Patterns of pleiotropy in *Arabidopsis thaliana* short stamen loss across an altitudinal cline

OBERLIN COLLEGE & CONSERVATORY

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Introduction

Tetradynamy: A floral arrangement with two short stamens and four long stamens

- Defining characteristic in Brassicaceae[1]
- Adaptive in outcrossing plants[2]
- Lost function in highly selfing *Arabidopsis thaliana*, no known contribution to fitness (seed set)[3]

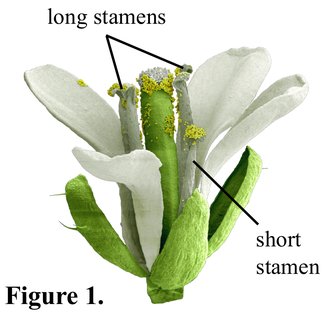

Figure 1.

A. thaliana demonstrates an unexplained pattern of short stamen loss across an altitudinal cline in its native range[3]

High altitudes = More short stamens
Low altitudes = Fewer short stamens

Altitudinal clines can be found in several other traits[4]

Research Questions

1. Is there a fitness advantage to short stamen loss?
2. Can the altitudinal cline of short stamen loss in *A. thaliana* be explained by pleiotropic correlations with other traits involved in altitudinal adaptation?

Results

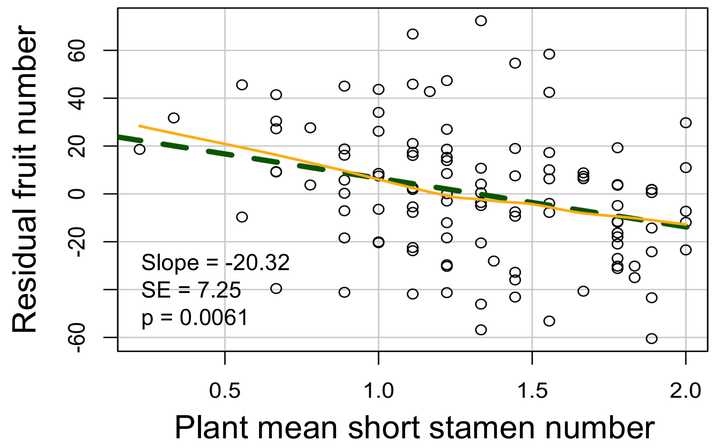

Figure 3. Residuals plot of fruit number, corrected for nine other trait variables in the model, on plant mean short stamen number.

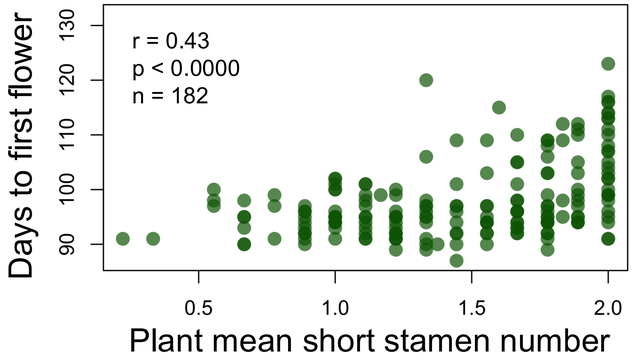

Figure 4. Distribution of days to first flower on mean short stamen number. Pearson correlation coefficient (r) and p-value from correlation matrix.

Discussion

- The negative relationship between mean short stamens and fruit number provides evidence of selection for reduced short stamen number
  - Loss of short stamens is associated with higher plant fitness, leaving the retention of short stamens at high altitudes unexplained
- Higher mean short stamen numbers are associated with more days to flowering
  - Later flowering is selected for in climatic conditions associated with higher altitudes in this cline[4]
  - Plants with the fewest short stamens do not exhibit late flowering
  - Genetic correlation between these traits may act as constraint of short stamen loss at high altitudes

Future Directions

- Completion of data collection on later flowering plants
- Seed set will be used to calculate total fitness
- Replicate experiments will enable data analysis using plant line means and distinguish genetic correlations from environmental effects on traits
- Field experiments and genomic analyses will continue to investigate selection on short stamen number and other mechanisms of stamen loss

Methods

Recombinant inbred lines (RILs) grown from a cross between:

High altitude, 1.60 short stamen parent × Low altitude, 0.60 short stamen parent

- Recorded 15 traits throughout growth and flowering for 195 RIL plants
- Data collection is ongoing

Short stamens counted on a subset of nine flowers on each plant, 1572 total flowers

Figure 2. Side profile images of naturally occurring *A. thaliana* flowers with 2, 1, and 0 short stamens

References

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[4] Montesinos-Navarro, A., Wig, J., Pico, F. X., & Tonsor, S. J. (2010). *Arabidopsis thaliana* populations show clinal variation in a climatic gradient associated with altitude. *New Phytologist*, 189, 282-294.

Acknowledgements

Funding for this project was provided by the Doug and Maria Bayer Fund for Undergraduate Research and by the National Science Foundation. Thank you to everyone in the Conner Lab for your ongoing support and guidance, and to Scarlett for collaborating on intensive data collection throughout the process.

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