Comparison of Phenology and Floral Traits of Ex situ vs. In situ Populations of *Oenothera organensis*

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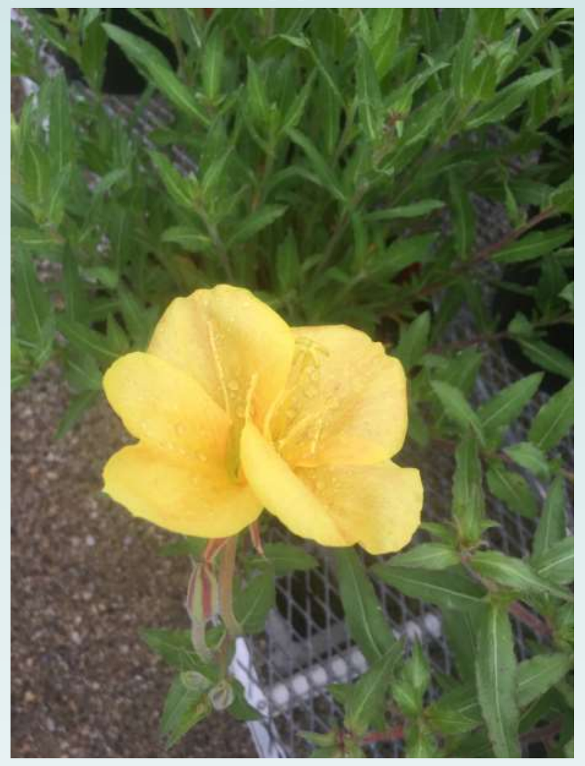
Introduction

Oenthothera organensis, Evening Primrose, is an Onagraceae plant endemic to the Organ Mountains of New Mexico. It is a perennial herbaceous plant with preferred habitats in springs, seeps, and montane scrubs[1].

A primary pollinator for Oenothera organensis is the hawk moth, belonging to the Sphingid family. Hawk moths have one of the largest proboscis of any insect, allowing them to reach the nectar within the primrose flowers[2].



Project Overview

The purpose of our study is to provide evidence of significant variation in phenology and floral traits in plants cultivated in ex situ conditions (GH population) vs wild plants grown in situ (NM population) we collected data from two populations of Oenothera organensis. The cultivated population was hand pollinated in a greenhouse at Indiana University, for which no specific traits were selected. The wild population was cultivated on site at the Chicago Botanic Garden using seeds collected from the Organ mountain range in New Mexico.

Our hypothesis is that the cultivated population grown in the greenhouse will show significant variations in floral traits when compared to the wild population due to hand pollination in the greenhouse being relaxed about selecting for specific traits relative to in the wild.

Our null hypothesis is that the cultivated population will not experience any significant variations in floral traits when compared to the wild population.

Methodology

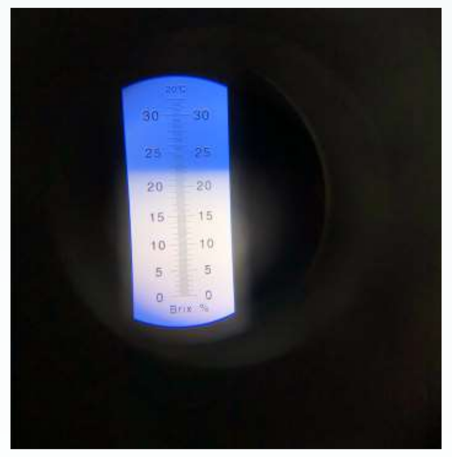
We recorded daily floral phenology and collected measurements of floral traits from flowering wild New Mexico and green house plants. Data collection began each morning at 9 am by recording the start time, the current temperature and the current humidity. When data collection was finished we then recorded the end time, as well as the current temperature and current humidity.

Rulers were used to measure the hypanthium length in to the closest millimeter.

Calipers were used to measure the floral tube diameter in millimeters.

Glass capillary tubes were used to extract nectar from within the hypanthium for testing.

Refractometers were used to measure the sucrose percent in the nectar extracted from the flowers.



Inside of refractometer, indicating sucrose percentage in nectar of a blooming flower.

Differences between plants of wild and cultivated origin were analyzed using t tests. We did not analyze sucrose concentration due to inconsistencies in the data.

Results

We found that New Mexico plants started flowering earlier than those originating from the greenhouse population. Plants of greenhouse origins had significantly longer hypanthium lengths and wider floral tube diameter.

Both the plants of greenhouse origins and New Mexico followed the same general blooming trends, with the greenhouse plants spiking slightly higher in the middle of the season on July 20, 2019 with 257 open flowers.

