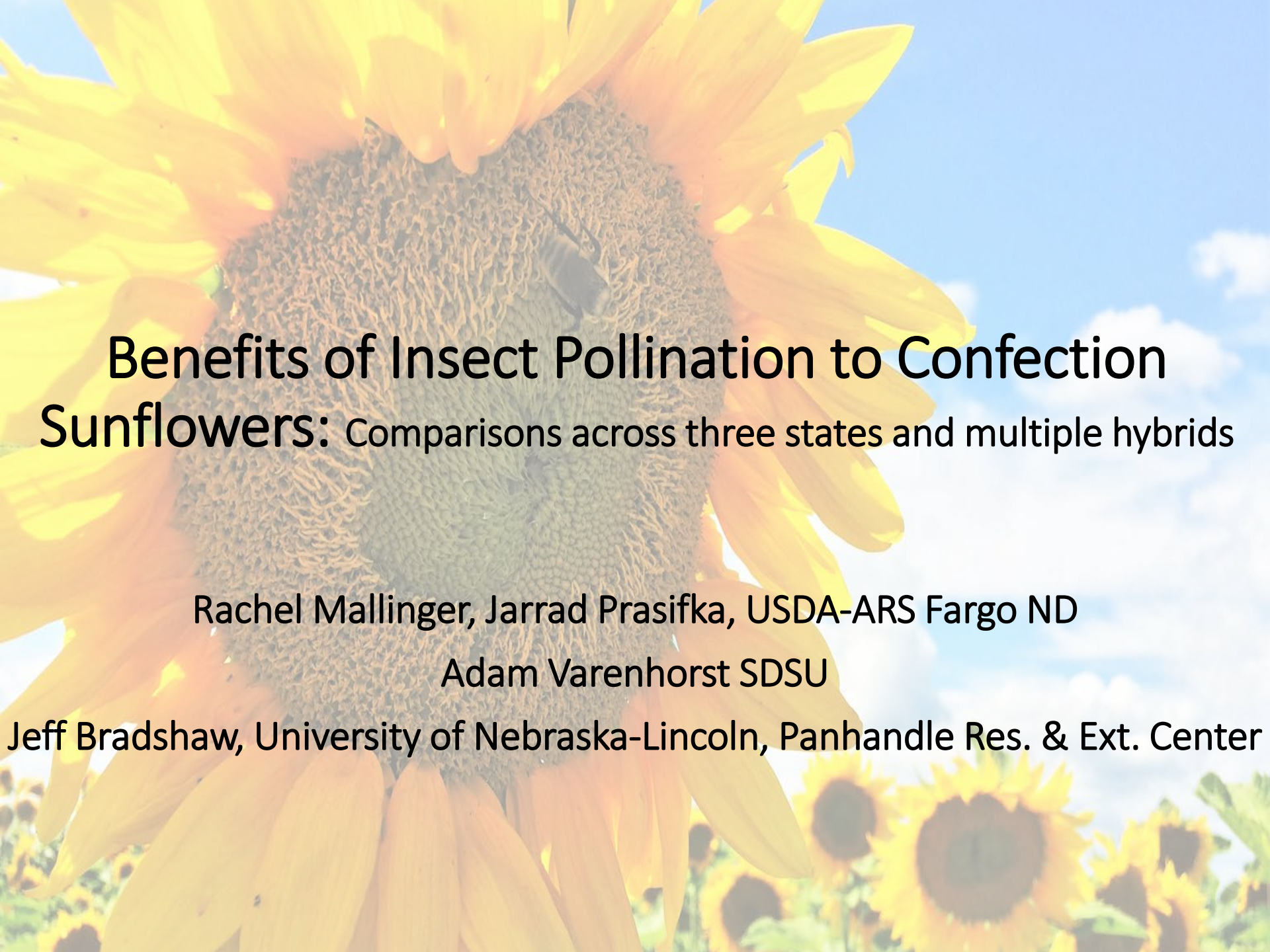


Benefits of Insect Pollination to Confection Sunflowers: Comparisons across three states and multiple hybrids

