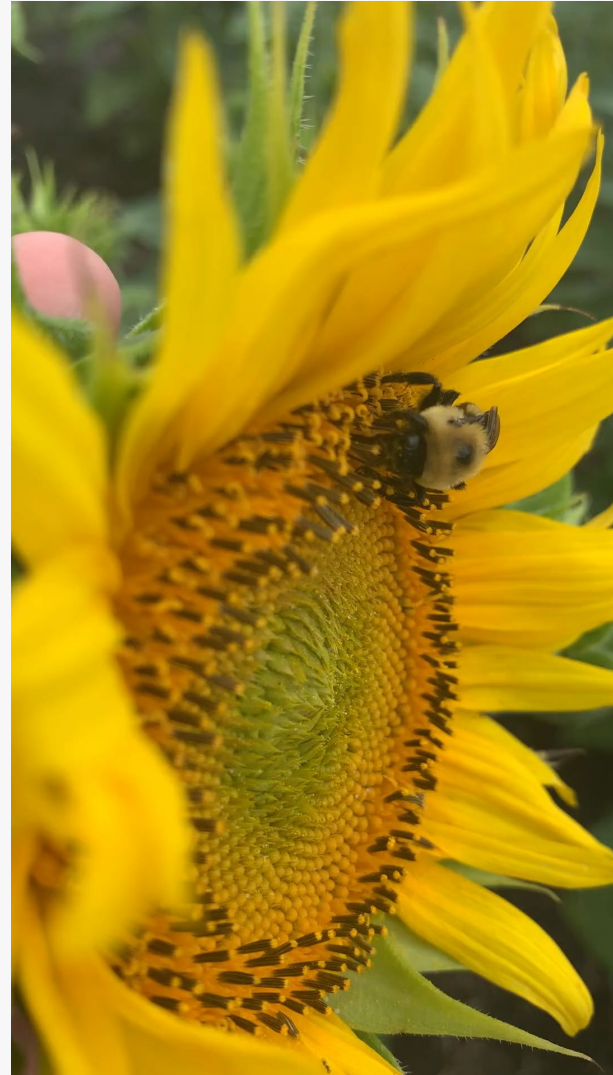

Future Directions in Sunflower- Pollinator Interactions

Intersection of Nutrition
and Behavior

*Beth Ferguson, Jarrad Prasifka,
Mark Carroll, and Pam Puppó*



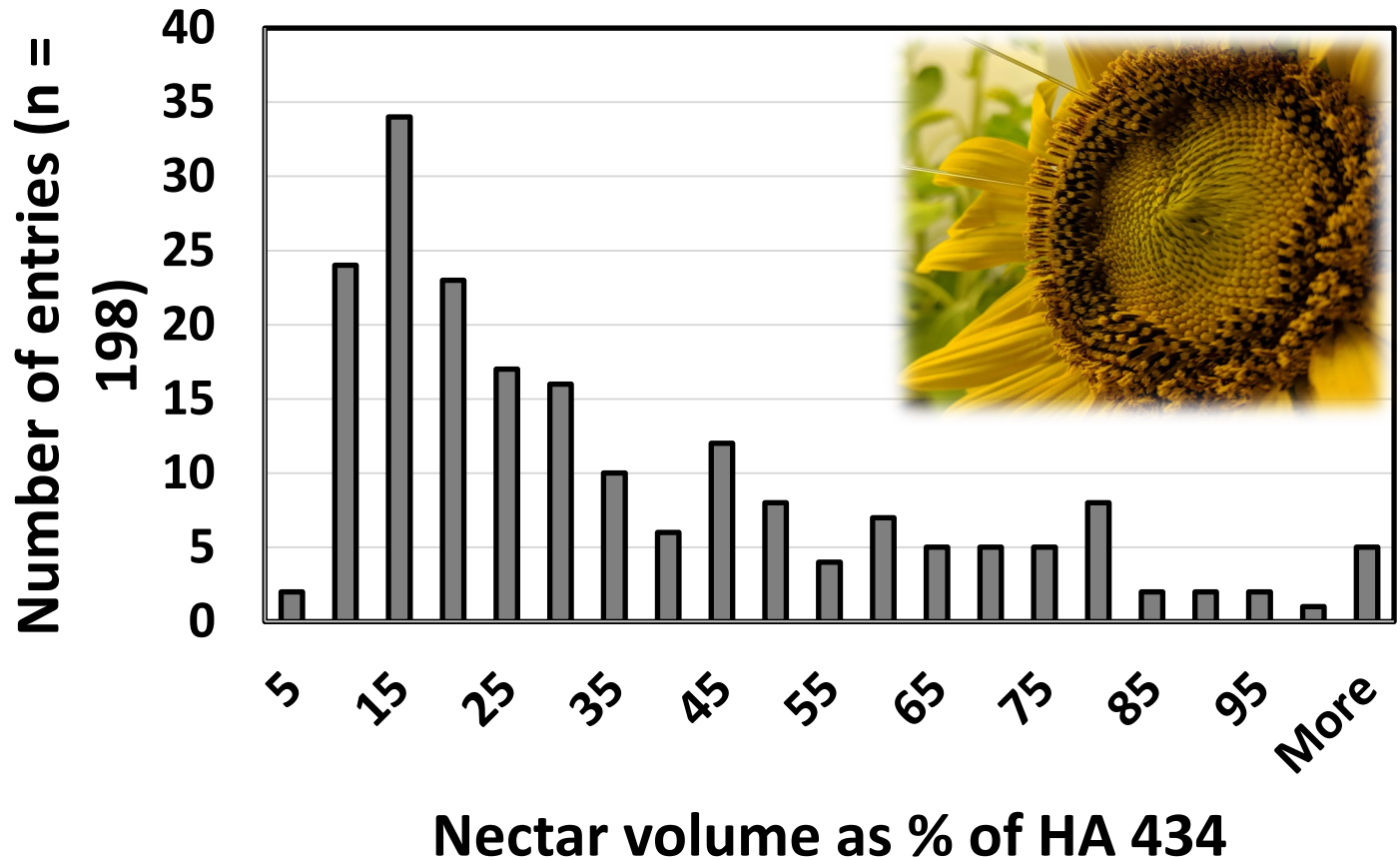
Past Pollinator Projects: A Review

- Use phenotypic data to map genes controlling nectar volume
- Examine inbred lines for genotype, environment, and genotype x environment effects on nectar volume and composition
- Model how nectar access, volume, and other traits influence bee visitation

