Inbreeding depression and morphological study of *Oenothera hartwegii* subsp. *filifolia* and *O. gayleana*

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CHICAGO BOTANIC GARDEN
2016 Research Experiences for Undergraduates Program

HUMBOLDT STATE UNIVERSITY

Introduction

- Inbreeding depression is the decrease in population mean fitness with increased mating between related individuals (inbreeding).
- In plants the frequency of inbreeding will depend on the species self-compatibility system and pollination system.
- Our study species: *Oenothera hartwegii* subsp. *filifolia* and Oenothera *gayleana* are both from the Calylophus section of the family *Onagraceae.* They are both self-incompatible species *(*Heiser & Shaw 2005) but differ in their pollinator system. *Oenothera hartwegii* subsp. *filifolia* flowers open in evening and has large floral tube which are likely pollinated by hawkmoths, while *O. gayleana has flowers which open during day and short flower are likely pollinated by bees.*
- As these pollinators have very different behavior this may impact their levels of inbreeding. Hence in this study we are looking at the morphological differences associated with different levels of inbreeding (high, medium and none: Selfing, Sibling, Within and Between populations respectively.

Question

- Is there different expression of inbreeding depression between species which vary in pollinator preference: *Oenothera hartwegii* subspp. *filifolia* (Hawkmoth) and *Oenothera gayleana* (bee)*?*

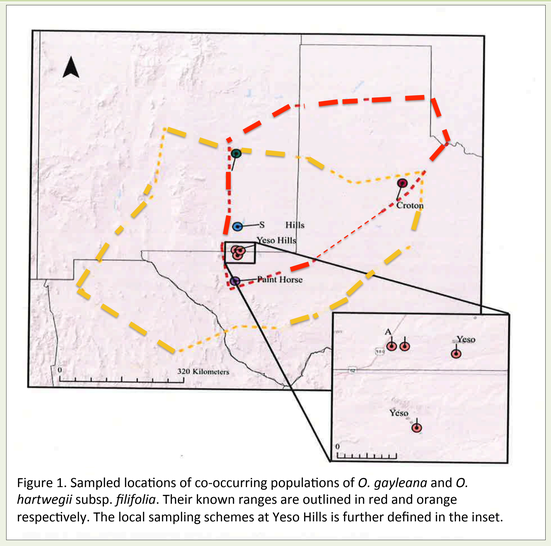

Figure 1. Sampled locations of co-occurring populations of *O. gayleana* and *O. hartwegii* subsp. *filifolia*. Their known ranges are outlined in red and orange respectively. The local sampling schemes at Yeso Hills is further defined in the inset.

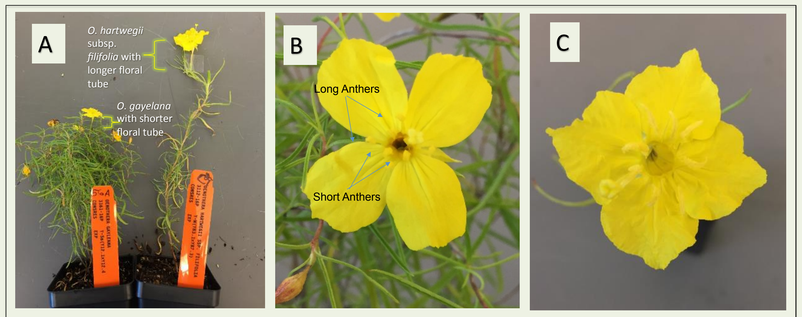

Figure 2. Image A compares the smaller, bushy *O. gayleana* with shorter floral tube and thinner, taller *O. hartwegii* subsp. *filifolia* with longer floral tube respectively.
Image B shows *O. gayleana* that has a short style, two rows of 4 anthers and a short tube to attract bees for pollination.
Image C shows *O. hartwegii* subsp. *filifolia* that has one row of 8 anthers, a long style and long wide nectar tube to attract hawkmoths.

Methods

- Specimen collection was done in 2014 at five locations in New Mexico and Texas (Yeso Hills, Trigg Ranch, Croton, Seven Hills and Paint Horse Draw (Fig 1).
- Seeds from field were grown to flowering and hand pollinated to make desired crosses the winter of 2014-15 (Fig 3).
- Crosses were selected to stimulate different levels of inbreeding (Selfing, Siblings, Within and Between)
- Seed count and percent germination of each cross was recorded for F1 generation.
- Morphological measurements was done on a minimum of 3 flowers per plant using a caliber (Included corolla diameter, floral flare, anther length, stigma length and tube length).
- ANOVA analyses were conducted to interpret any significant differences between cross types and generations.

