Bee-sunflower interactions:

Evaluating plant traits that attract bees and crop pollinator-dependency

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Outline

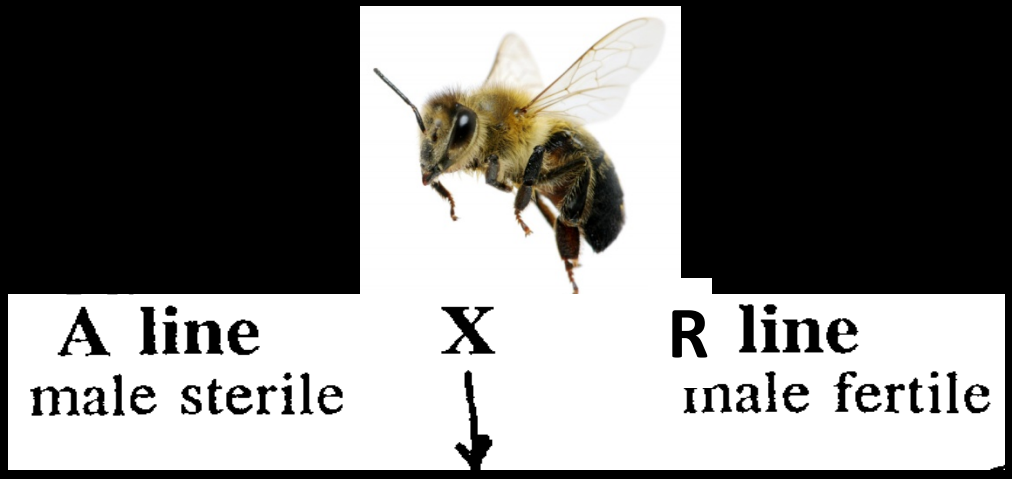
- Sunflower-pollinator background
- Effects of pollinators on sunflower yields (2014)
- Floral traits of sunflowers that attract bees (2015)
- Future directions

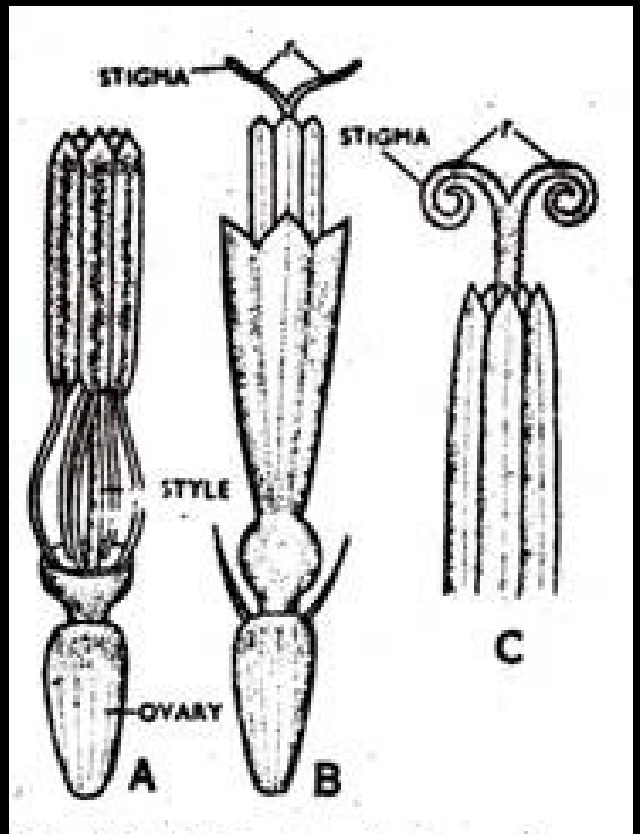
Pollinators of sunflower

- Managed honey bees
  - Non-native bee (European)
  - Social: Queens, workers, males
  - Generalists
- Wild bees
  - ~4,000 species in NA
  - 400+ species on sunflowers in US
  - Mostly solitary, ground-nesting
  - Specialists of sunflower

Sunflower pollinator-dependency

- Seed production: high
- Confection and oilseed production: moderate?
  - Breeding for self-fertility
  - Yield increase with bees and cross-pollination