Pollinator

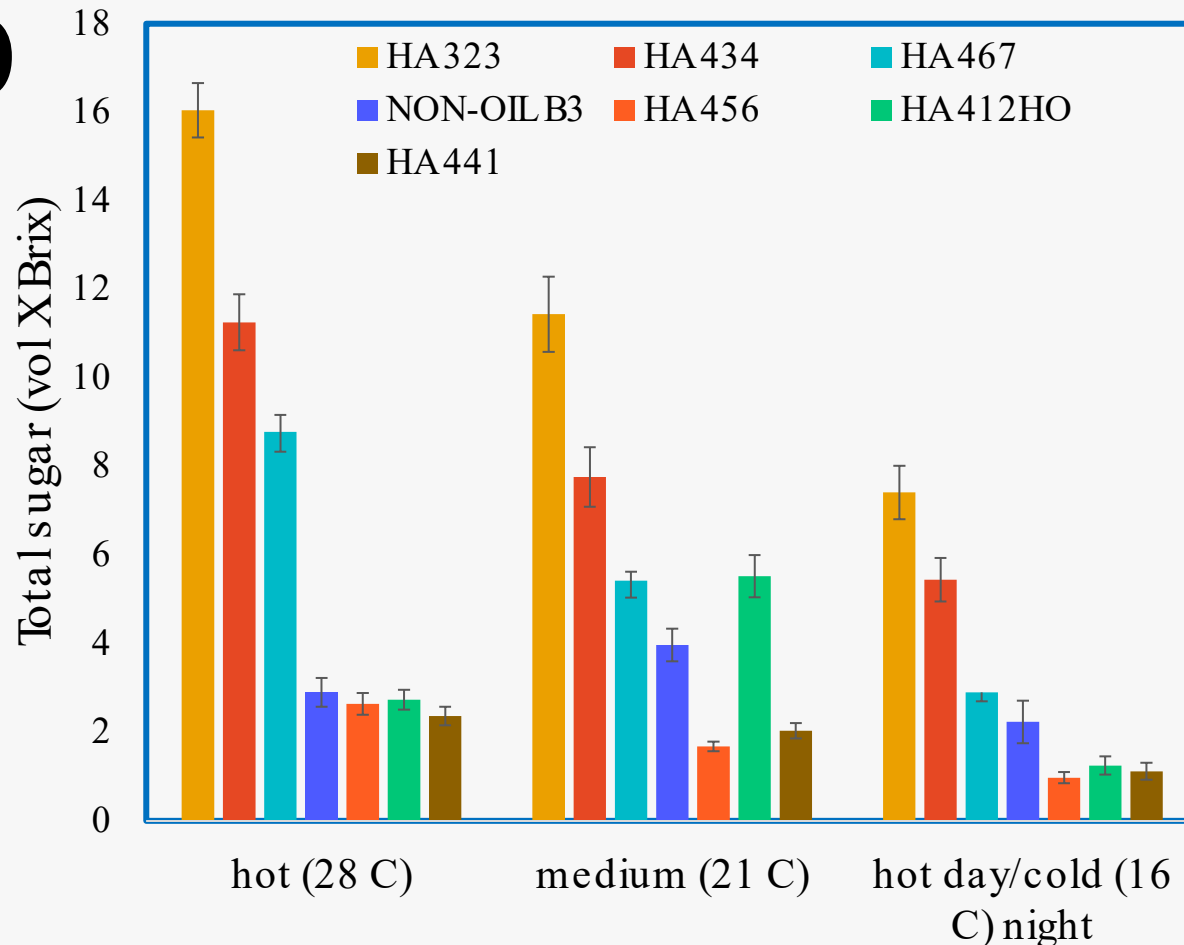
Projects: 2020-2021

- Use phenotypic data to map genes controlling nectar volume



Pollinator Projects: 2019- 2020

