

What happens when you cross plant species with two distinct sexual systems?

An ex situ hybridization approach

Morphometric analyses confirm that the pollen recipient influences the F1 morphology to the greatest extent; further analyses are being conducted on the F2 and subsequent generations.

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Project Goal

To assess how the andromonoecious and dioecious sexual systems manifest in Australian *Solanum* hybrids, relative to the parent's role as the pollen donor and pollen recipient.

Background

The evolution of the dioecious sexual system, in which pistillate and staminate flowers grow on separate plants, has been an area of intrigue in biology since Darwin's time (Anderson & Symon 1989). *Solanum* species display not only the rare dioecious system, occurring in only 6-10% of angiosperm species, but also the andromonoecious and hermaphroditic sexual systems, rendering them an ideal group to study sexual system evolution (Renner and Ricklefs 1995; Renner 2014). While current research suggests the origin of dioecy from andromonoecy in Australian *Solanum* (Martine & Anderson 2007), the observation of a dioecious hybrid evolving from an originally andromonoecious species would provide compelling evidence for the origin of andromonoecy first as an intermediate from hermaphroditism, and then a final transition to dioecy as a means to increase genetic variation by decreasing self incompatibility (Anderson & Symon 1989). Additionally, this would inform phylogenies where the origin of dioecy is not yet understood.



Figure 1 Andromonoecious sexual system displayed on the hybrid species flowers.

Methods

Solanum hybrid seeds were acquired from a series of crosses and self-compatibility tests conducted by Dan Hayes in 2018 using 16 *Solanum* species (Hayes 2018). *Solanum dioicum* W. Fitzg. (dioecious) and *Solanum ultrapinosum* A.R. Bean (andromonoecious) were chosen as our study species, because their differing sexual systems enable us to observe how the andromonoecious and dioecious sexual systems manifest in hybrids. Morphometric analyses were conducted both in the greenhouse and using ImageJ measurement software, with an emphasis on reproductive traits. F1 individuals were hand pollinated by Drs. Chris Martine and Tanisha Williams during the summer of 2020. F2 hybrid plants are currently growing. Once these plants have grown to maturity, we will be conducting the same measurements and analyses with the F2 generation.



Figure 2 Hermaphroditic flower morphology: (A) *S. dioicum* (pollen donor species; functionally pistillate), (B) *S. ultrapinosum* (pollen recipient species), (C) hybrid.



Figure 3 Staminate flower morphology: (A) *S. dioicum* (pollen donor species), (B) *S. ultrapinosum* (pollen recipient species), (C) hybrid.

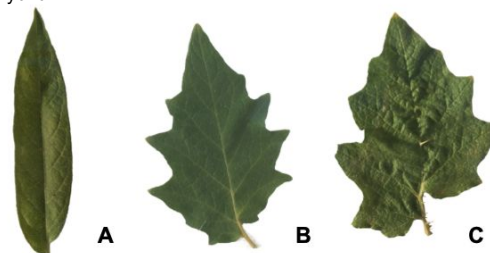


Figure 4 Leaf morphology: (A) *S. dioicum* (pollen donor species), (B) *S. ultrapinosum* (pollen recipient species), (C) hybrid.

Key Findings and Future Analyses

Hybrid Morphology:

- The morphology of F1 hybrids is most heavily influenced by the pollen recipient, and as such, all hybrids displayed the andromonoecious sexual system
- Based on the Principal Component Analysis (PCA) it appears the hybrids are morphometrically independent of both parents

Future Analyses:

- The same measurements will be continued in order to detect changes in the F2 and subsequent generations
- The absence or presence of inaperturate pollen is a key characteristic, in addition to a change in floral architecture, which would indicate changes incurred due to the pollen donor's influence



Figure 5 Species PCA: the hybrids are close, but independent of the pollen recipient species, indicating hybridization between *Solanum dioicum* and *Solanum ultrapinosum*

Implications

The ability to track changes in the sexual characters, if present, will allow for a clearer understanding of how hybridization occurs in *Solanum* species, and especially as to how the rare dioecious sexual system evolved. Particularly, if the loss of staminate function is observed, it will be indicative of a key transitional step from andromonoecy to dioecy in the hybrid sexual system, and support the established hypothesis of dioecy from andromonoecy.

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Support: David Burpee
Endowment and the
Presidential Fellowship

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