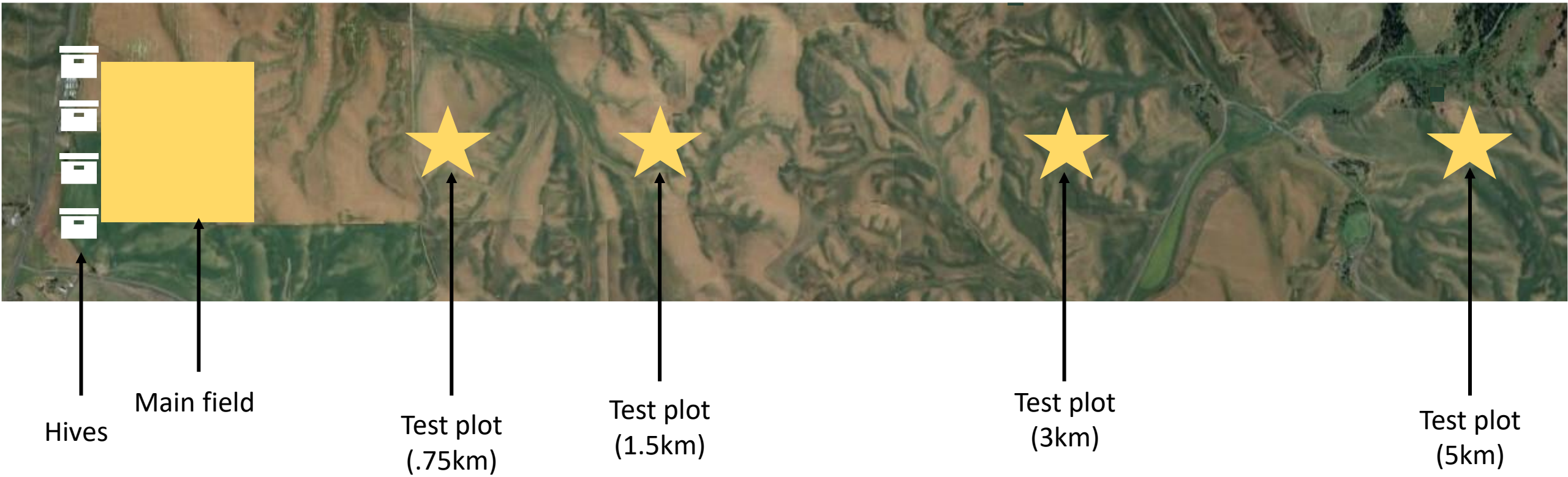
Hagler et al., 2021

Chapter 2: Canola

PNW Canola Association

Hypothesis 3: Providing supplemental in-hive feeding will increase the number of foragers working in the field without impacting overall foraging activity.