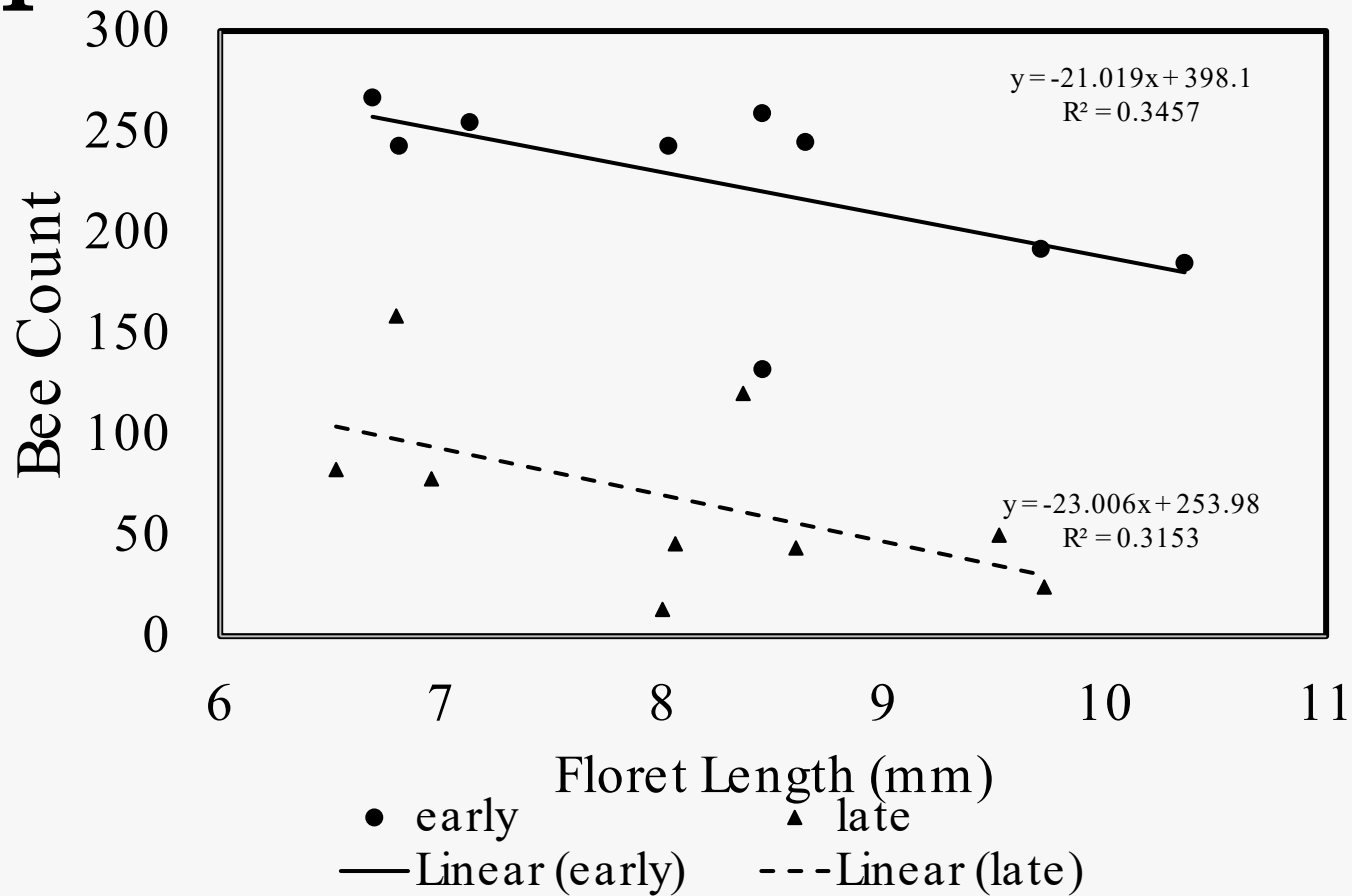
- Examine inbred lines for genotype, environment, and genotype x environment effects on nectar volume and composition