Bees attraction to sunflowers

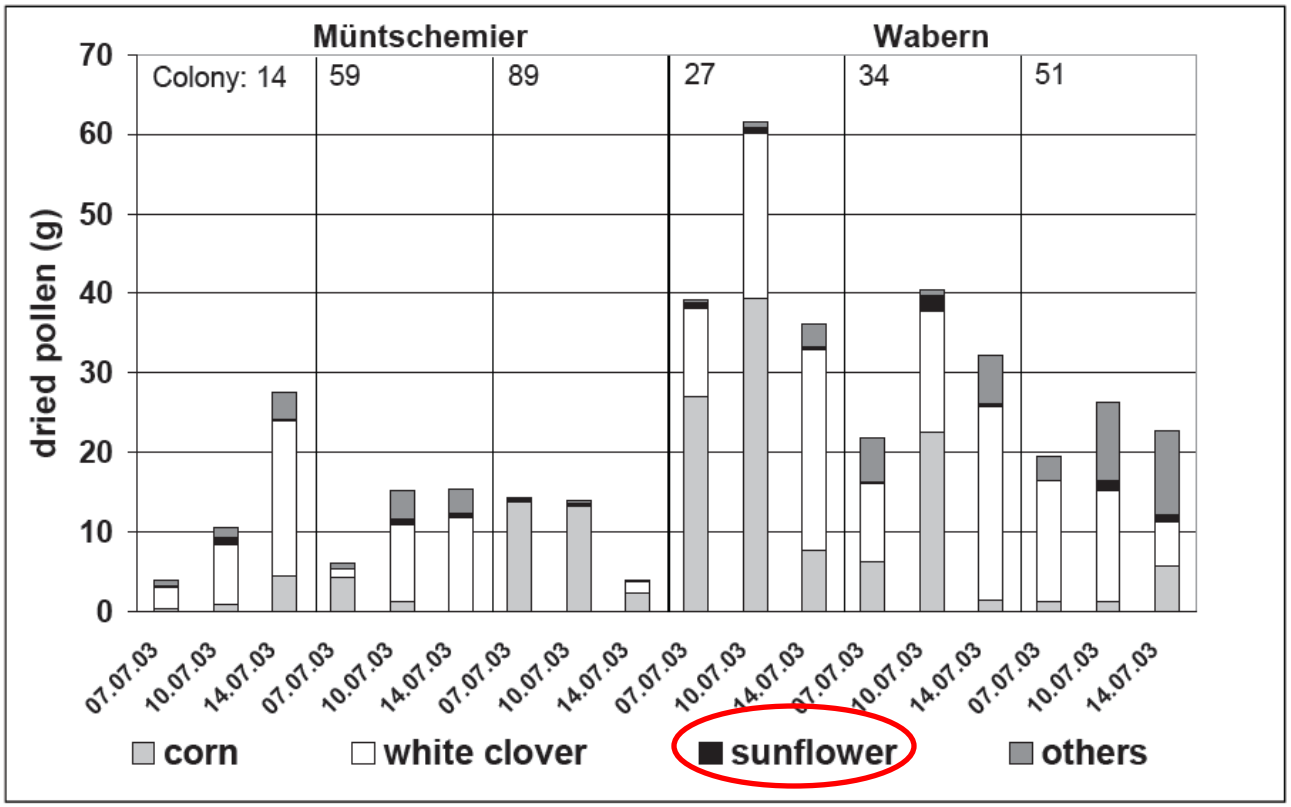


Fig. 7. Quantity and botanical origin of pollen harvested at Müntschemier and Wabern in 2003.

- Pollen quantity
- Pollen quality
- Nectar volume
- Nectar sugar
- Corolla length
- Flower color
- Floral volatiles

