Recombinant inbred lines expand variation in plasticity in *A. thaliana*

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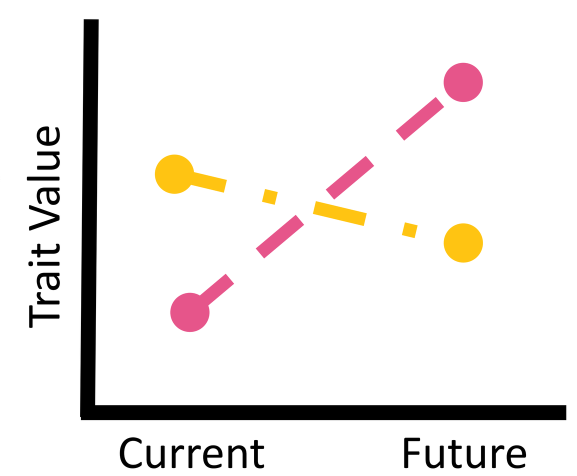
Introduction

- Plasticity is the ability of a genotype to produce different phenotypes in different environments.[1]
- Adaptively plastic populations are more likely to survive rapid environmental changes and persist long enough to genetically adapt to new environments.[2,3]
- The genetic basis of plasticity is not well understood.[4,5]
- Recombinant inbred lines are genetic tools used to identify the genetic basis of traits because each line is a unique combination of the parents' genomes.



Reaction Norm Analysis

- **Treatment**: compare one genotype between treatments. Is there plasticity?
- **Population**: compare genotypes within a treatment. Is there genetic differentiation?
- **Interaction (PxT)**: compare slopes. Is there genetic differentiation for plasticity?

Significance

Increased knowledge of plasticity can inform assisted gene flow and impact food system sustainability in increasingly variable future climates.

Methods

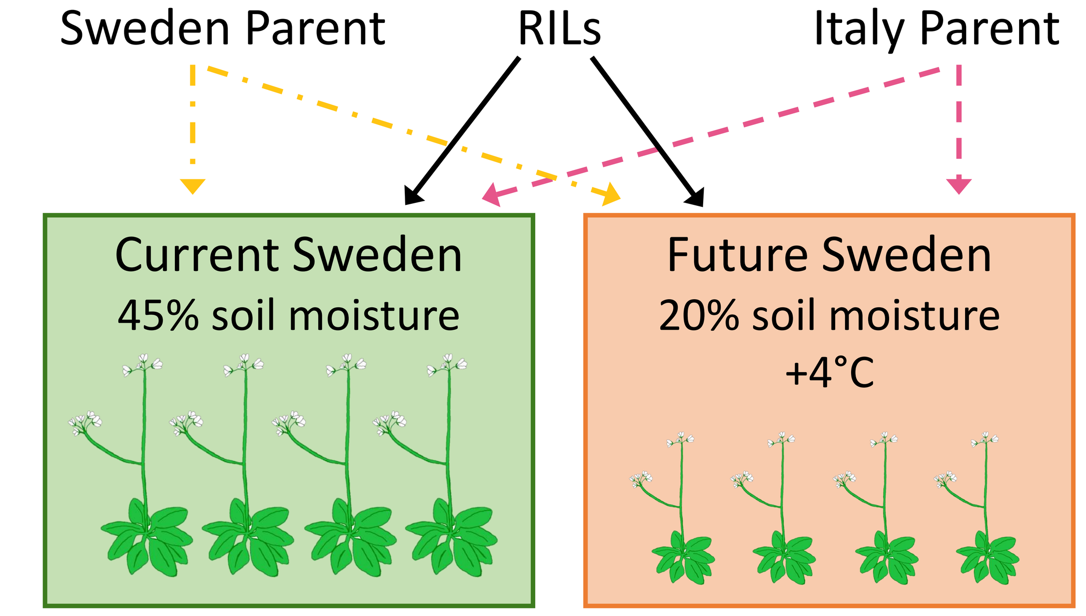
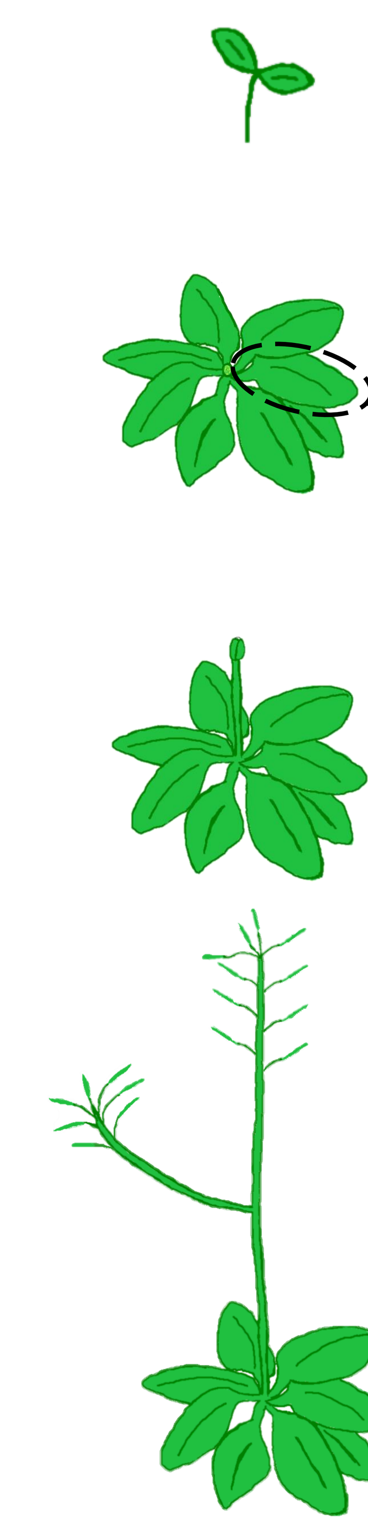


