Maximizing Self-Autonomous Pollination in Sunflower – Step 1

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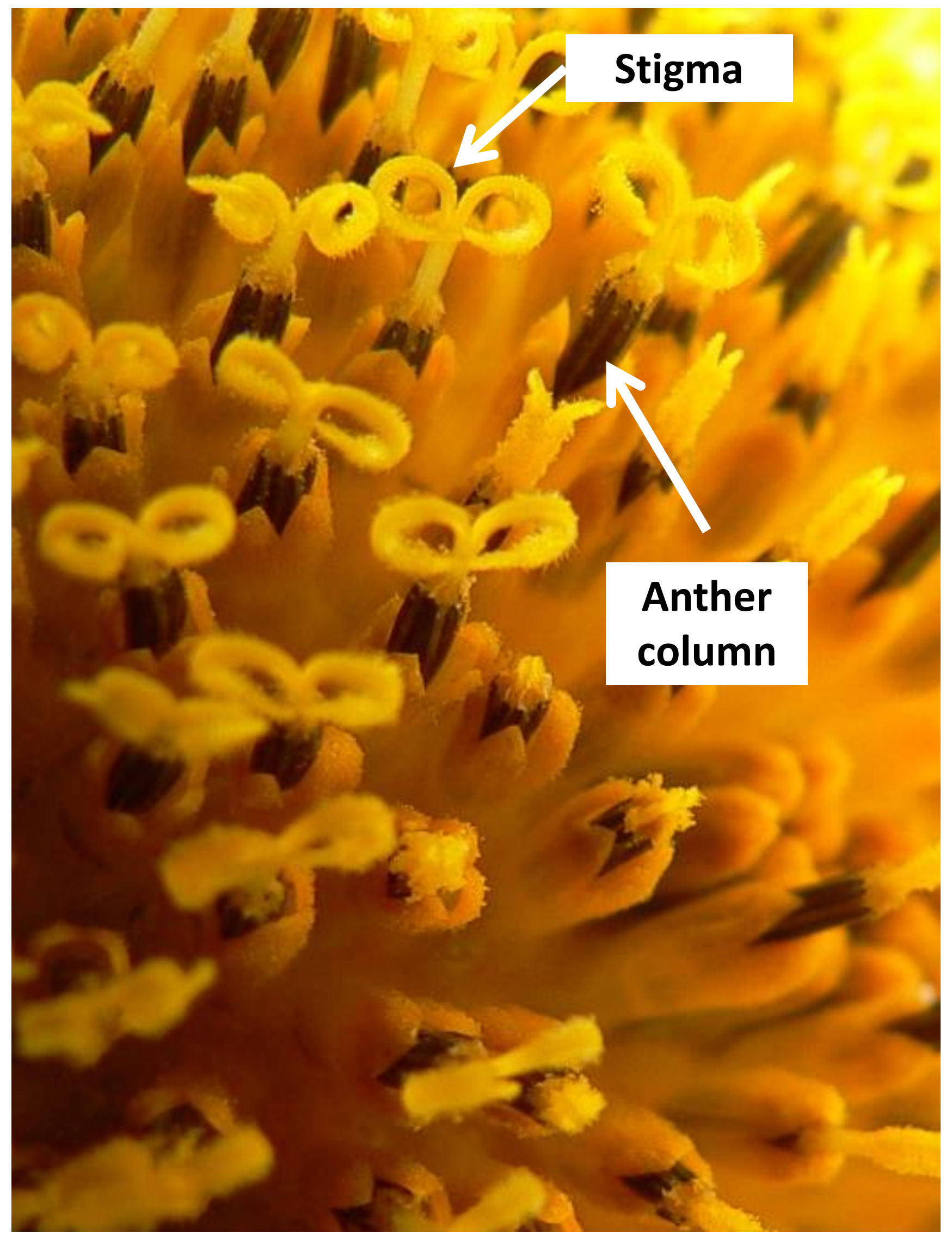
Background:

- Self-autonomous pollination is self-pollination in the absence of outside factors (i.e., insect or human activity, wind, water, etc.).
- Sunflower breeders strive to develop hybrids that are both self-compatible and capable of self-autonomous pollination so that seed set/yield is free of dependency on pollinator activity.
- Despite these goals research has shown that yield in sunflower is often improved when insects (especially honey bees) are present, and that yield in sunflower is sometimes limited by insufficient insect pollination at the time of anthesis.
- Although sunflower florets possess both anthers and stigmas, protandry and secondary pollen presentation (Leins and Erbar, 1989; Seiler, 1997) can both limit self-autonomous self-pollination thus requiring insect visits to transfer pollen among florets inside a single head (capitulum).