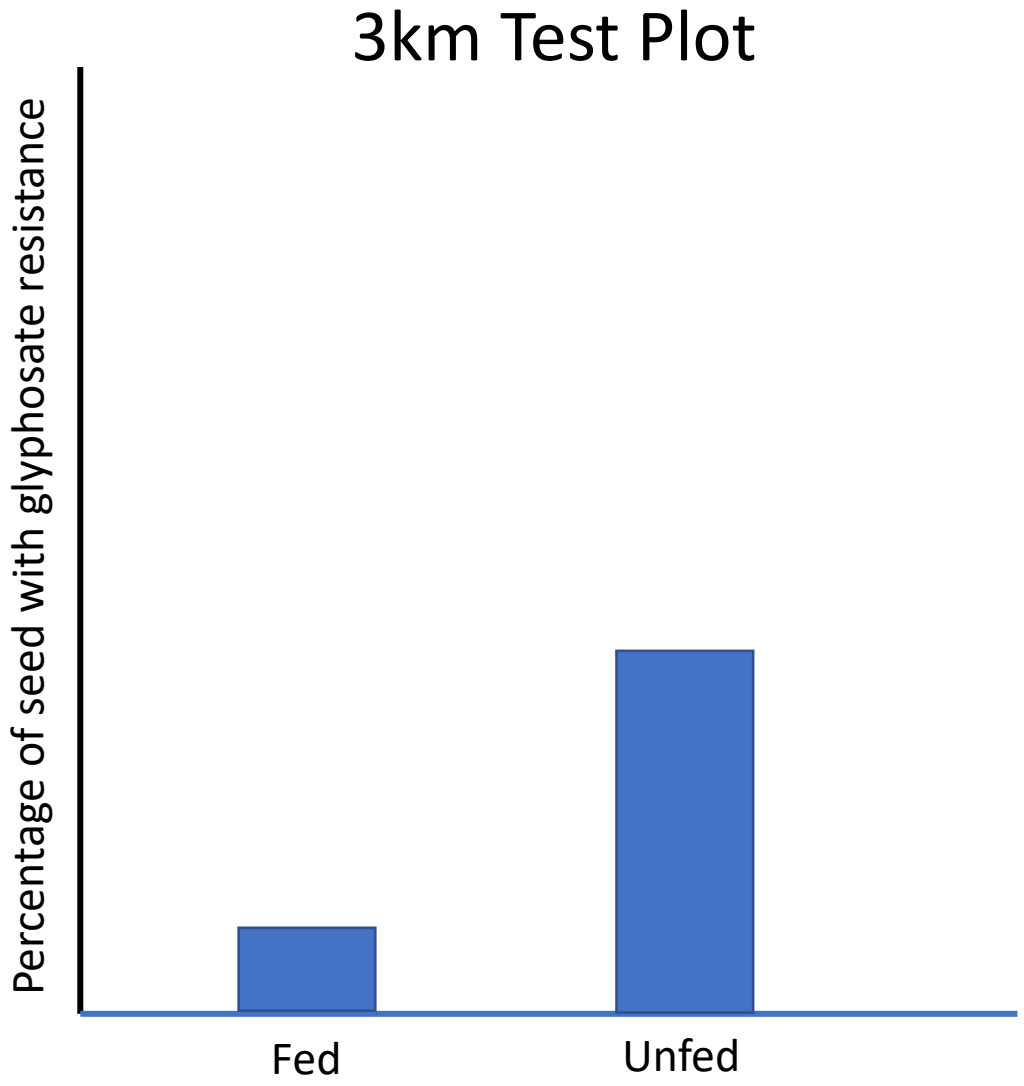
Year one will utilize a single field.



Hypothesis 4 : Providing supplemental in-hive feeding will result in higher seed purity.

Year two will utilize one field per treatment group

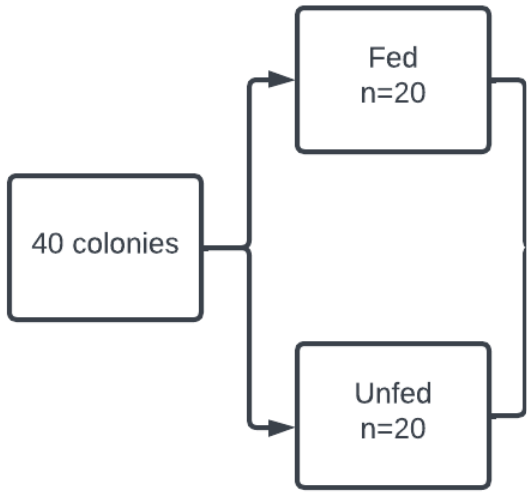
Expected results



Year three will combine years one and two

Chapter 3: Colony health

How does feeding during vegetable pollination impact colony health long-term?