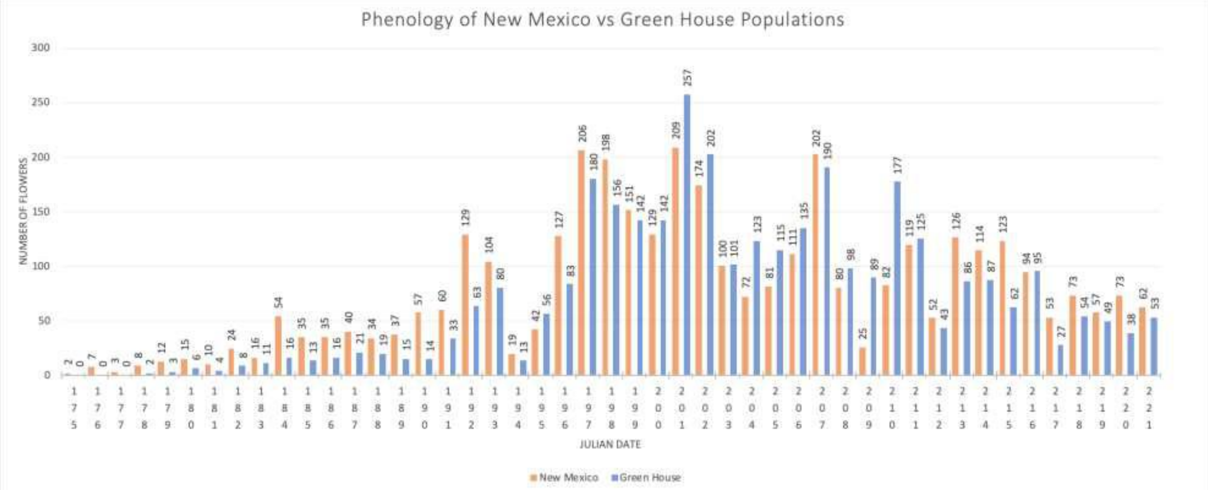


Figure 1: Shows the difference in flowering phenology for GH and NM populations, highlighting first day of flowering and total number of open flowers per population per day.

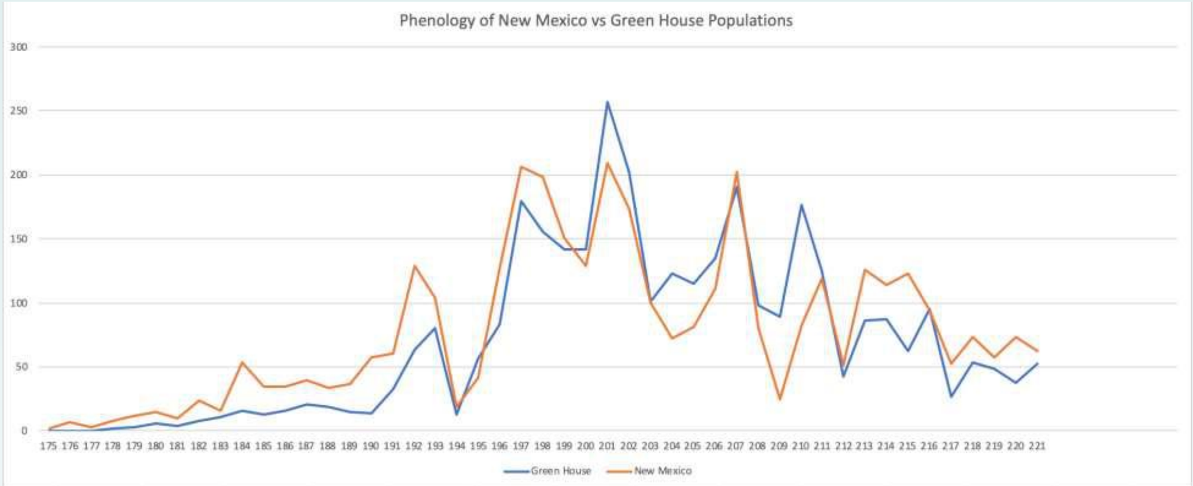


Figure 2: Shows the difference in flowering phenology of GH and NM populations, shows similarities and differences in blooming trends of both populations.