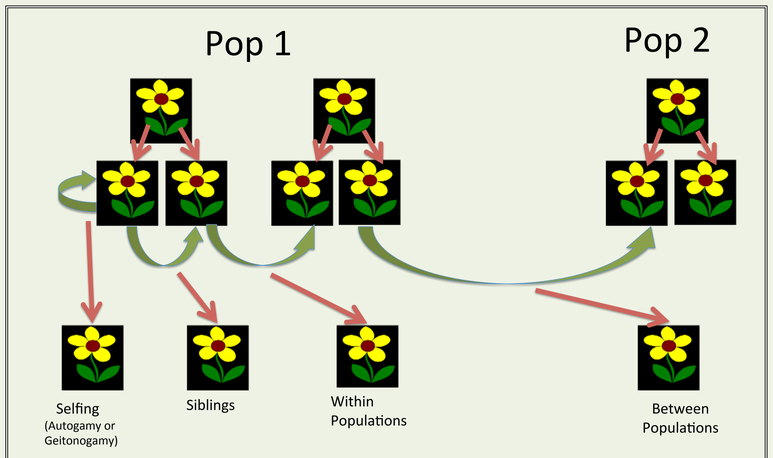

Figure 3. Cross types are shown in either the self-pollinated group: autogamy (AUT) where flower was crossed with its own pollen or geitonogamy (GEIT) where a flower is crossed with a different flower from the same plant. Also, outcrossing includes: sibling (SIB) where siblings from one mother plant were crossed with each other, within (WIN) where plants from the same population were crossed or between (BW) where two different populations were crossed.

Results

- *O. gayleana* shows significant differences by cross type for almost all measured traits.
- O. *hartwegii* subspp. *filifolia* only showed large significant difference for corolla length, but only weak significant variation for 3 other traits (filament length, tube length and floral flare).
- For most traits, Self and Sib crosses were smaller, suggesting a moderate to high loss of fitness, suggesting inbreeding depression.

Table 1. P values of all morphology measurements in O. *hartwegii* subspp. *filifolia* and *O. gayleana.*
*Are values that are significantly different with P < 0.05

	O. hart. filifolia	*O. gayleana*	
Corolla average	0.009*	0.013*	
Filament length (1 &2)	0.023*	0.027*	0.143
Style length	0.127	0.007**	
Tube length	0.021*	0.004**	
Floral flare	0.049*	0.0002**	
Herkogamy	0.228	0.001**	

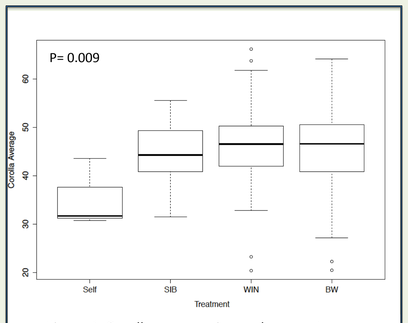

Figure 4. Corolla averages in mm by cross type in *O. hartwegii* subsp. *filifolia* .

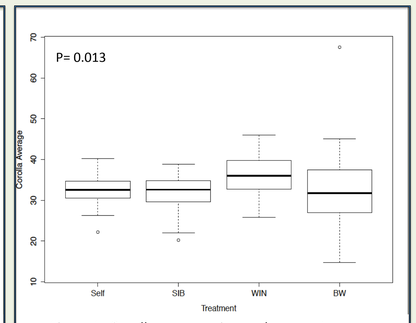

Figure 5. Corolla averages in mm by cross type in *O. gayleana.*

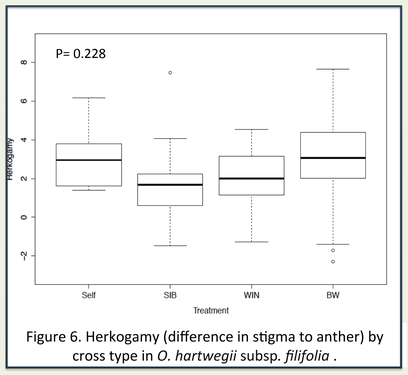

Figure 6. Herkogamy (difference in stigma to anther) by cross type in *O. hartwegii* subsp. *filifolia* .

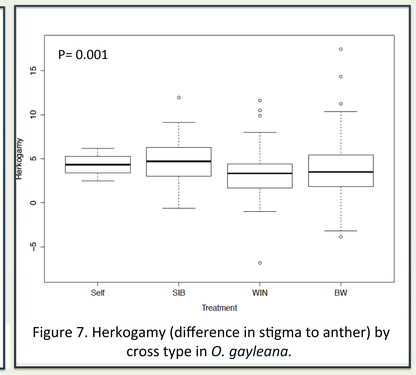

Figure 7. Herkogamy (difference in stigma to anther) by cross type in *O. gayleana.*

Conclusions/Discussion

- *O. gayleana* shows more signs of inbreeding depression than *O. hartwegii* subsp. *filifolia* overall.
- This could be due to the pollinator difference between the species. *O. gayleana* is bee pollinated and will visit plants in shorter distances resulting in more crosses between siblings, while a hawkmoth, which pollinates *O. hartwegii* subsp. *filifolia* travels farther.
- Only certain treatment predictions of our hypothesis were true possibly because of previous inbreeding in species.
- Future studies where all habitat and growth conditions for plants and equal levels of inbreeding in species could result in stronger differences than ours.

References

Heiser, David, and Ruth Shaw. "The Fitness Effects of Outcrossing in Calylophus Serrulatus , a Permanent Translocation Heterozygote." *Evolution*, 60.1 (2006): 64-76.

Acknowledgments

Special thanks to Cielo Delgado. Funding provided by NSF award DBI-1461007
REU Site: *Plant Biology & Conservation Research Experiences for Undergraduates - From Genes to Ecosystem*

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