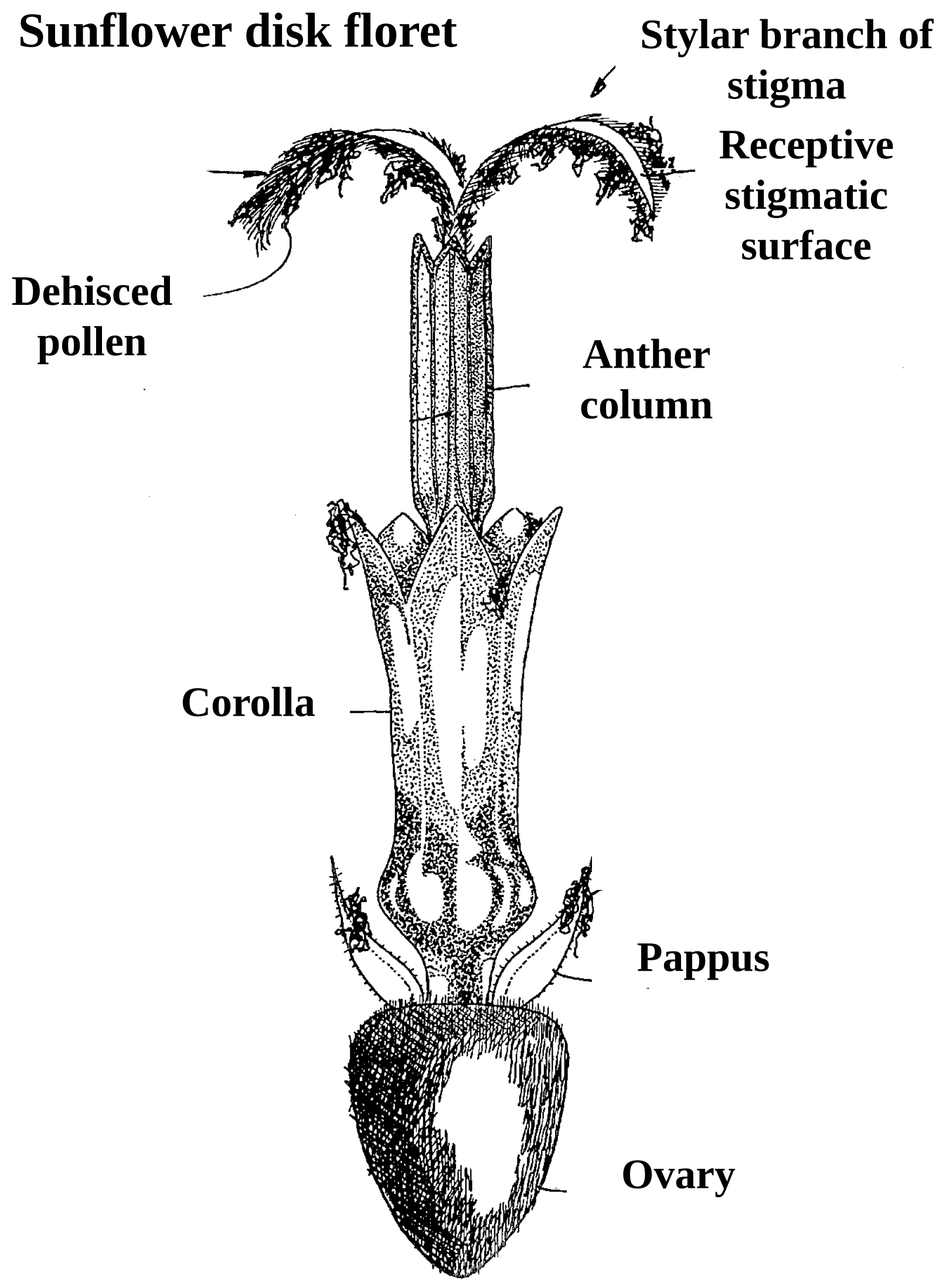


Figure 1. Sunflower floral morphology

Research Objectives:

- Identify genotypes that yield the same with or w/o pollinator (i.e., honey bee) activity
- Identify genotypes that yield differently when pollinated by insects and/or when hand pollinated
- Characterize these genotypes to determine which traits (e.g., pollen load/viability/durability, floral architecture, synchronicity of pollen shed and stigma receptivity, etc.) play a role in maintaining yield in the absence of insect pollinators

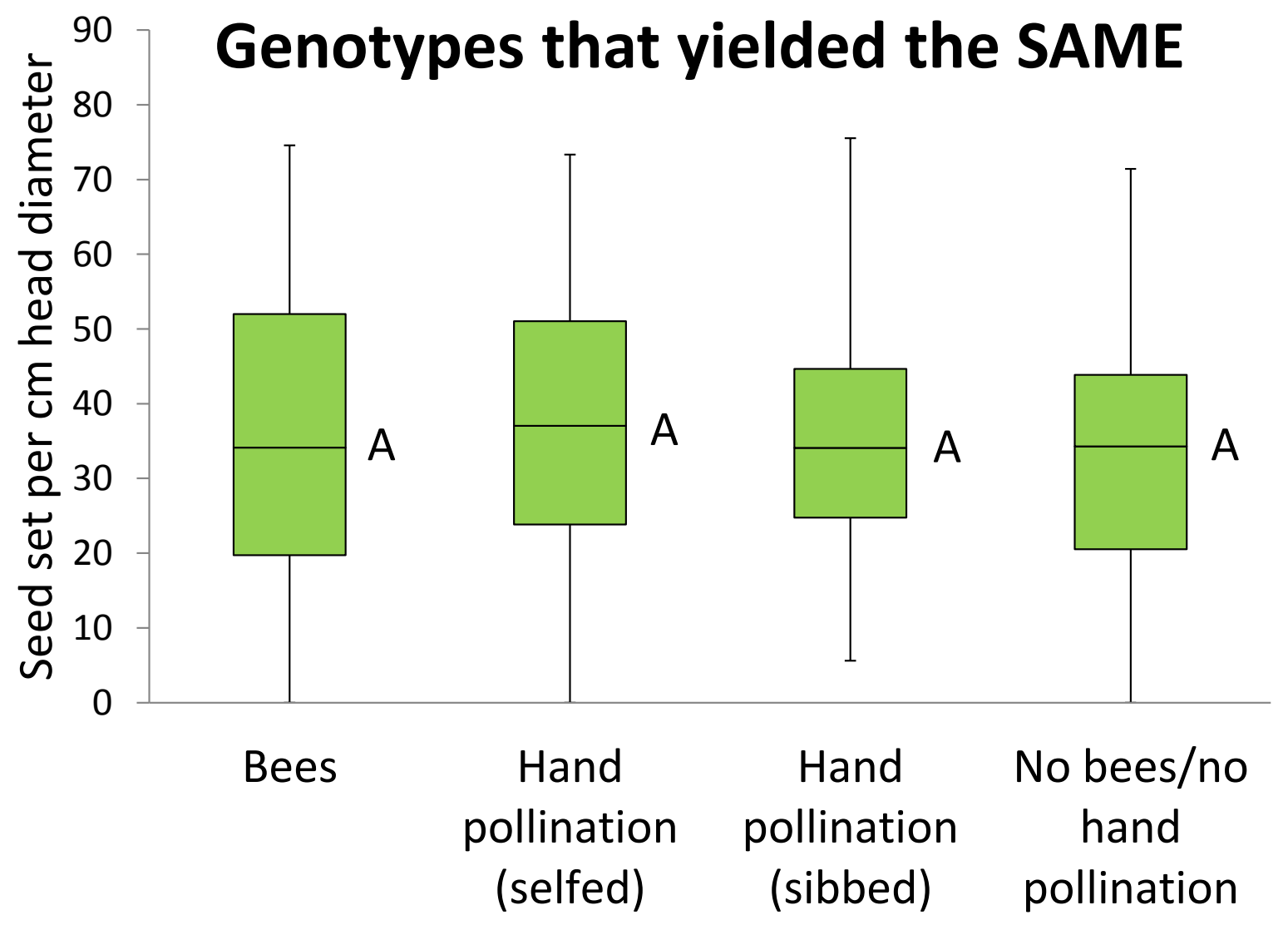
Long Term Goals:

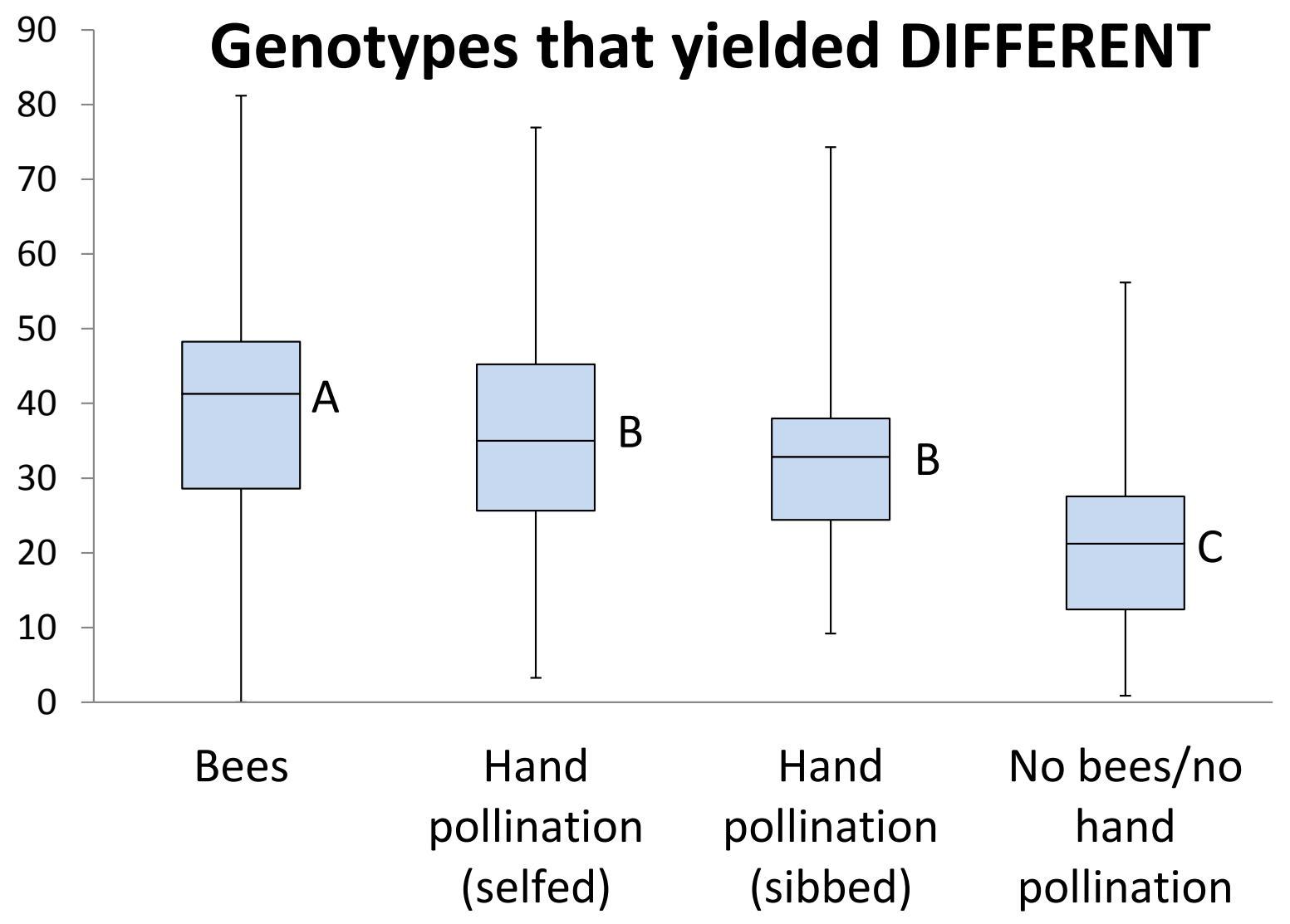
- Identify traits that promote self-autonomous pollination in sunflower
- Characterize the genetic basis of these traits and incorporate useful alleles into breeding lines to develop hybrids that yield well regardless of pollinator activity

Materials:

Plant material: $F_7 – F_{10}$ seed representing A- and R-lines from oilseed and non-oilseed backgrounds was used. 5 lines (DIFFERENT) were previously identified to yield more when hand-pollinated vs. no pollination (HA 371, HA 320, HA 406, RHA 328, EXPT line from INRA). 4 lines (SAME) were previously identified to yield the same with or w/o hand-pollination (RHA 389, RPET2, HA 292, HA 343).
Experimental design: CRD w/ subsampling (12 – 39 plants per treatment*genotype combination), 4 pollination treatments were conducted in cages: honey bees, hand-pollination (selfed), hand-pollination (sibbed), and no pollination
Phenotyping: Seed set per plant was presented on a per cm of head diameter basis to minimize size differences among plants. Data were analyzed using Proc GLM (SAS 9.4), mean separation was achieved using the Tukey-Kramer method to account for unbalanced subsampling, CONTRAST statements were used to test post hoc hypotheses.

Treatment effects for SAME or DIFFERENT genotypes:

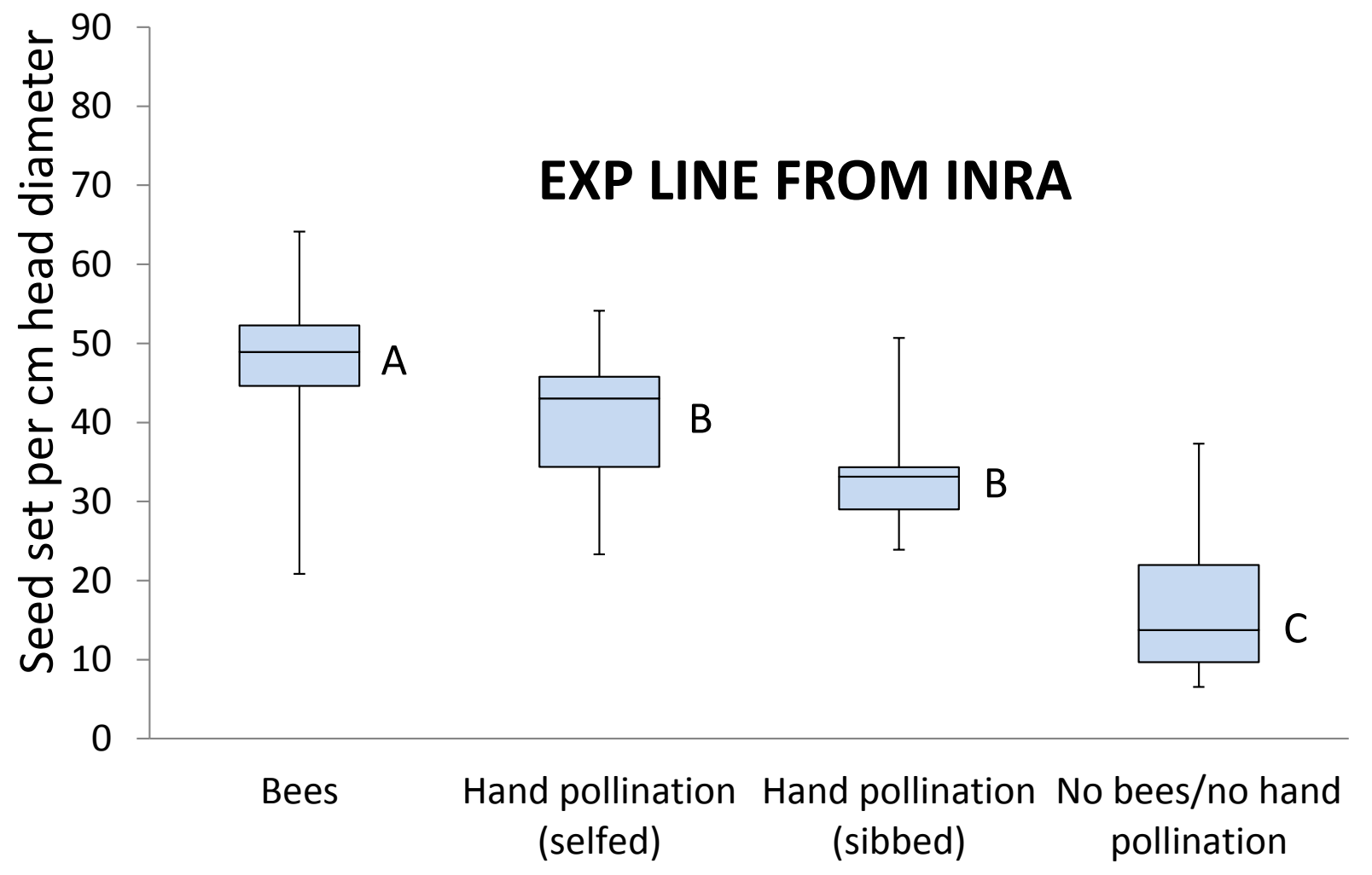


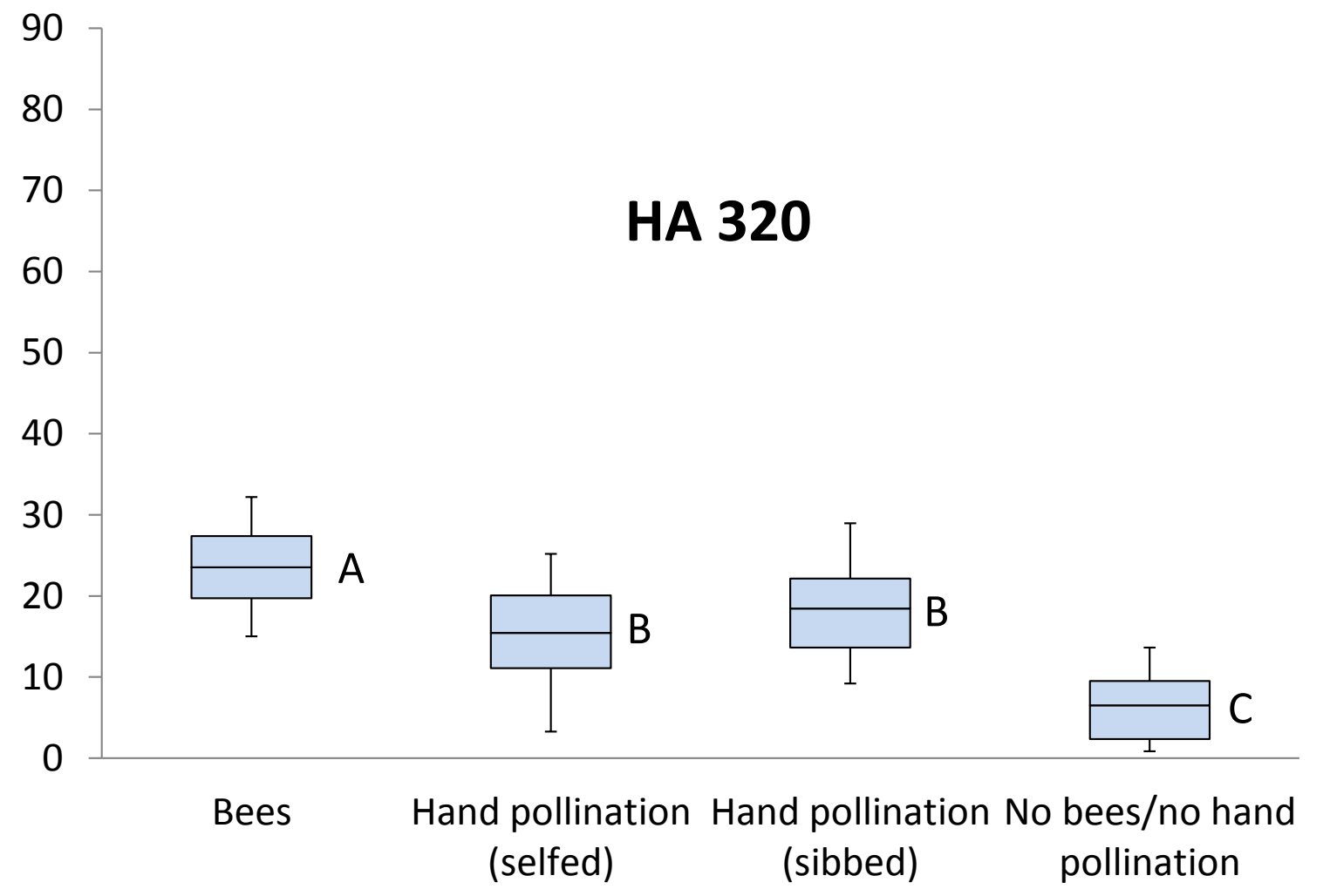


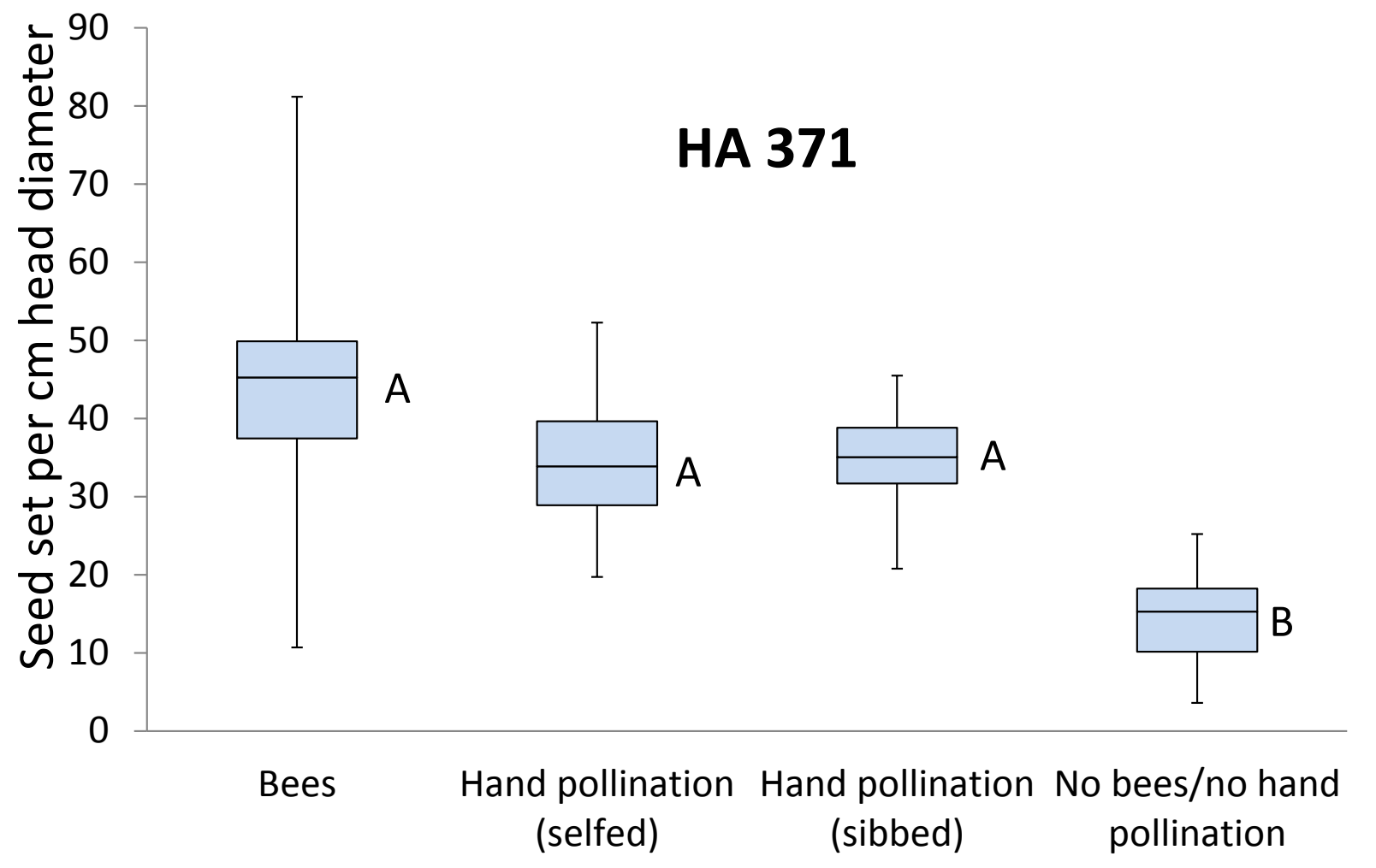
- **Genotypes previously identified to yield the same when hand pollinated vs. no pollination (SAME) showed no treatment effects ($p = 0.1947$)**
- **Genotypes previously identified to yield more when hand pollinated vs. no pollination (DIFFERENT) produced more seed when