Line: $p < 0.05$
Treatment: $p < 0.05$
Line* $Treatment$: $p < 0.05$

Pollinator Projects: 2020- 2021

- Model how nectar access, volume, and other traits influence bee visitation



Summary

- Factors mediating bee-sunflower interactions are complex
 - Some floral traits more readily observed (i.e. floret depth, nectar amount)
 - Other traits may be less obvious
 - Pollen nutrition
 - Humidity gradients
 - Plant stress
-

Pollinator Nutrition and Behavior- Current and Future Projects

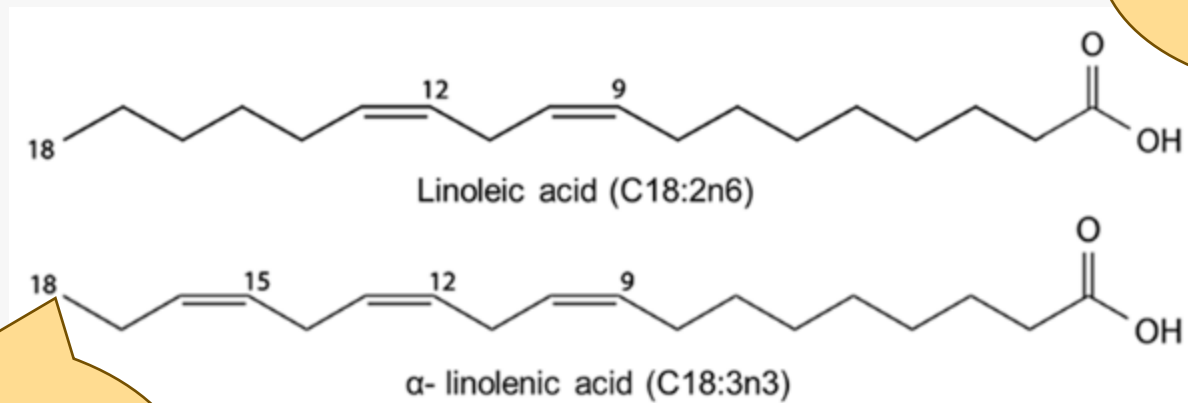
What is the fatty acid composition and profile in sunflower pollen?

What pollen sources are native bees using?

How do bees interact on sunflower heads?

Pollen Fatty Acids - Introduction

- Fatty acids are components of fat molecules
 - Aid in memory and learning
 - Important for fertility and health
- Linoleic and α -linolenic are essential