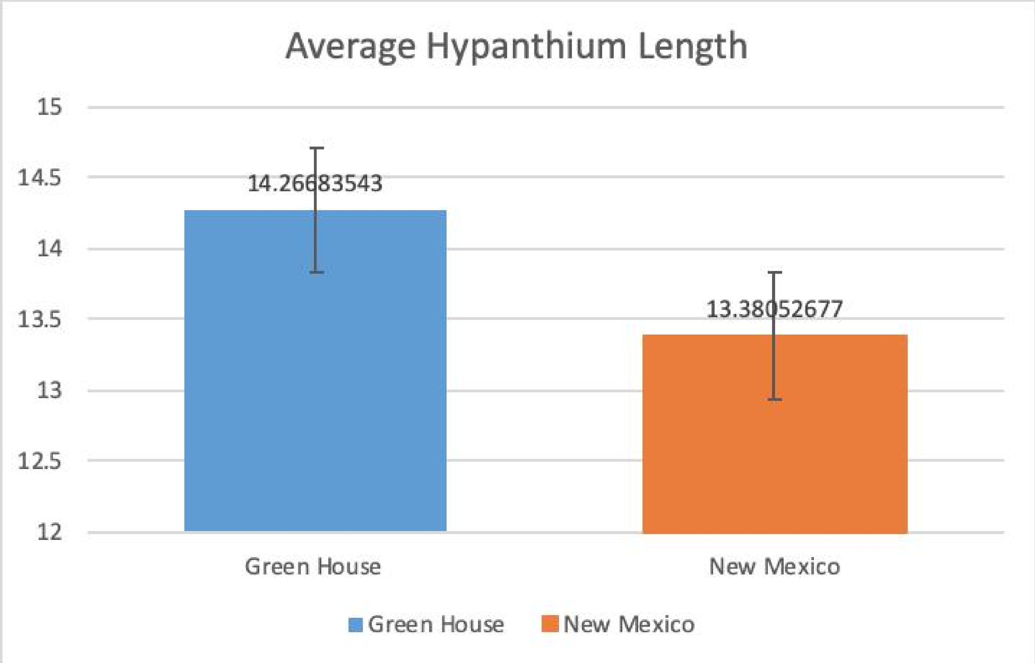


Figure 3: Shows the difference in average hypanthium lengths of GH and NM populations.

t Stat	18.32943218
P(T<=t) one-tail	5.31696E-72
t Critical one-tail	1.645293505
P(T<=t) two-tail	1.06339E-71
t Critical two-tail	1.960648858

Table 1: Shows results for t test for hypanthium length, with a p value less than 0.00001 indicating significant differences between the means.

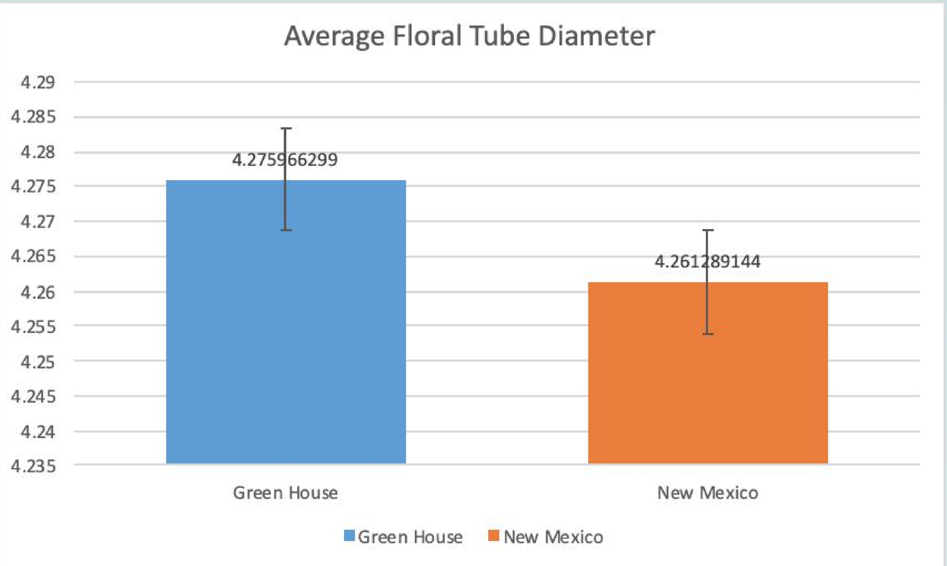


Figure 4: Shows the difference in average floral tube diameter of GH and NM populations.

t Stat	0.672886467
P(T<=t) one-tail	0.25053221
t Critical one-tail	1.64529376
P(T<=t) two-tail	0.501064421
t Critical two-tail	1.960649254

Table 2: Shows results for t test for floral tube diameter, with a p value of 0.5 indicating there is no significant differences between the means.

Conclusion

Phenology, hypanthium length and floral tube diameter are all traits important to pollinators. We observed differences in these traits between the cultivated greenhouse population and the wild population, in particular, there is a statistically significant difference of hypanthium length between populations. Such differences in these traits, which may be due to relaxed selection in the greenhouse, could negatively impact pollination if these greenhouse populations were reintroduced back into the wild. Relaxed selection in the greenhouse results from the absence of pollinators to impose selection on these plants.

This study provides a cautionary tale about changes that can happen to populations when they are maintained ex situ for multiple generations.

Future analysis will include effects of individual plant, maternal line and origin on these traits.

Follow Up Questions

How did weather trends effect phenology?

See if early blooming families are consistently early blooming over multiple years.

Do Mompha moth larvae effect nectar quality and quantity?

Acknowledgements

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Sources: [1]"Oenothera Organensis (Organ Mountains Evening Primrose)." *Rare Plant List*, nmrareplants.unm.edu/rarelist_single.php?SpeciesID=121., [2]Buchman, Steve. "U.S. Forest Service." *Forest Service Shield*, www.fs.fed.us/wildflowers/pollinators/pollinator-of-the-month/hawk_moths.shtml.