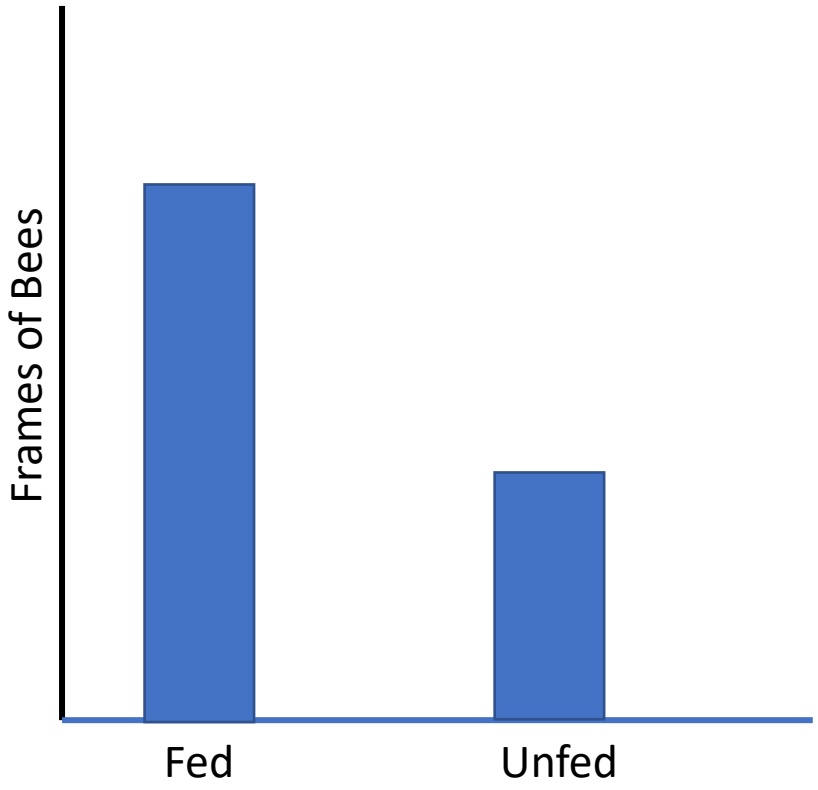


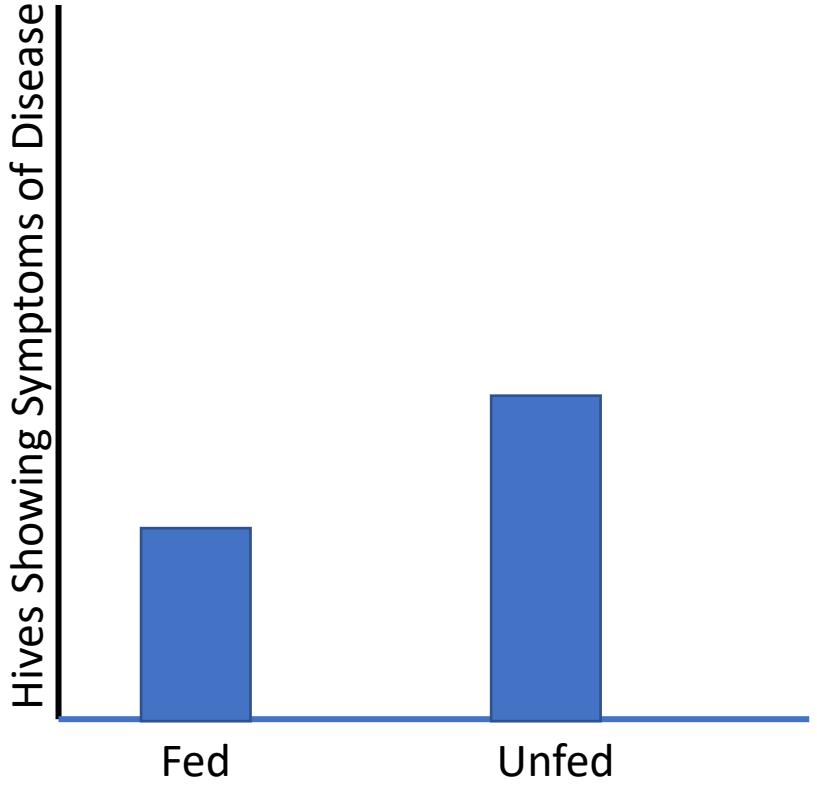
Hypothesis 5: Providing supplemental in-hive feeding during vegetable seed pollination will improve colony health long term.

Metrics

- Frames of bees
- Frames of brood
- Frames of food
- Signs of disease
- Varroa mite load

Expected results





Summary

- Movement of pollinators between seed fields decreases seed value
- Honey bees can fly extreme distances when needed
- We want to remove that need
- Bees are really hard to mark effectively

Part 2: Full Hives

Goals

- Increase pollination quality
- Improve colony health
- Updated colony strength recommendations
- Changes to beekeeping practices including the timing of supering

Twohoneys bee co.