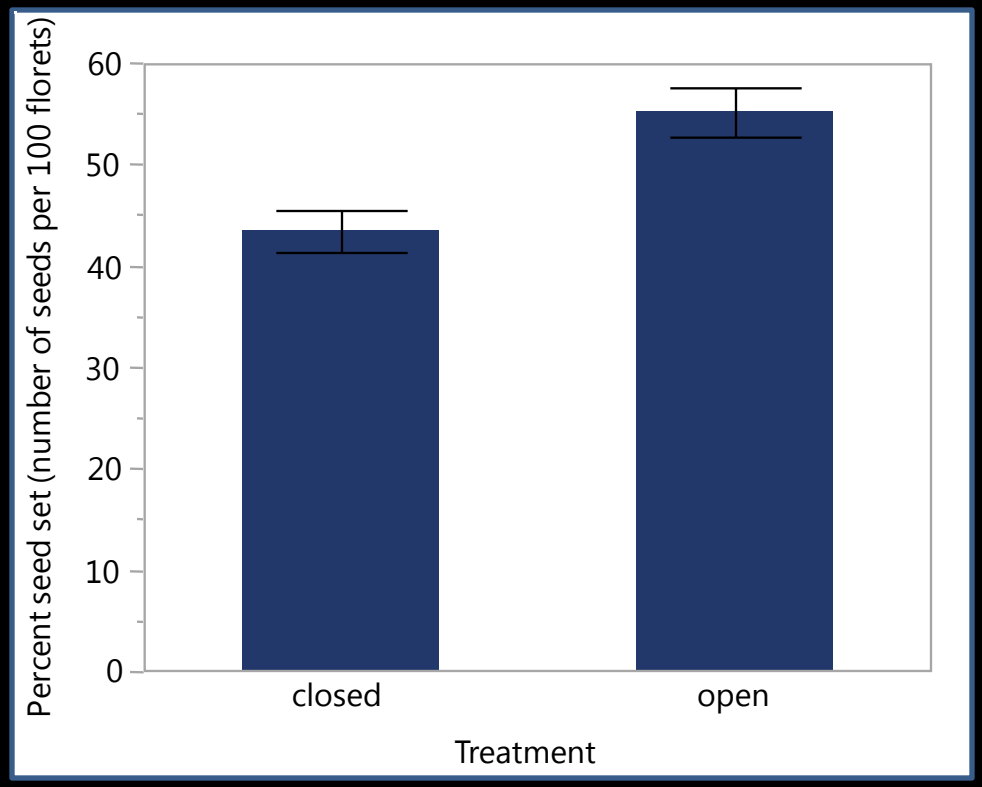
Research questions

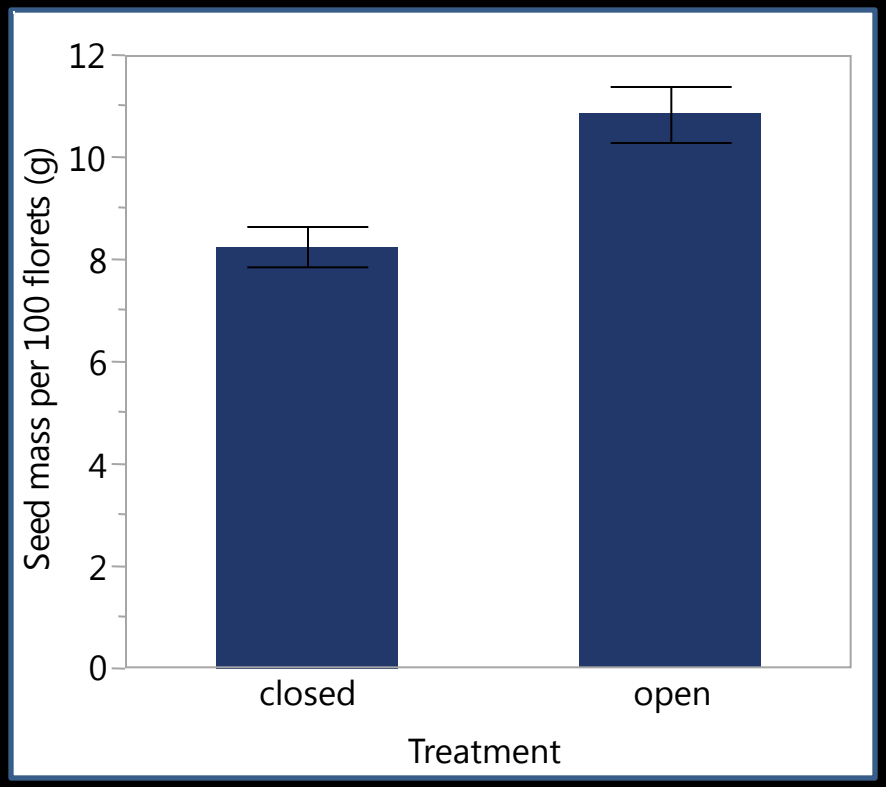
1. How much do bees increase confection sunflower yields?
   - Across different hybrids
   - Across different years and growing conditions
2. What floral traits influence bee attraction?
   - Can we breed sunflowers to be more attractive to bees?

How much do bees increase confection sunflower yields?

- 15 different hybrids
- 3 different seed companies
- ~ 7 closed, 7 open heads
- # filled seeds per head
- Seed mass per head
- # florets per head

How much do bees increase confection sunflower yields?