Omega-6 Fatty Acid

Omega-3 Fatty Acid

Pollen Fatty Acids

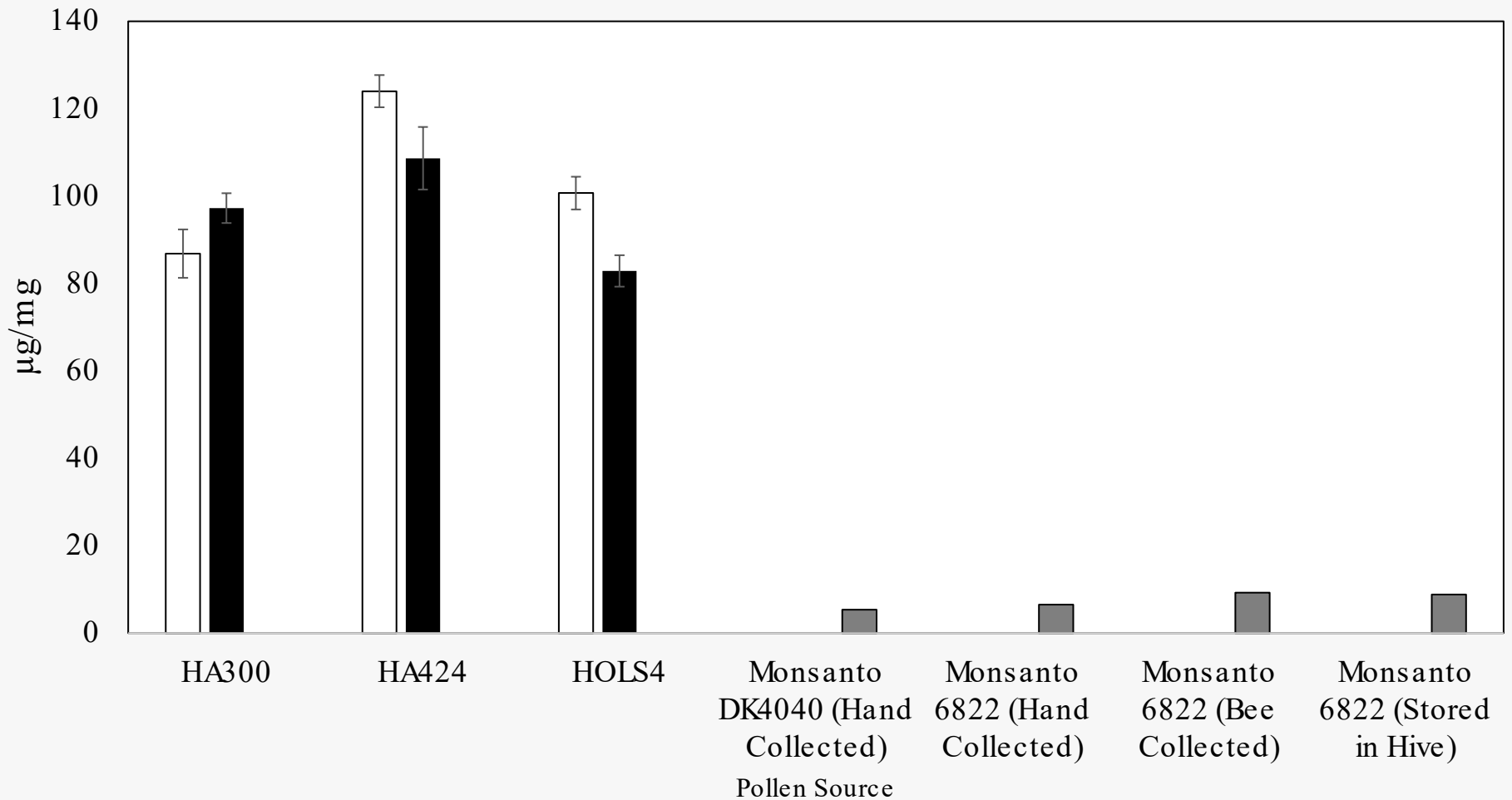
- Pollen collected from bagged plants grown in Arizona
- 4 lines in 2019
- 10 lines in 2020
- Fatty acid profiling (FAME) conducted