Rachel Mallinger, Jarrad Prasifka, USDA-ARS Fargo ND

Adam Varenhorst SDSU

Jeff Bradshaw, University of Nebraska-Lincoln, Panhandle Res. & Ext. Center

Benefits of pollinators to sunflower production

- Wild sunflowers: self-incompatible
- Domesticated sunflowers
  - Seed production: high
  - Confection and oilseed production: low-moderate?
    - Breeding for self-fertility
    - Yield increase with insect pollination

Benefits of pollinators to sunflower production

- Variation across plant genotypes
  - Self-compatibility: complex, allelic variation, multiple loci (Gandhi et al 2005, Sun et al 2012)
  - Selfing rates vary with plant morphology (Gandhi et al 2005, Griffiths and Erickson 1983)
- Variation across environments
  - Selfing rates vary with growing conditions (DeGrandi-Hoffman and Chambers 2006, Vaknin et al 2008)
  - Pollinator abundance and diversity vary across locations (DeGrandi-Hoffman and Chambers 2006)

Sunflower Pollinators

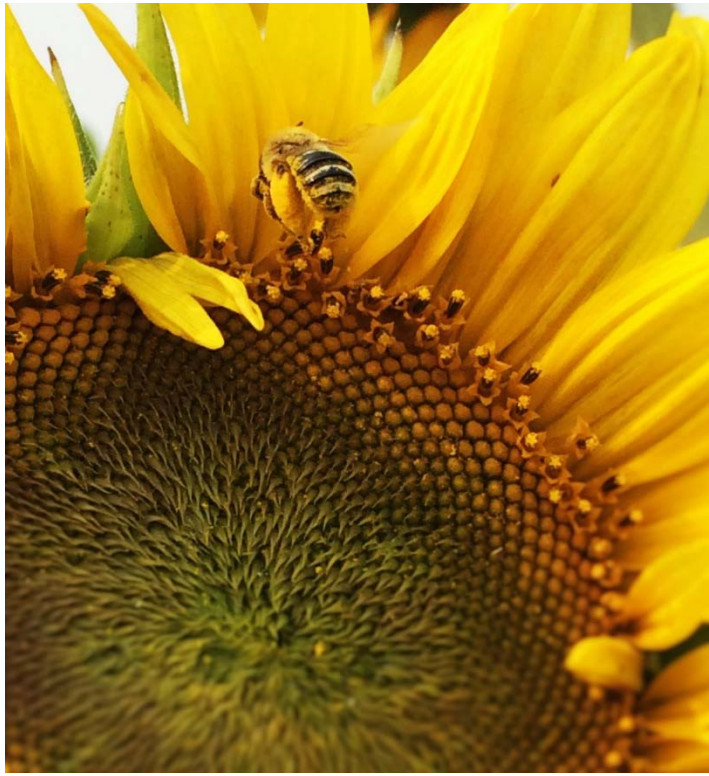
- Managed honey bees
  - Non-native generalists
- Wild bees
  - ~4,000 species in NA
  - 400+ species on sunflowers
  - Specialists of sunflower
- Pollinator efficacy
  - Abundance
  - Visitation rates
  - Bee body size
  - Foraging behavior

Research Goals

1. Pollinator benefits to confection sunflowers
   - Variation across 10 hybrids
   - Variation across 3 states
2. Which pollinators are the most effective?