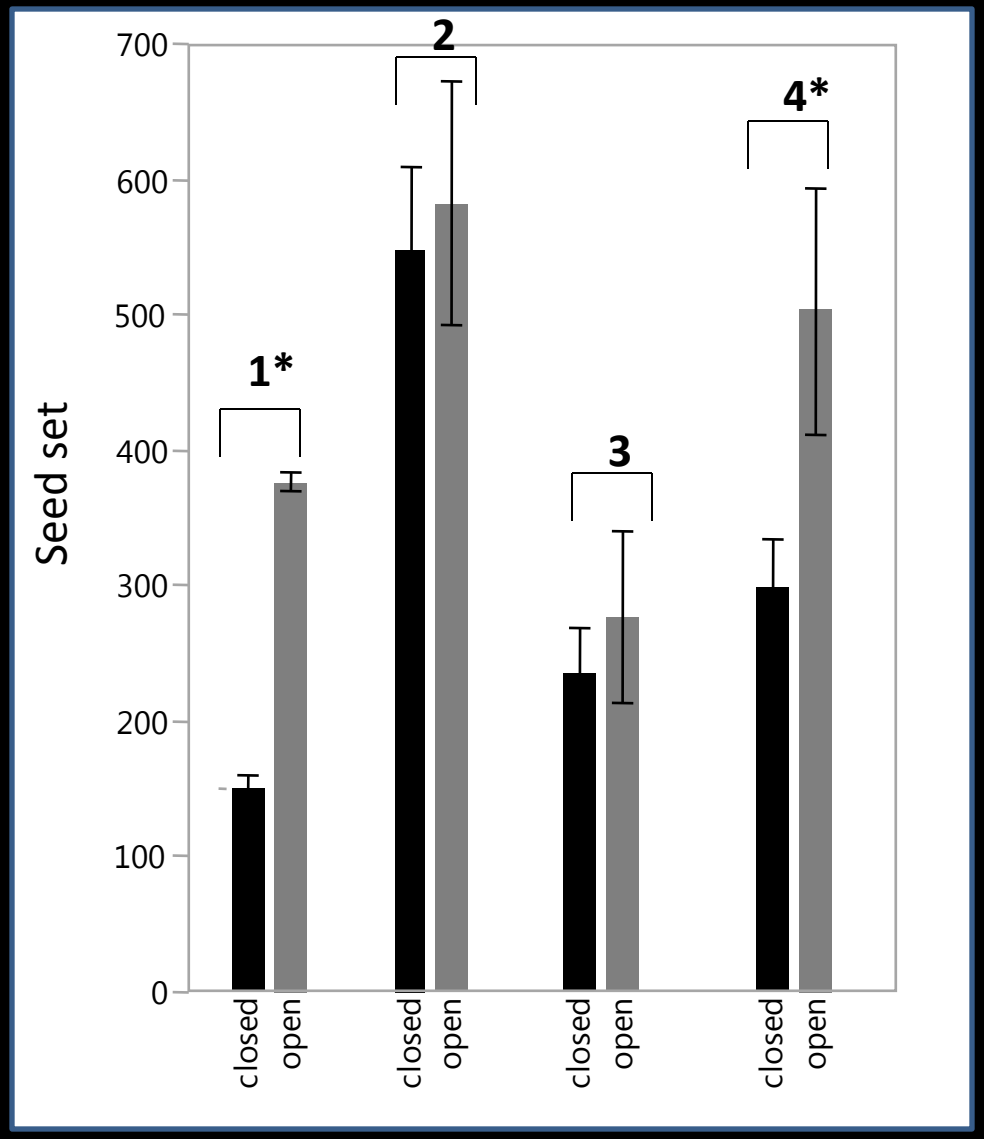




~30% increase in seed set and mass with pollinators

How much do bees increase confection sunflower yields?

* Sig differences among hybrids



Conclusions

- Pollinators could increase confection yields by 30%+
  - Bees most abundant and effective
- Some sunflower hybrids more dependent on pollinators than others
- Comparable to oilseeds?