Figure 1: Methods Schematic. 455 *Arabidopsis thaliana* recombinant inbred lines (RILs) and their locally adapted parents from Rodåsen, Sweden (SW) and Castelnuovo di Porto, Italy (IT)[6,7] were grown in a current and future environment (465 plants x 2 treatments = 930 plants) and phenotyped for traits related to phenology, drought response, biomass allocation, and fitness *(in progress)*. Chamber temperatures were adjusted weekly.



- Emergence Date
- Leaf Number 4 weeks after planting

- Bolting Date
- Specific Leaf Area
- Leaf Dry Matter Content
- Water Stress
- Rosette Leaf Number
- Above / Below Ground Biomass (subset)

- Flowering Date

- Rosette Leaf Number
- Above Ground Biomass
  - Rosette
  - Reproductive
- Height
- Fruit Number
- Seed Number

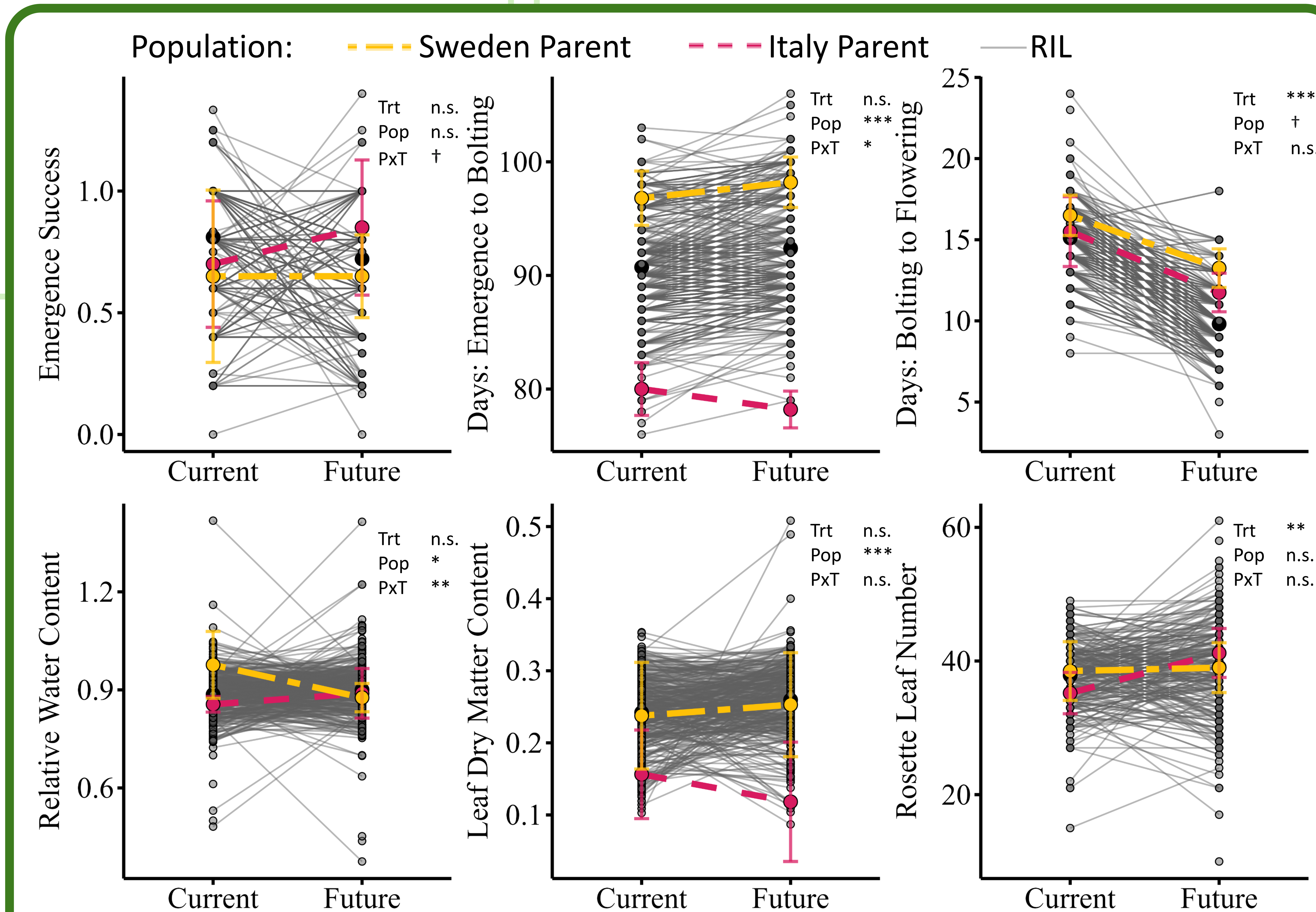


Figure 2. Recombinant inbred lines expand variation in phenotypes and in plasticity. Large points are population means and error bars are 95% confidence intervals. Small points are individual RIL trait values (one point = one plant). Lines connect trait values of the same genotype. Model statistics shown in each corner are for the RIL parents only (see introduction for explanation).

Sneak Peak: Biomass Allocation

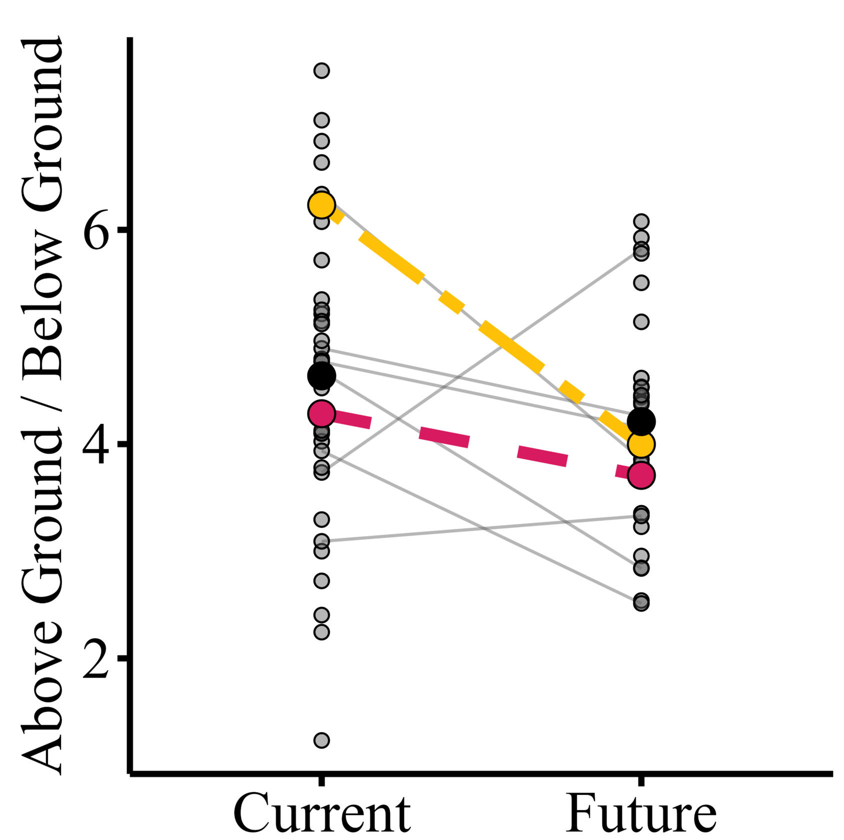