Traditionally growers have preferred the hives with the most frames of bees

=

Image courtesy of popeye.com

Behavioral studies show that colonies forage less under those conditions (Seeley & Tovey, 1994)

=

Photo by Lily Shui

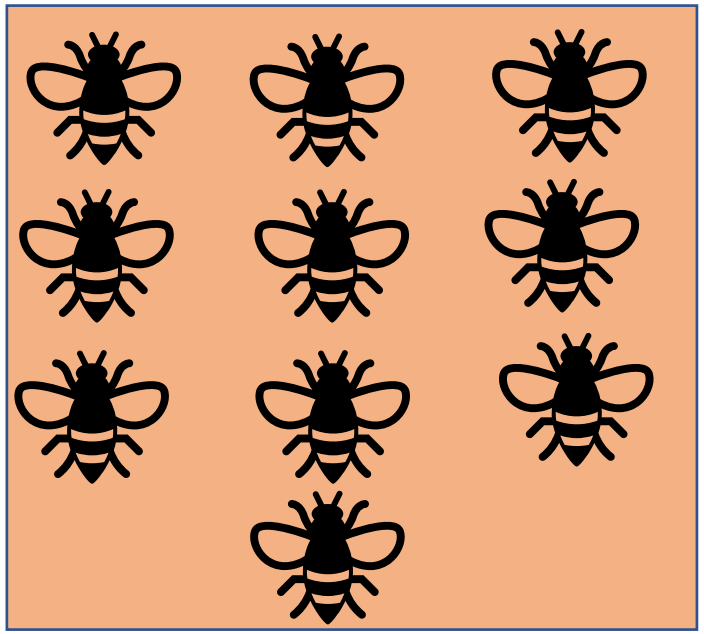
What we want

What we don’t want

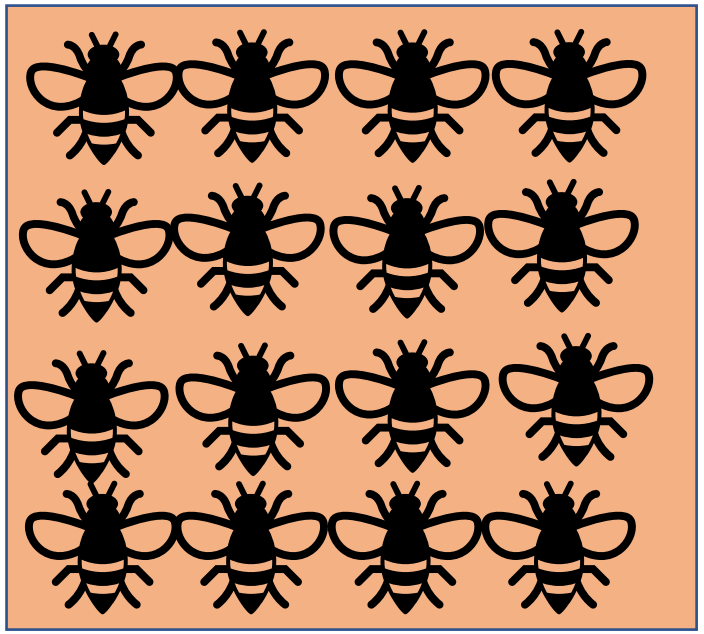
Hypothesis: Colonies with more space will exhibit increased foraging activity

Twohoneys bee co.