*Data are from three lines grown both years

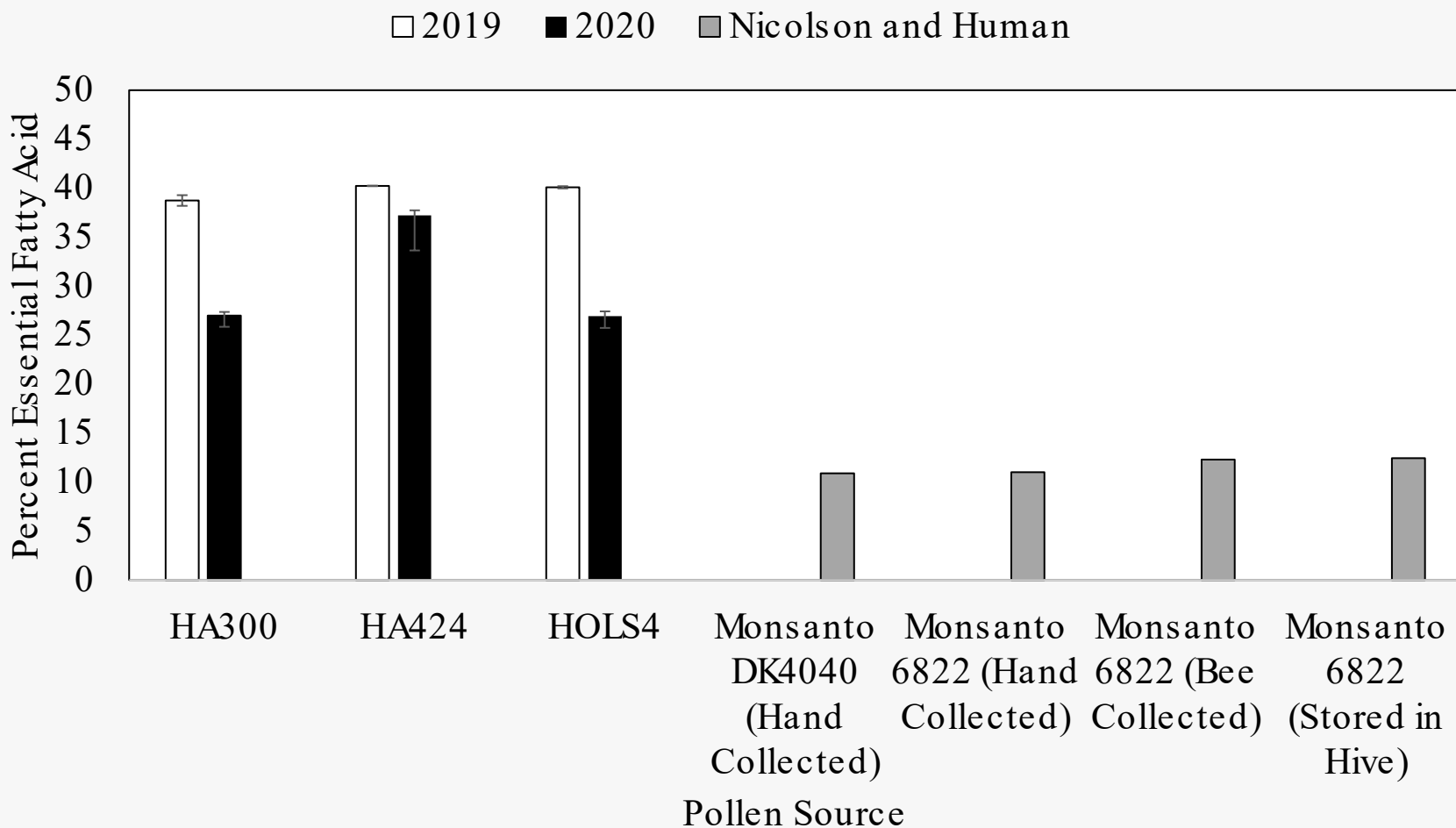


Total Fatty Acid Content

□ 2019 ■ 2020 ■ Nicolson and Human



Fatty Acid Content- Percent of Total



Summary

- Results varied from prior research
 - Different genetic lines
 - Difference in methods
 - Collection, storage, how pollen was broken down (or not) for processing
- Demonstrated sunflowers can be a good source of essential fatty acids for honey bees
- Some inbred lines are more nutritious than others (data not shown)



Pollen Foraging



Pollen samples collected from sunflower specialists

Melissodes agilis

Melissodes trinodus



Sunflower field located at North Dakota State University Agronomy Seed Farm



ABLAST of the pollen samples was done to determine plant source



Summary

- *Helianthus* detected on all bees collected
 - 60-68% of bees only had sunflower pollen
- Despite being specialists, both species had pollen from a variety of non-*Helianthus* plants
 - Peas (Fabaceae)
 - Mustards (Brassicaceae)
 - Flax (Linaceae)