Figure 3. Parental populations show differentiation for plasticity in biomass allocation. The Sweden parent reduces above ground biomass in the future environment more than the Italy parent. Each point is a single individual. Differentiation for plasticity between the parental populations was replicated in a prior study by REU student Tori Nicholes.

Discussion

- Plant phenology differences occur after plant bolting.
- Relative Water Content, a measure of water stress, is generally maintained in the Future environment indicating plant mechanisms to maintain leaf moisture (observationally, future plants also had smaller leaves).
- For all traits, RILs show expanded variation in phenotypes and in plasticity!

Future Work

- Analyze biomass allocation and fitness from initial growing season.
- Identify quantitative trait loci for phenotypes and for plasticity.
- Quantify how frequently plasticity is adaptive.
- Replicate! A second growing season is in progress.

References

[1]Bradshaw (1965) *Adv Genet* [2]Ghalambor et al. (2007) *Funct Ecol* [3]Kawecki & Ebert (2004) *Ecol Lett* [4]Bradshaw (2006) *NewPhyt* [5]Laitinen & Nikoloski (2019) *J Exp Bot* [6]Agren & Schemske (2012) *NewPhyt* [7]Agren et al. (2013) *PNAS*

Acknowledgements

Thank you to the Josephs and Conner labs, especially Trevor Markwood and Mia Stevens. Funding from MSU Paul Taylor Award, KBS Research Funds, and NIH-R35GM142829 to EJ.

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