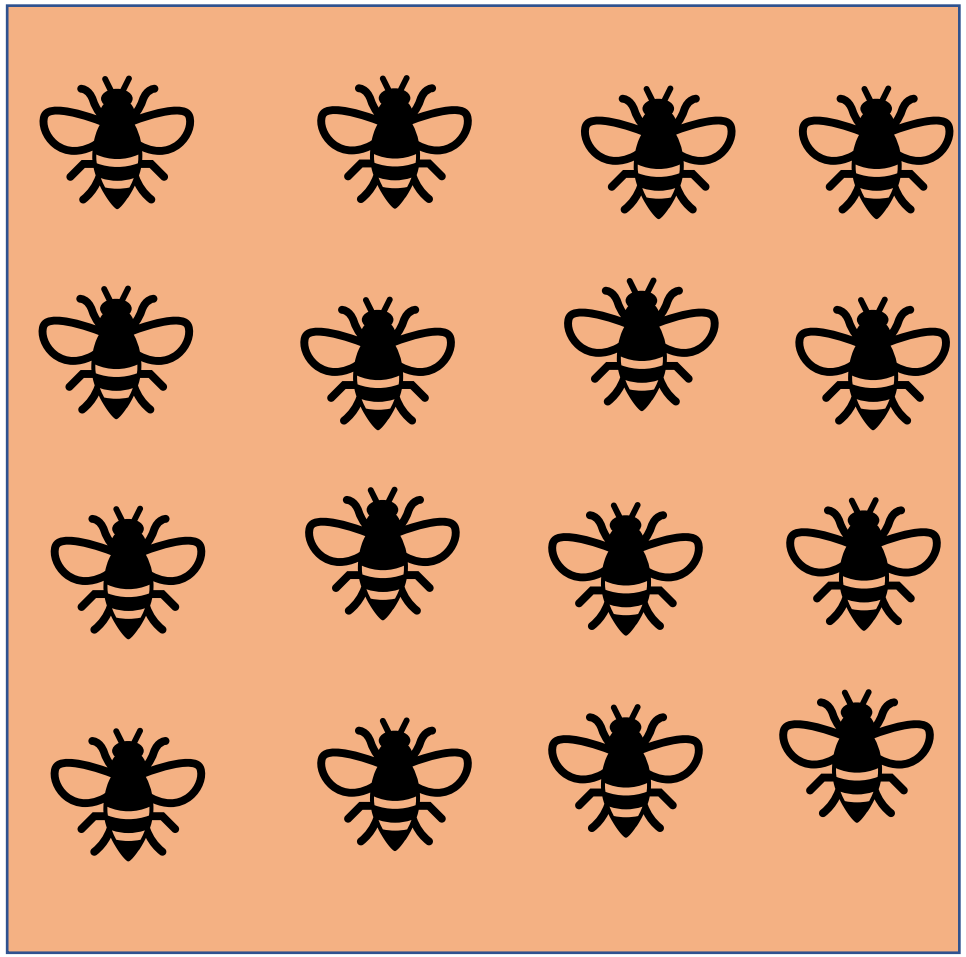
Small hive
Small colony



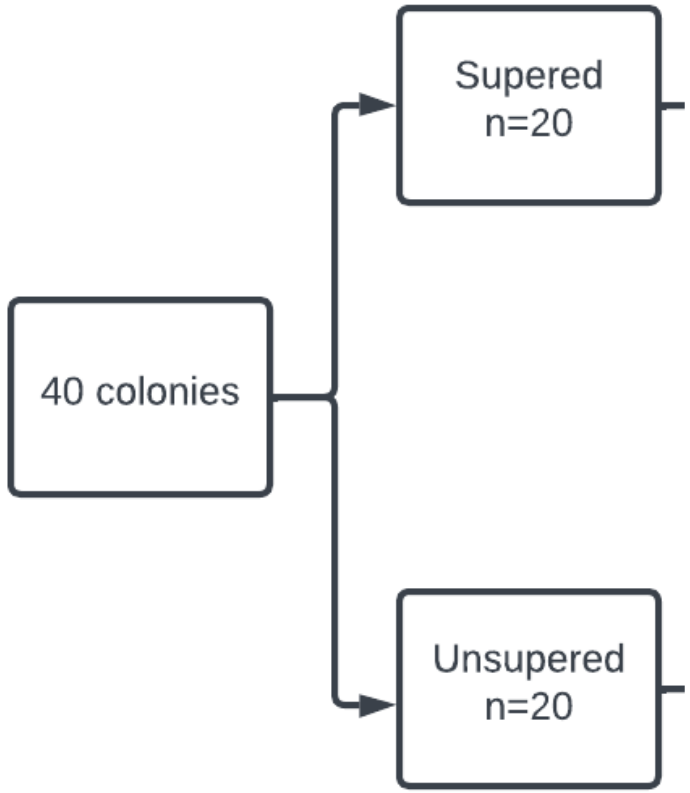
Small hive
Large colony



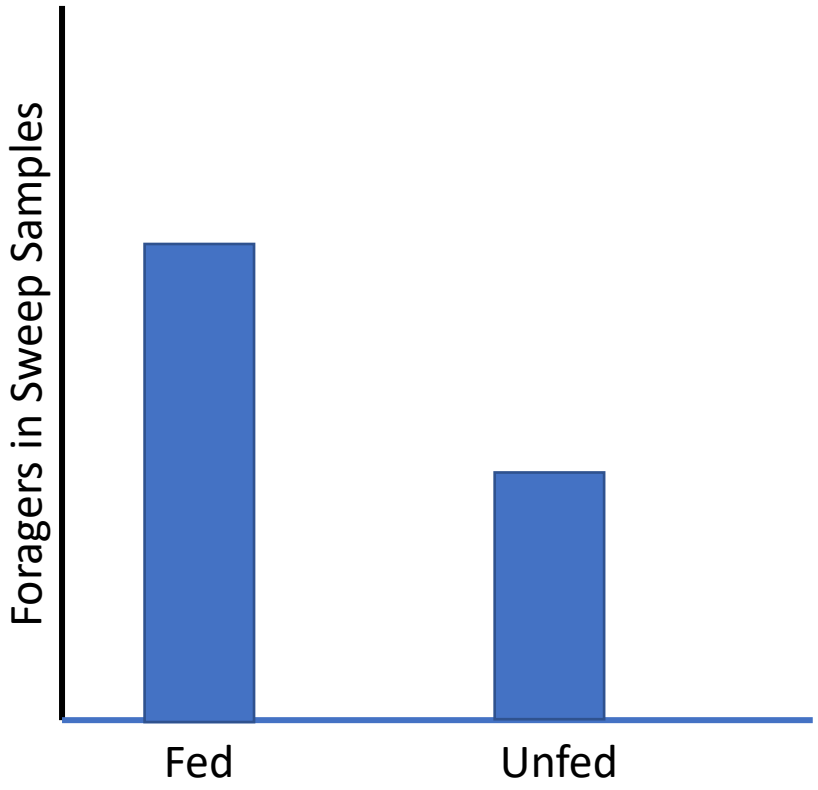
Large hive
Large colony

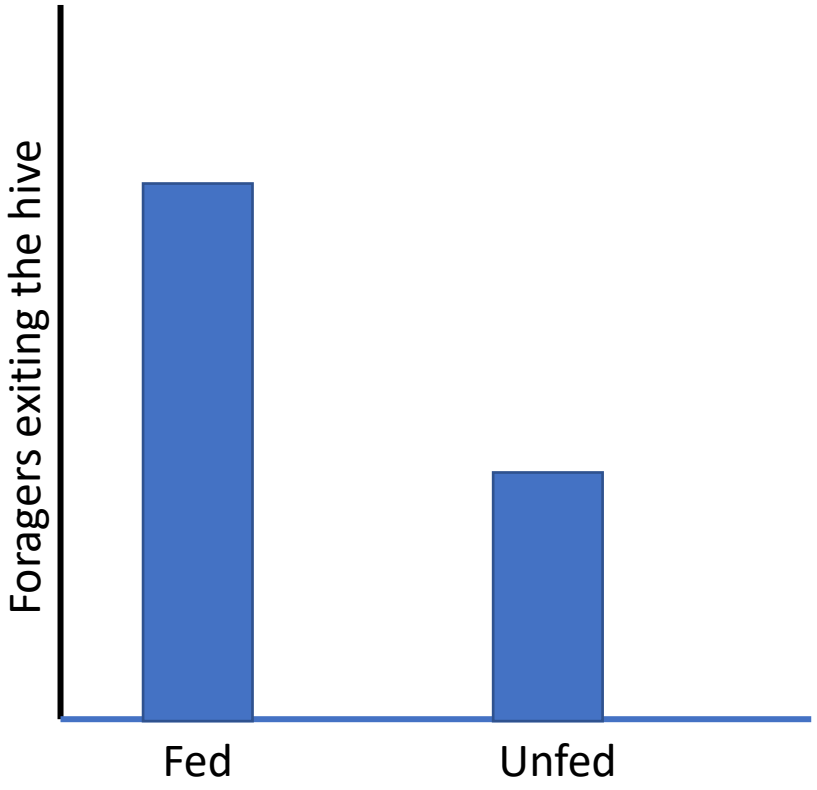


How does adding a super impact foraging activity?



Expected results

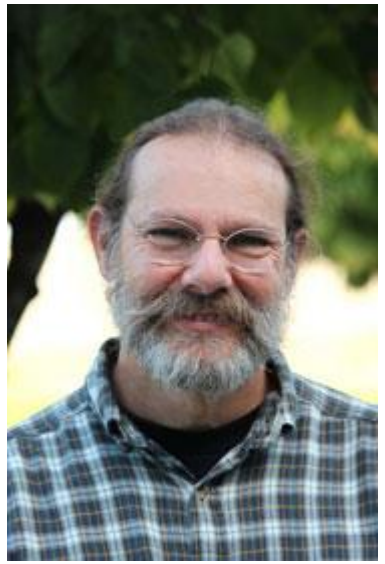




Summary

- Honey bee foraging behavior decreases as available space in the hive decreases
- The strongest hives may not be the best pollinators
- I will test how adding a super impacts foraging during carrot seed pollination

Thanks



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Questions?

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- Feedback survey →
- https://bugmanriley.com/

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