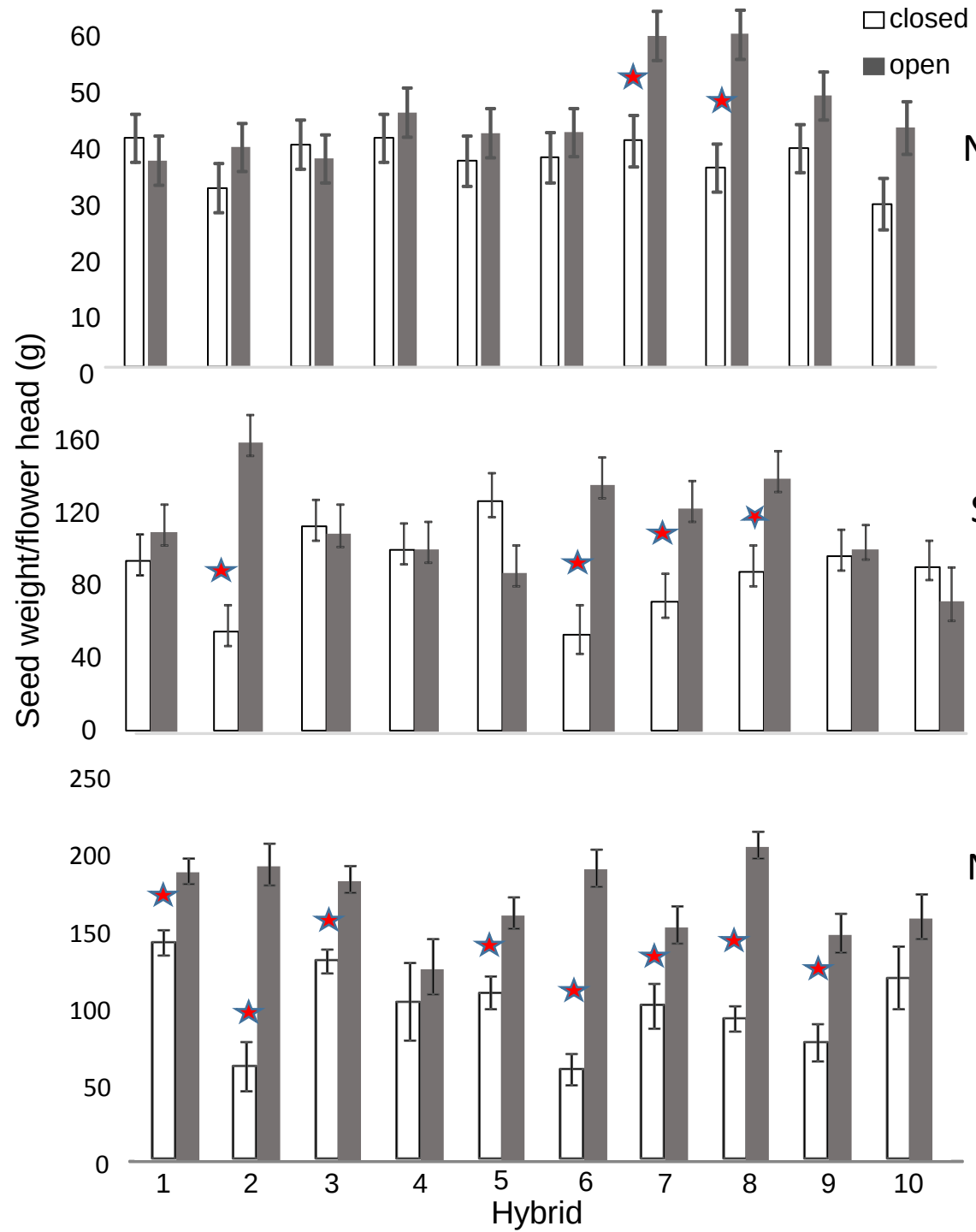
1. Pollinator benefits to confections

- 10 commercial hybrids in ND, NE, and SD
- Insect-exclusion treatments (bagged, open-pollination)
- Seed mass per flower head (yield)
  - Closed heads across hybrids (self-fertility)
  - Differences between open/closed across hybrids and states (pollinator benefits)
- Pollinator visitation rates
  - Differences across hybrids and states
  - How do pollinator visitation rates affect pollinator benefits?



2. Which pollinators are the most effective?

- Pollinator visitation rates: abundance and frequency
- Seed mass per single visit to CMS flowers
  - Bagged heads
  - Remove bags and wait for a single visit
  - Re-bag heads, harvest, total seed mass