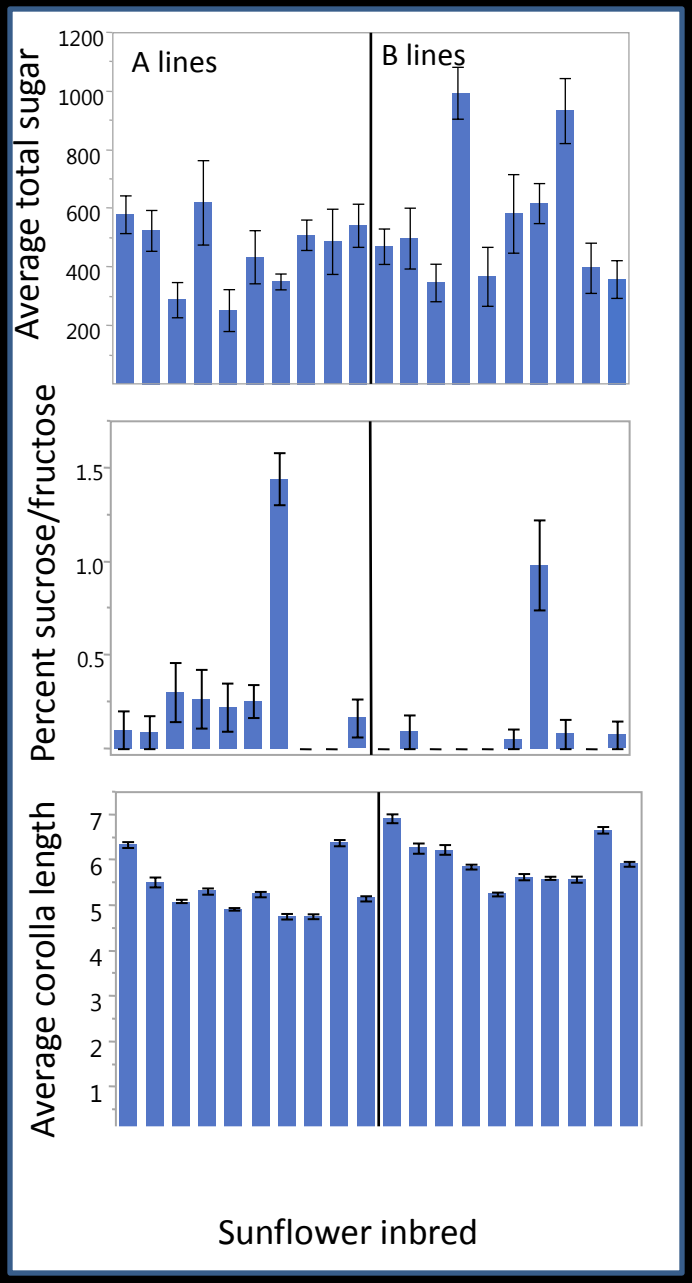
What floral traits influence bee attraction?

- Variation in oilseed inbreds
  - 10 A-line, male-sterile inbreds
  - 10 B-line, male-fertile inbreds
- Nectar: volume, sugar conc, suc:fruc:gluc, corolla length
- Bee visits: honey bee, wild bees

What floral traits influence bee attraction?

- 92% of visits by wild bees
  - *Andrena helianthi*
  - *Melissodes trinoides*
- Honey bees
  - Over 90% of pollen collected was not sunflower
- In 2014, 50% HBs and 50% WBs

What floral traits influence bee attraction?