pollinated with bees vs. hand pollination vs. no pollination ($p < 0.0012$)**
- **This difference between bee pollination and no pollination is unlikely a factor of just sibbed vs. selfed seed because the yield of sibbed vs. selfed seed produced via hand pollination was not statistically different ($p = 0.5920$)**

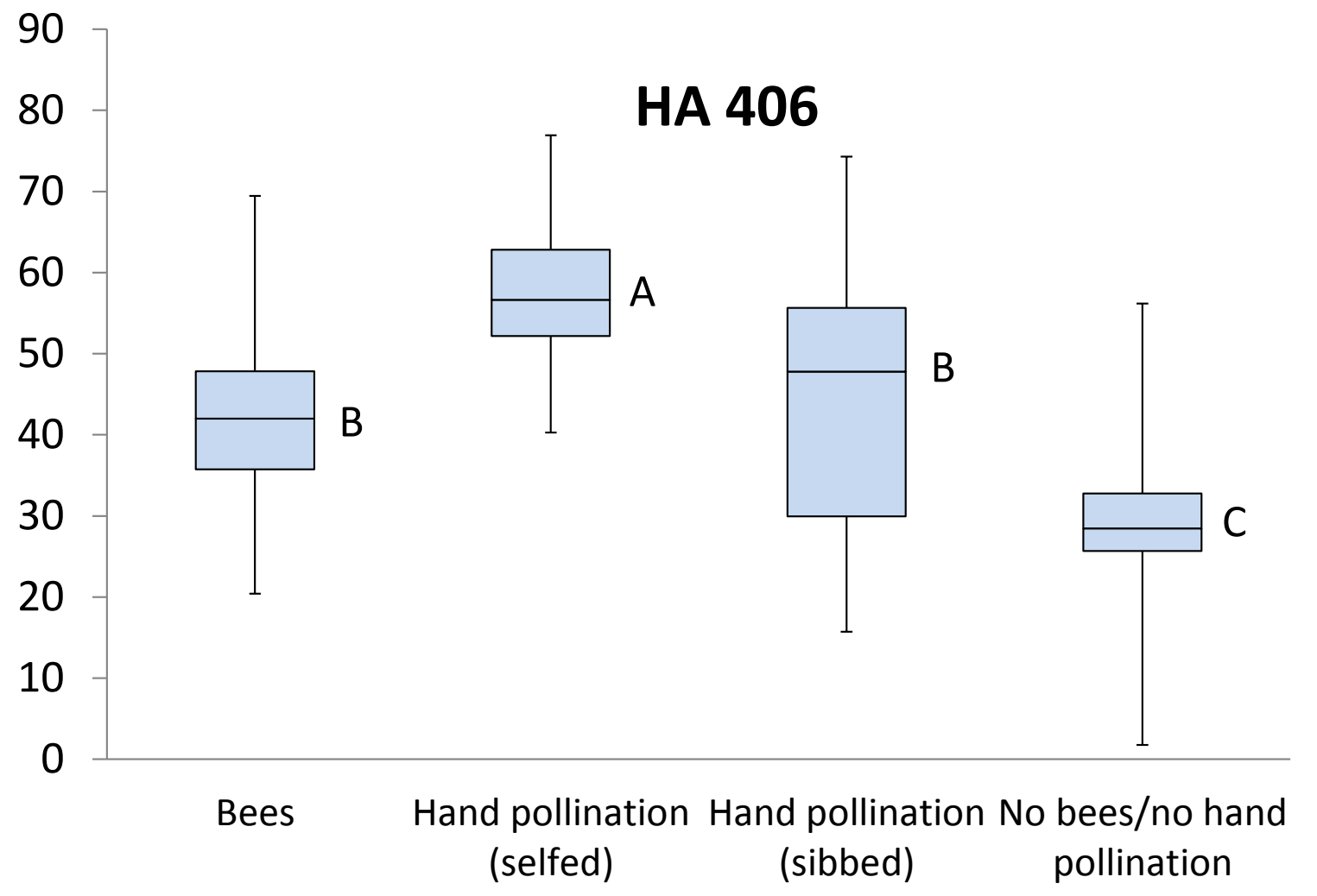
Treatment effects for individual genotypes:

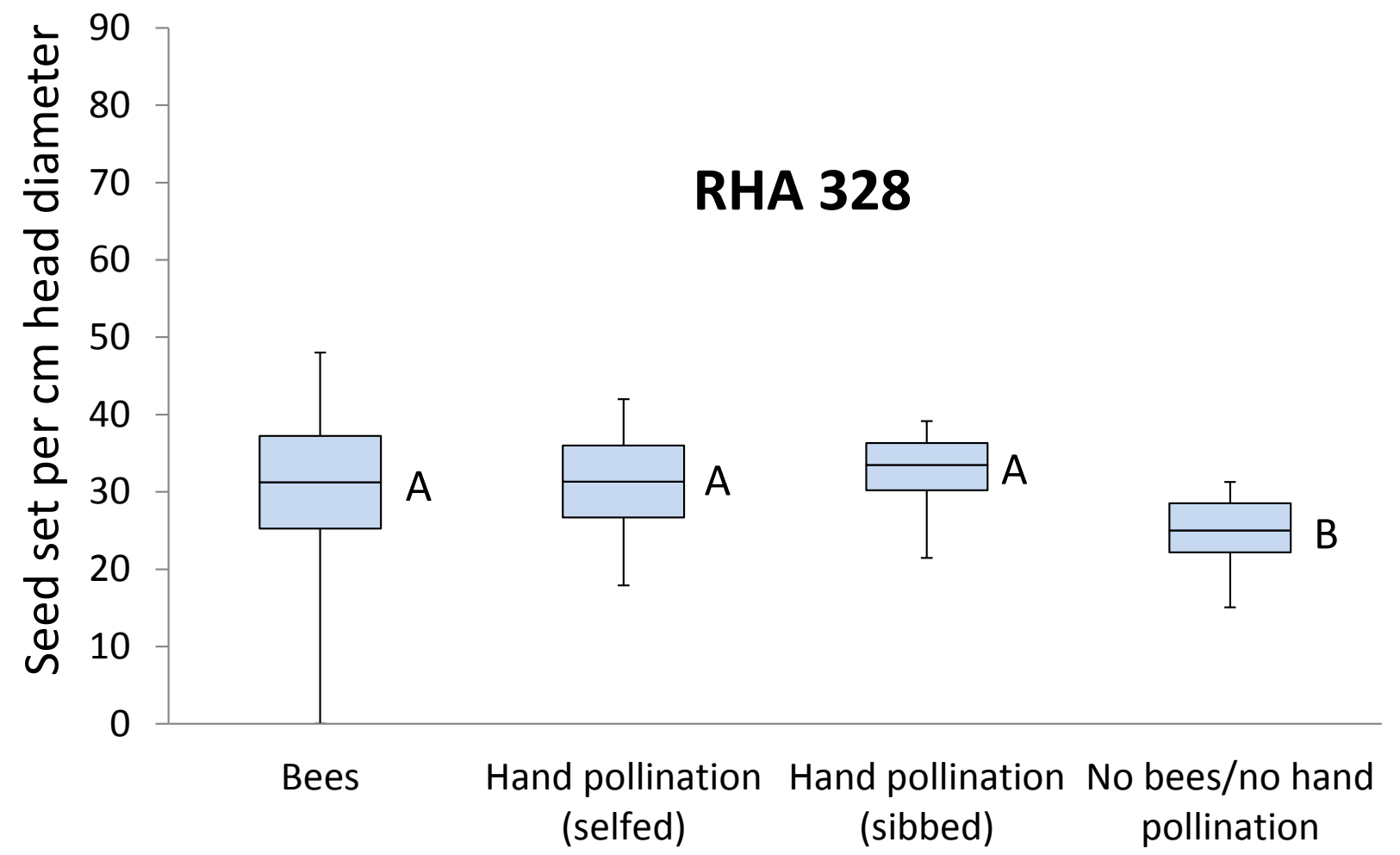
- For both groups (SAME and DIFFERENT) the genotype*treatment interactions were significant ($p < 0.0001$) so the data were examined for each genotype individually.