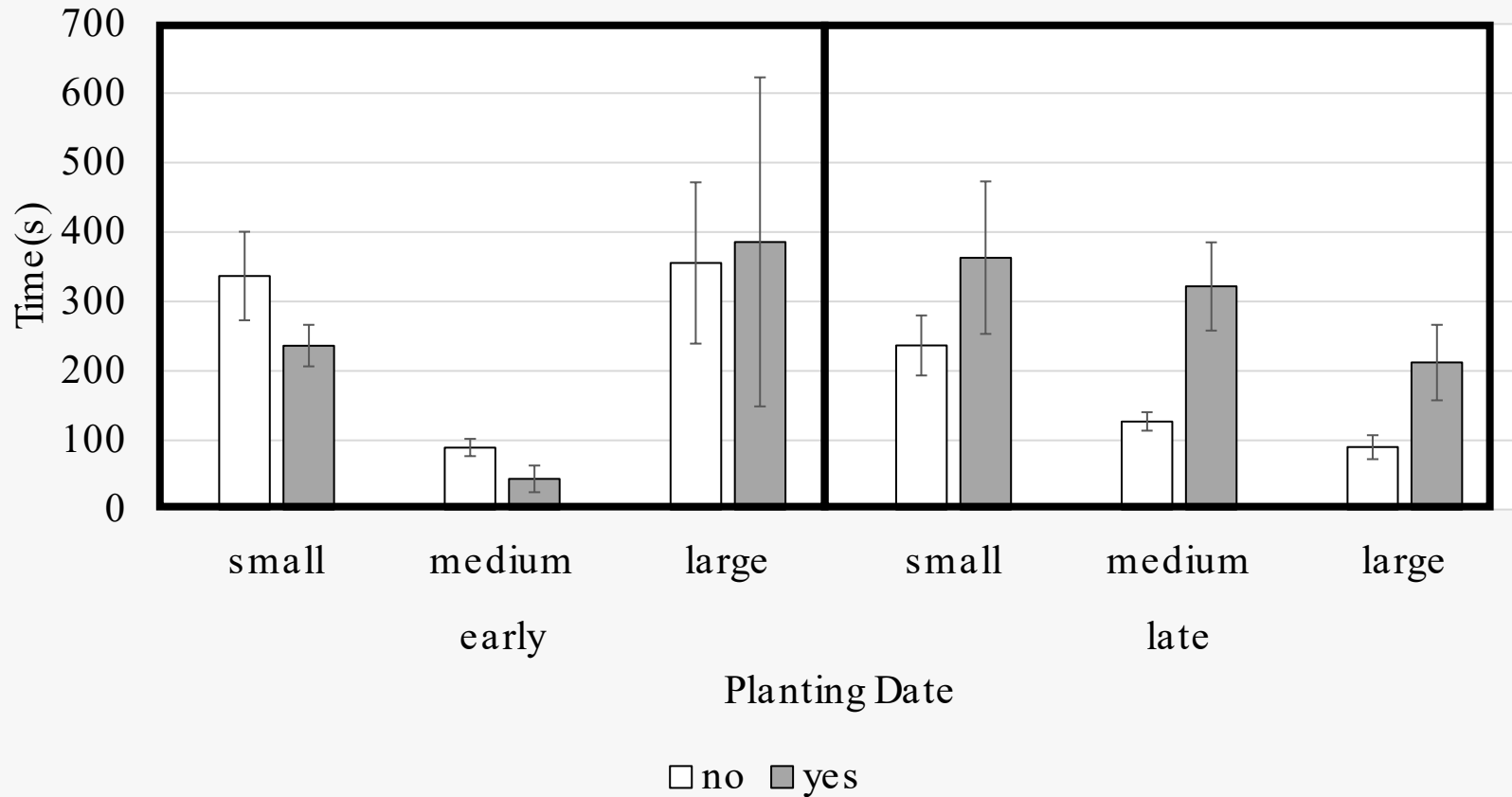
Bee Behavior

- Recorded bee interactions in sunflower fields in 2020 and 2021
- Observations taken on
 - Frequency of interactions
 - What species are interacting
 - Major behavior
- 2020 had an outbreak of painted ladies