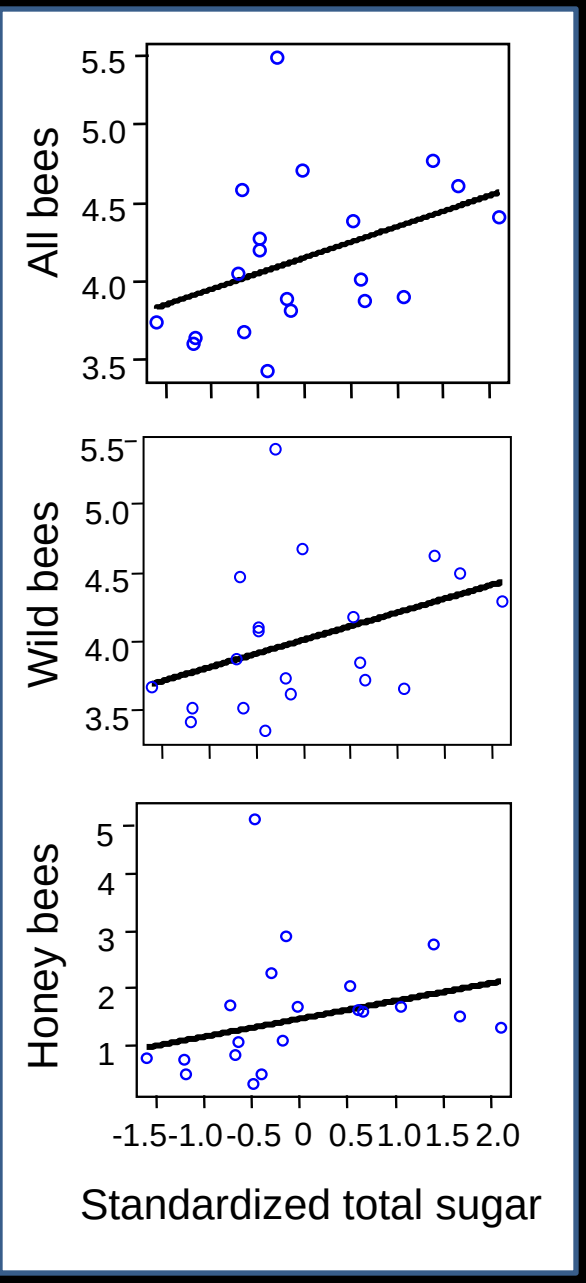


* Significant variation in nectar sugar (vol * conc)

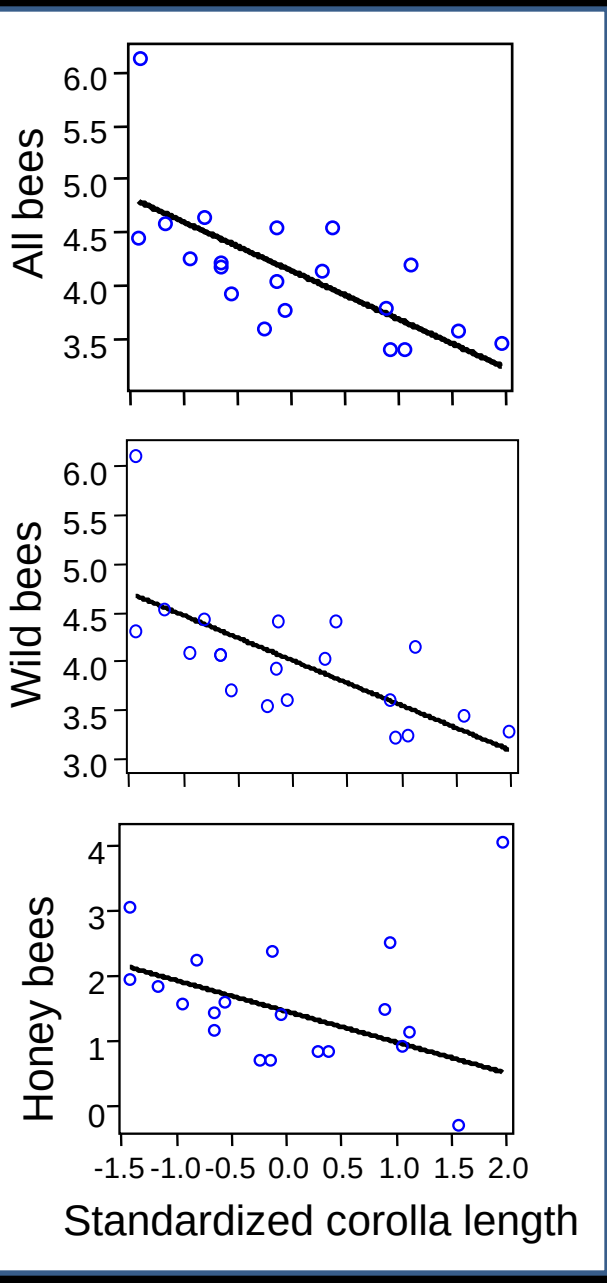
* Significant differences in suc:fruc:gluc

* Significant differences in corolla length

What floral traits influence bee attraction?



- Nectar sugar: **Pos**
- Corolla length: **Neg**
- Suc:Fruc:Gluc: **No effect**



Conclusions

- Nectar sugar amount increases bee visits
  - Nectar volume and sugar concentration
- Corolla length decreases bee visits
  - Affects availability of nectar sugar
- Sugar composition less important
  - Sucrose low with few exceptions
- Honey bees and wild bees respond similarly

Future directions

1. How much do bees increase confection sunflower yields?
   - Across different years and growing conditions (states)
   - Center seed set
   - Efficacy of different bee species (honey bees, other)
2. What floral traits influence bee attraction?
   - Pollen quality and quantity
   - Nectar manipulations
   - Nectar genomics