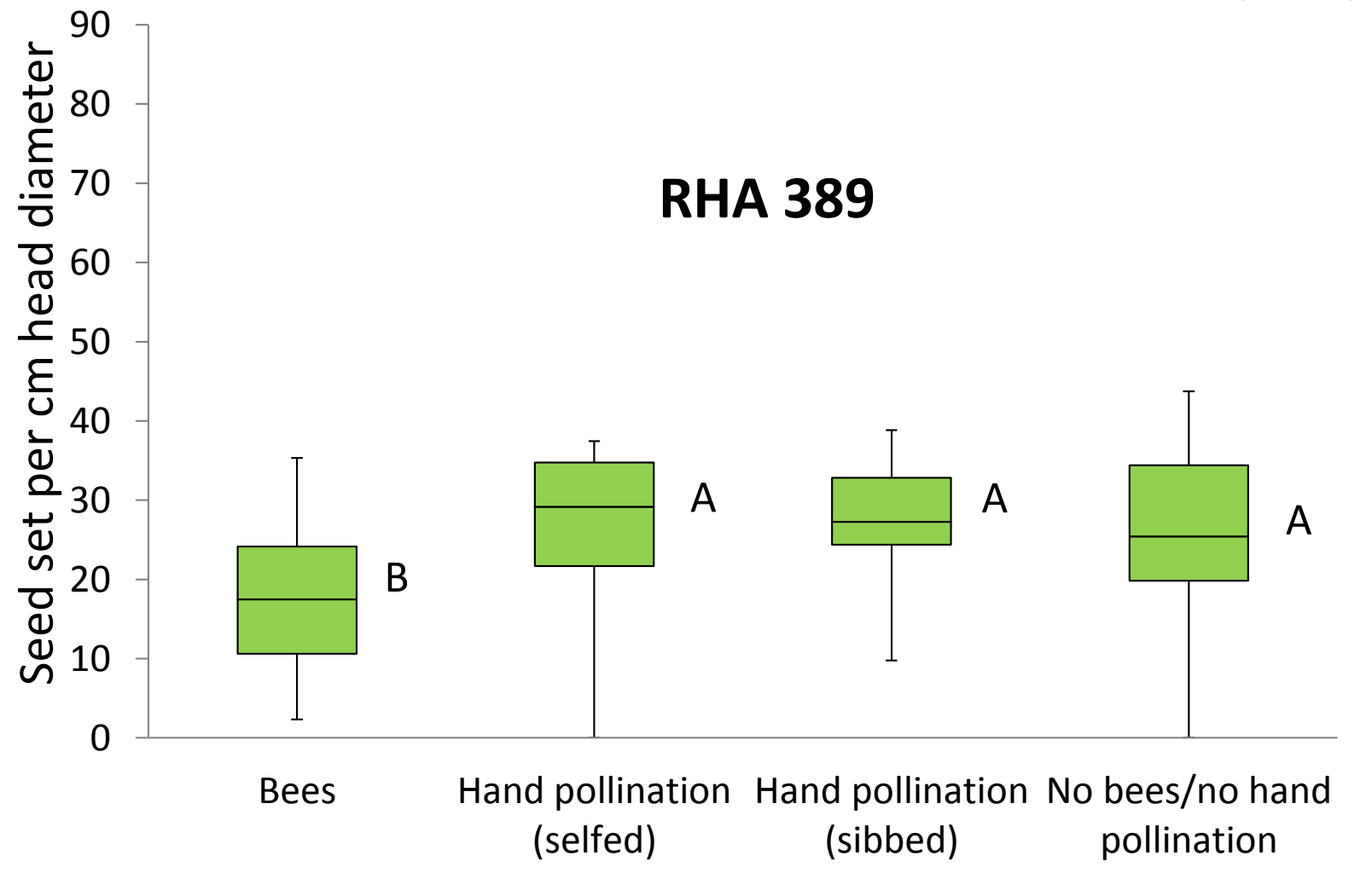


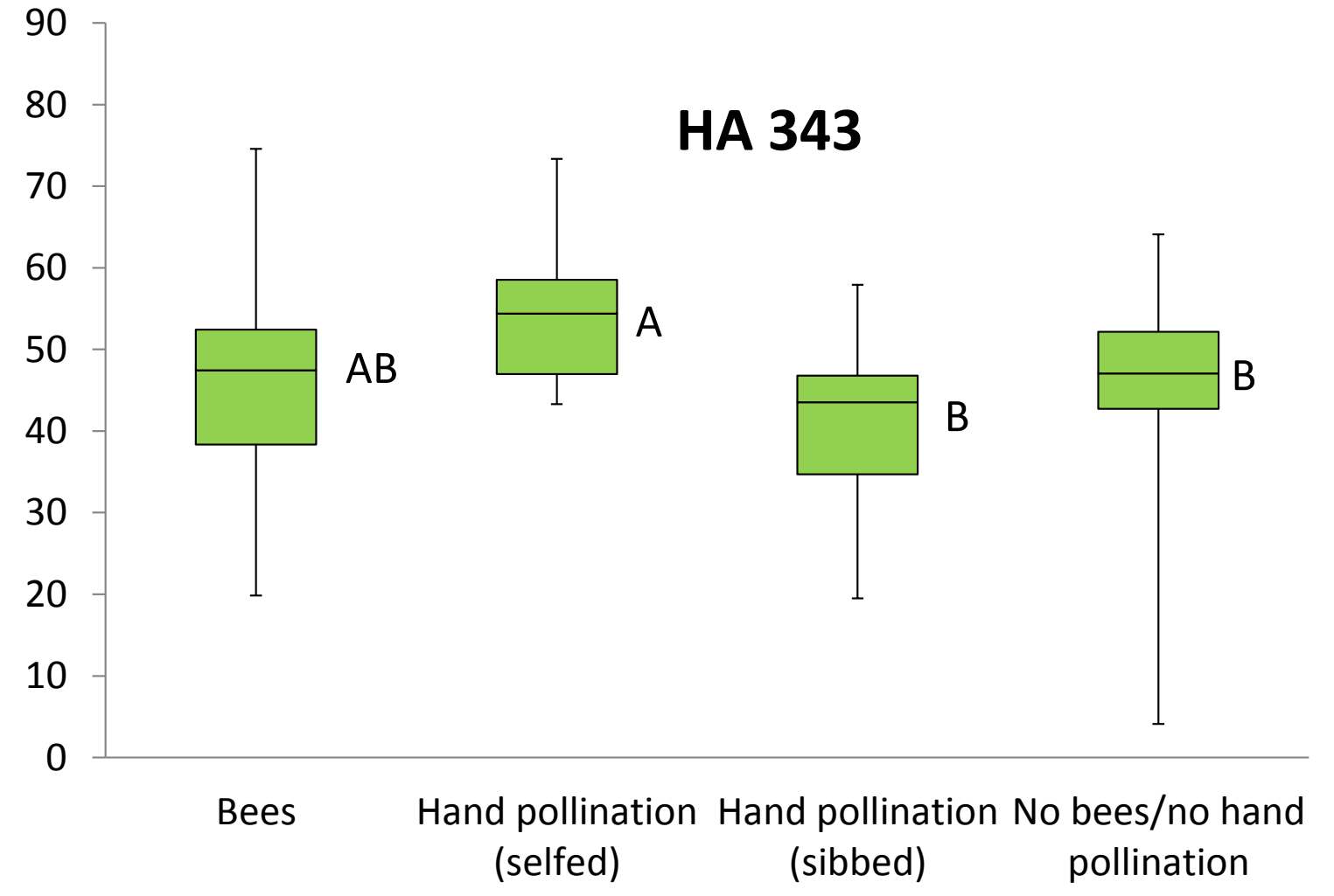


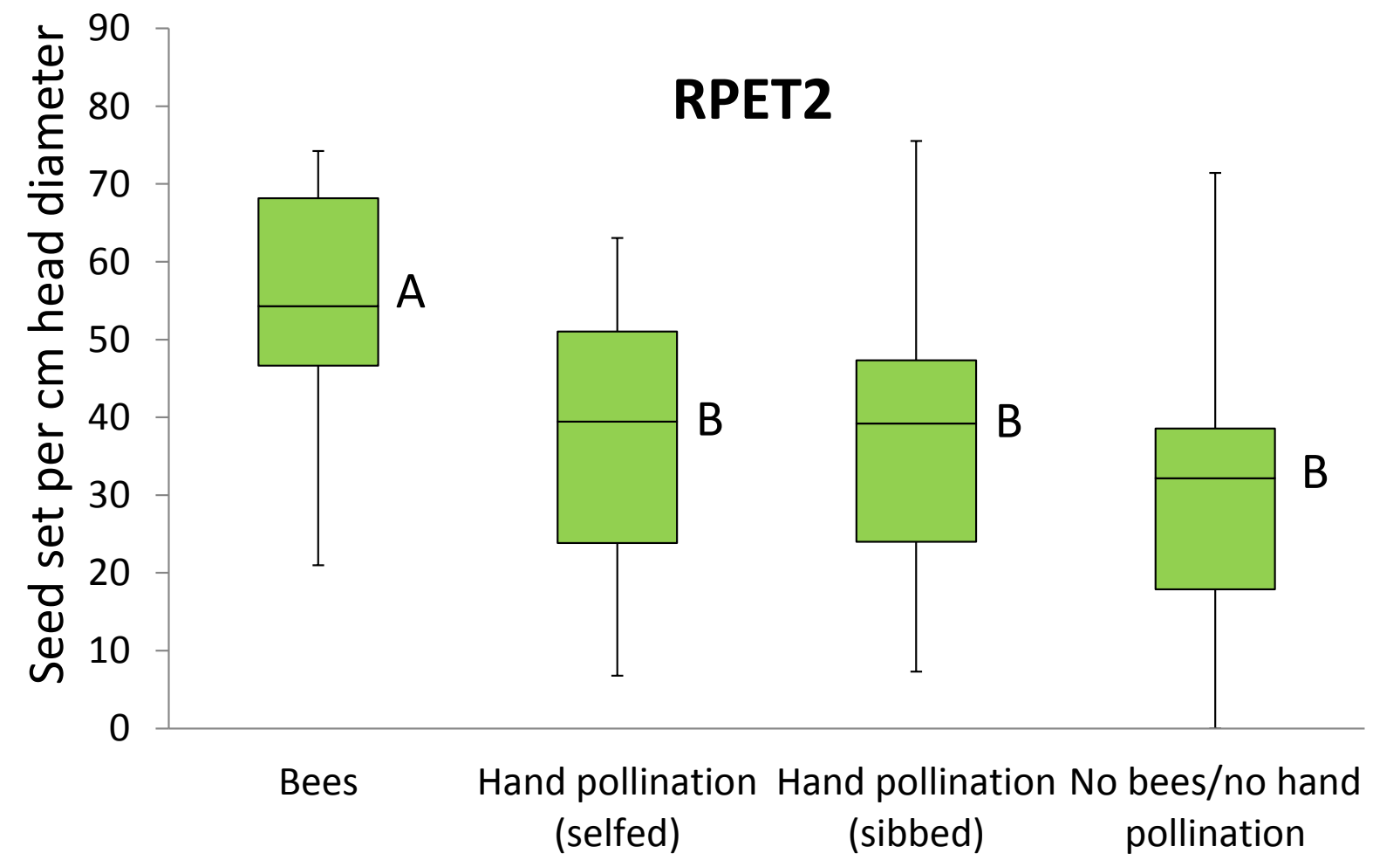


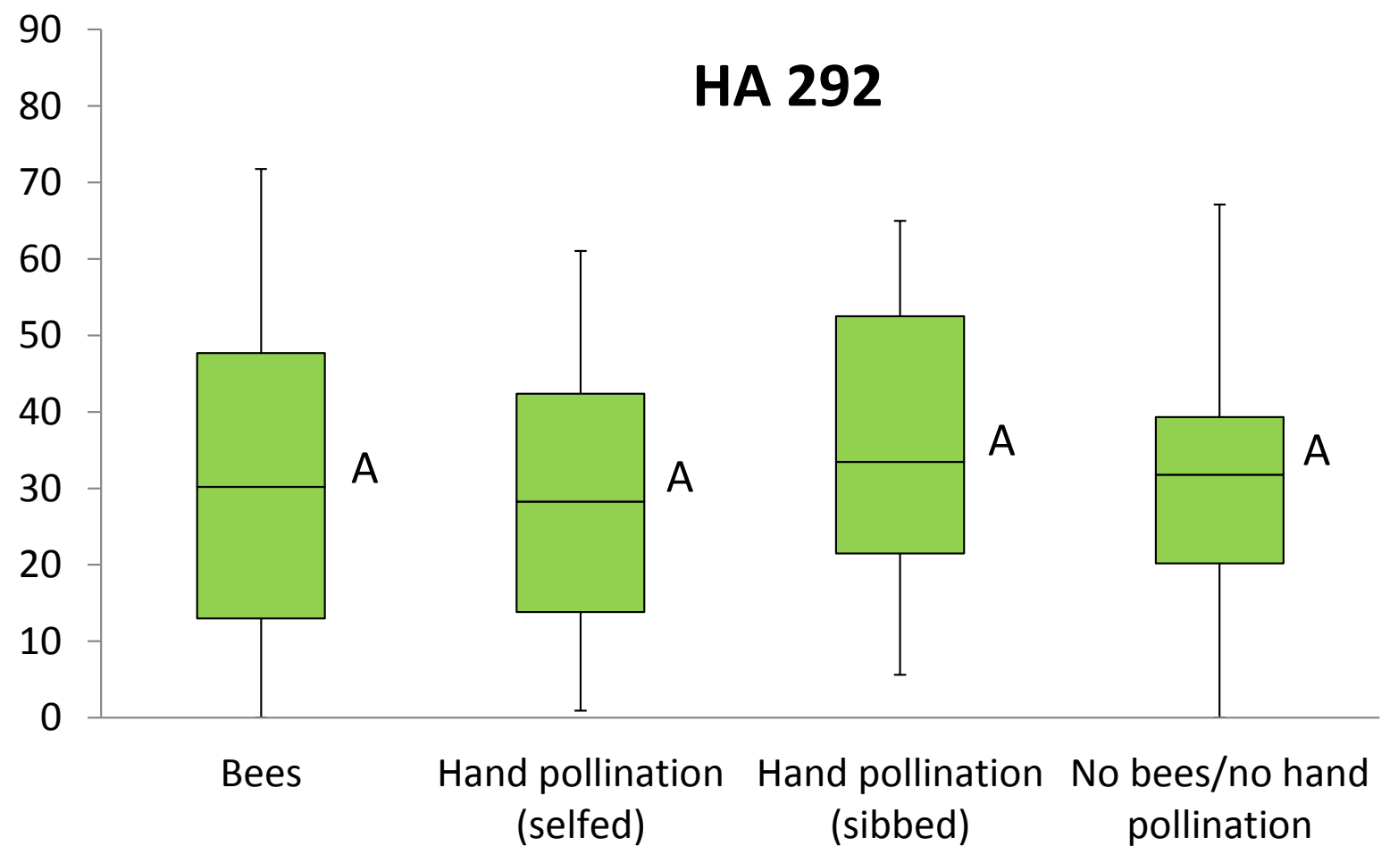












Future projects:

- Selected genotypes will be further characterized to identify which traits are associated with pollination efficiency in the absence of insect pollinators.

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