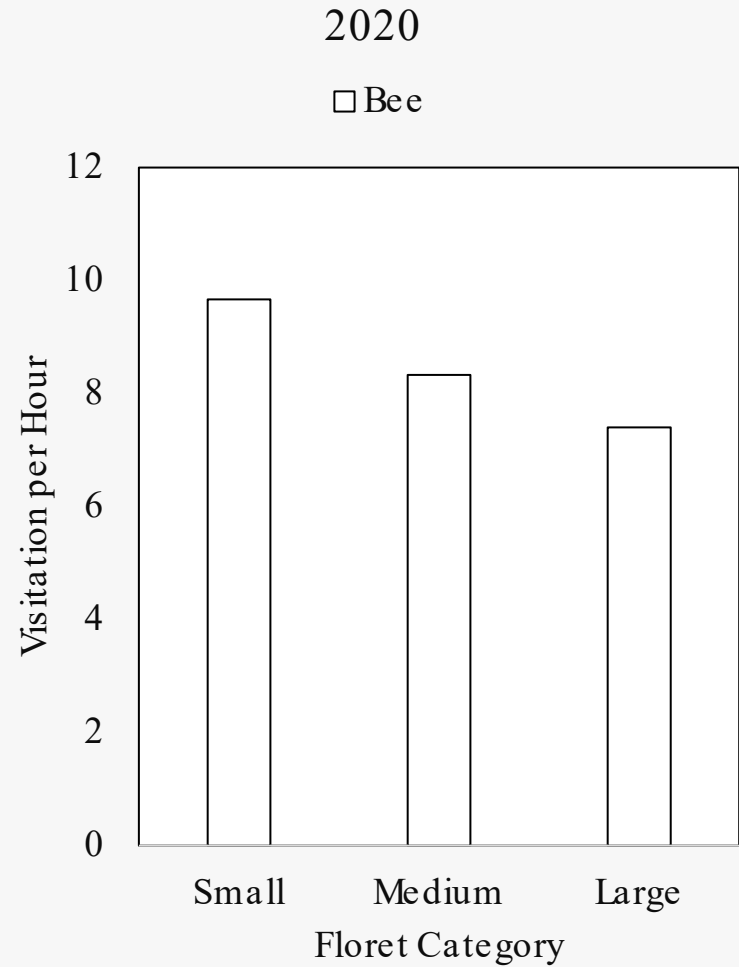
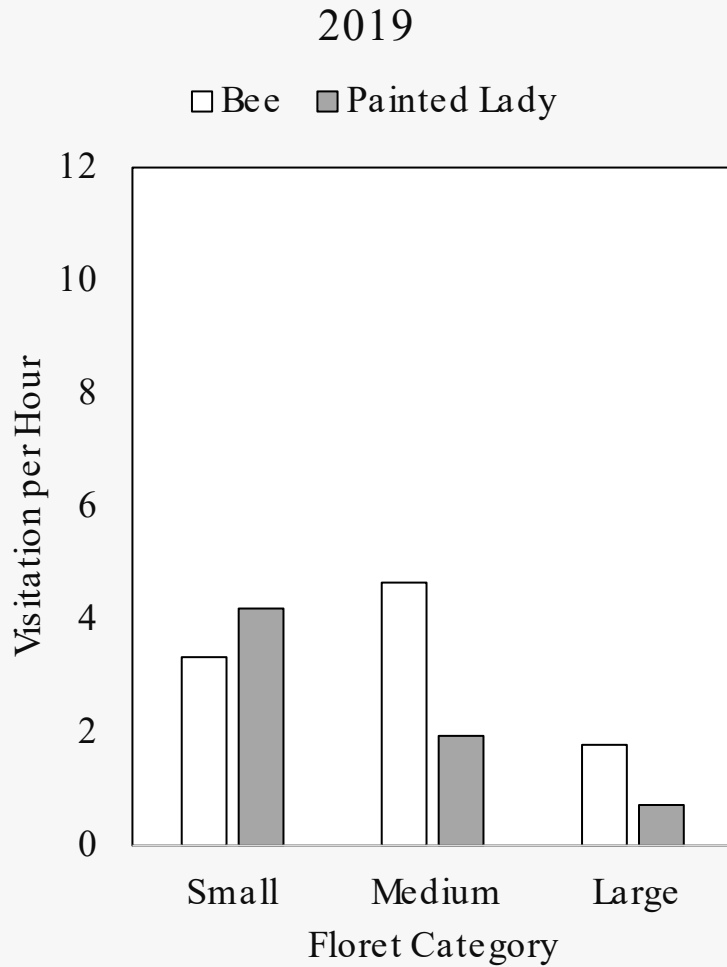


Foraging Time- 2019

Foraging Time Early to Late (split by interaction)



Visitation Rate



Summary-Behavior

Early vs Late 2020

- Foraging time early in the season unaffected by whether the insect interacted with another insect
- Late season insects with interaction foraged significantly longer

2020 vs 2021

- Bee visitation more frequent on all sizes of sunflower florets
- Visitation double or triple of the prior year
- Painted ladies may be interfering with pollination services

Summary

- Sunflowers are capable of producing pollen that is good quality
 - Results differed from prior studies
 - Further testing on environmental effects
- Sunflower specialist bees have pollen from outside the sunflower genus
 - Three other plant families found
 - May reflect the small field size available
- Bee foraging impacted by other insect foraging
 - Late-season foragers spent longer on flowers after interacting
 - Painted ladies seem to reduce bee visitation

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