ND: 22 % increase with open pollination

2 hybrids with sig benefits

No differences in closed seed mass

SD: 27 % increase with open pollination

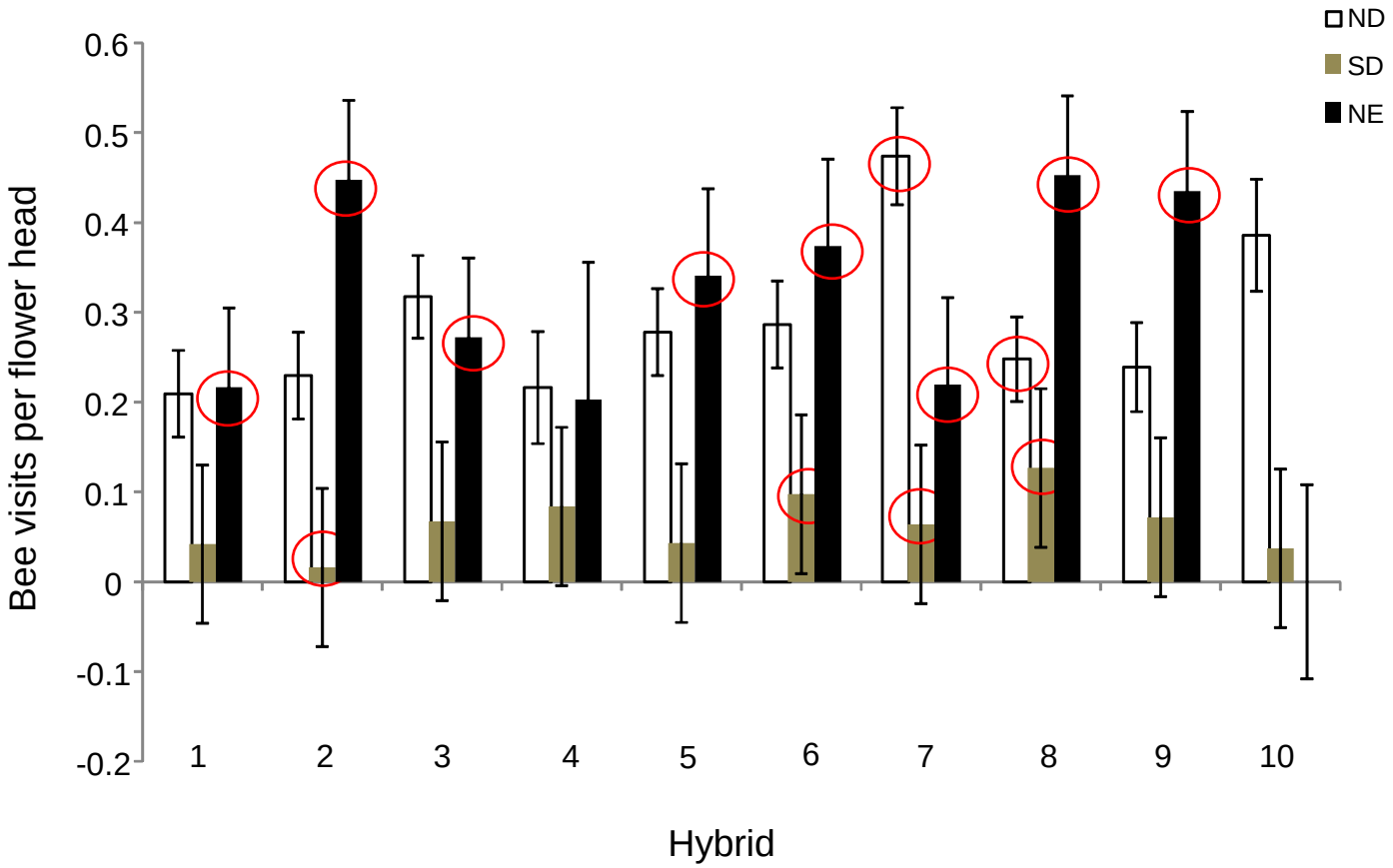
4 hybrids with sig benefits

Sig differences in closed seed mass

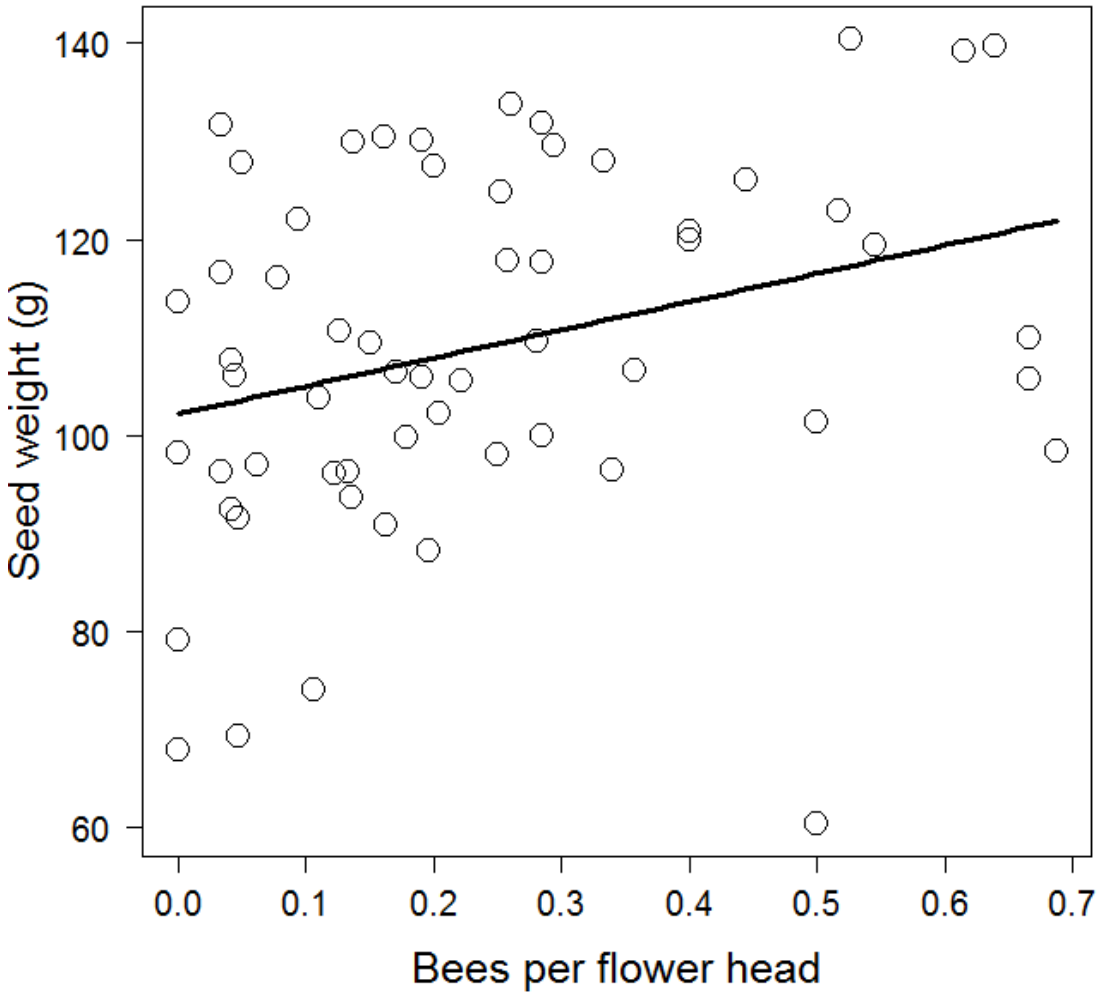
NE: 73 % increase with open pollination

8 hybrids with sig benefits

Sig differences in closed seed mass



- Visitation rates vary across states and hybrids
  - States: different pollinators, alternative forage
  - Hybrids: floral traits, plant density, herbivore or disease damage
- Pollinator benefits partially explained by visitation rates

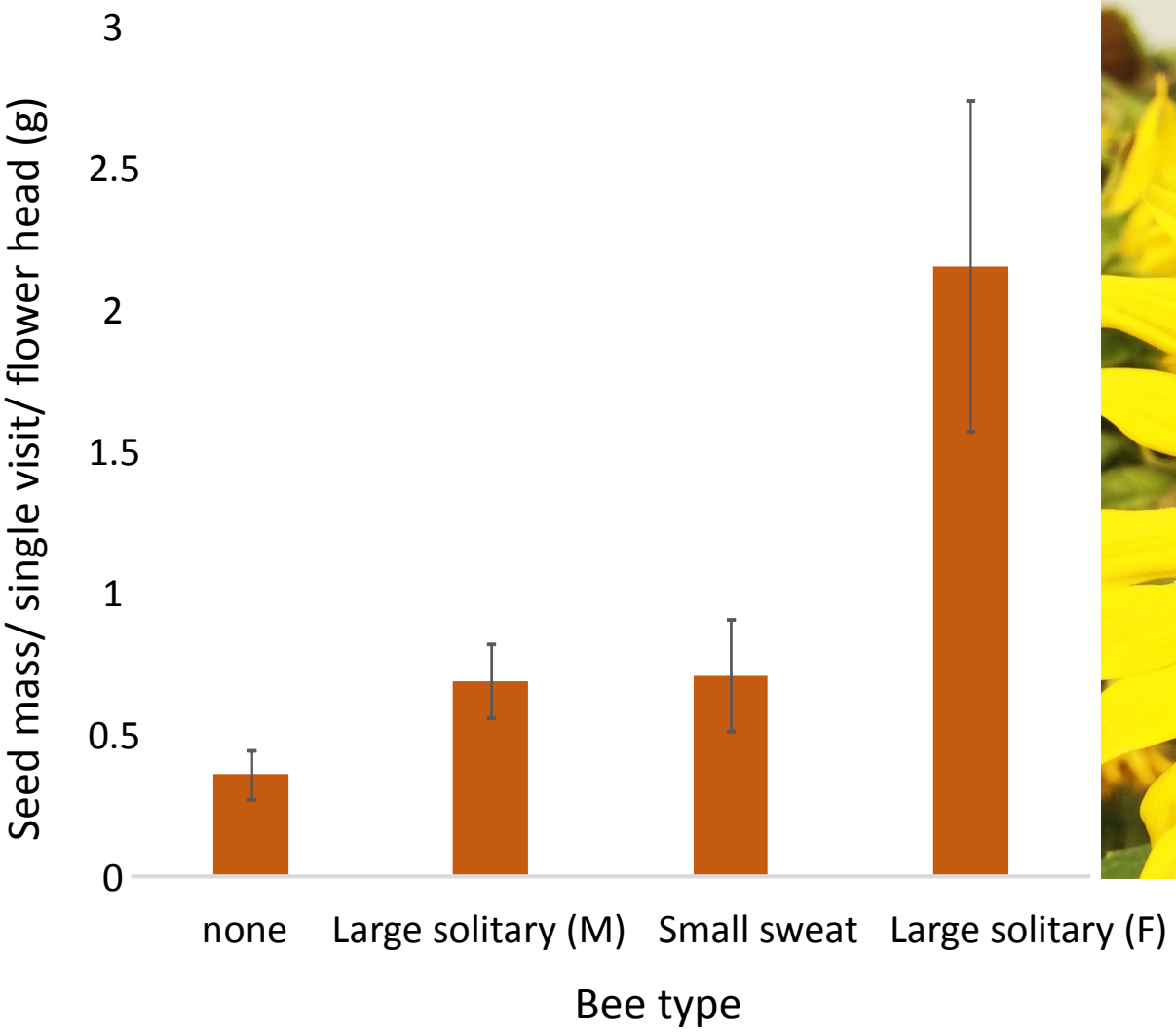


- 19% increase in seed mass across range in bee visits (P = 0.04)

Bee Community

- Large-bodied solitary bees (n = 717)
    - *Melissodes agilis, Melissodes trinodis, Svastra obliqua, Megachile latimanus*
- Bumble bees (n=83)
- Small-bodied sweat bees (49)
    - *Duforea* spp., *Lasioglossum* spp.
- Green sweat bees (7)
- Honey bees (4)

Large-bodied Female Solitary Bees Most Effective



Conclusions

- Confection sunflowers benefit from insect pollination
  - Correlation between yields and number of bee visits
- Self-fertility varies across hybrids and environments
- Pollinator benefits vary across hybrids and environments
  - Different degrees of self-fertility
  - Different pollinator visitation rates = different attractiveness to pollinators
- Wild bees more frequent visitors than honey bees
- Female large-bodied solitary bees most effective pollinators

Acknowledgements

- NSA for funding
- Jamie Miller-Dunbar and Zoe Portlas, USDA-ARS Fargo ND
- Phil Rozeboom, SDSU
- Susan Harvey, University of Nebraska-Lincoln