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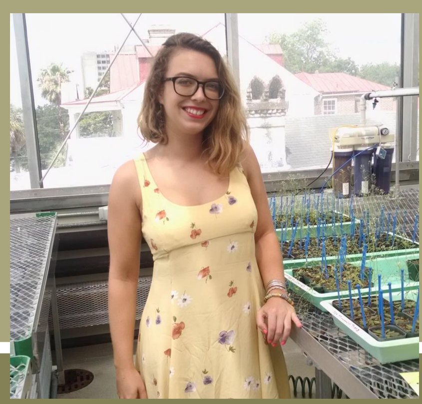

Among population variation in root and shoot plasticity and plasticity of integration in *A. thaliana*

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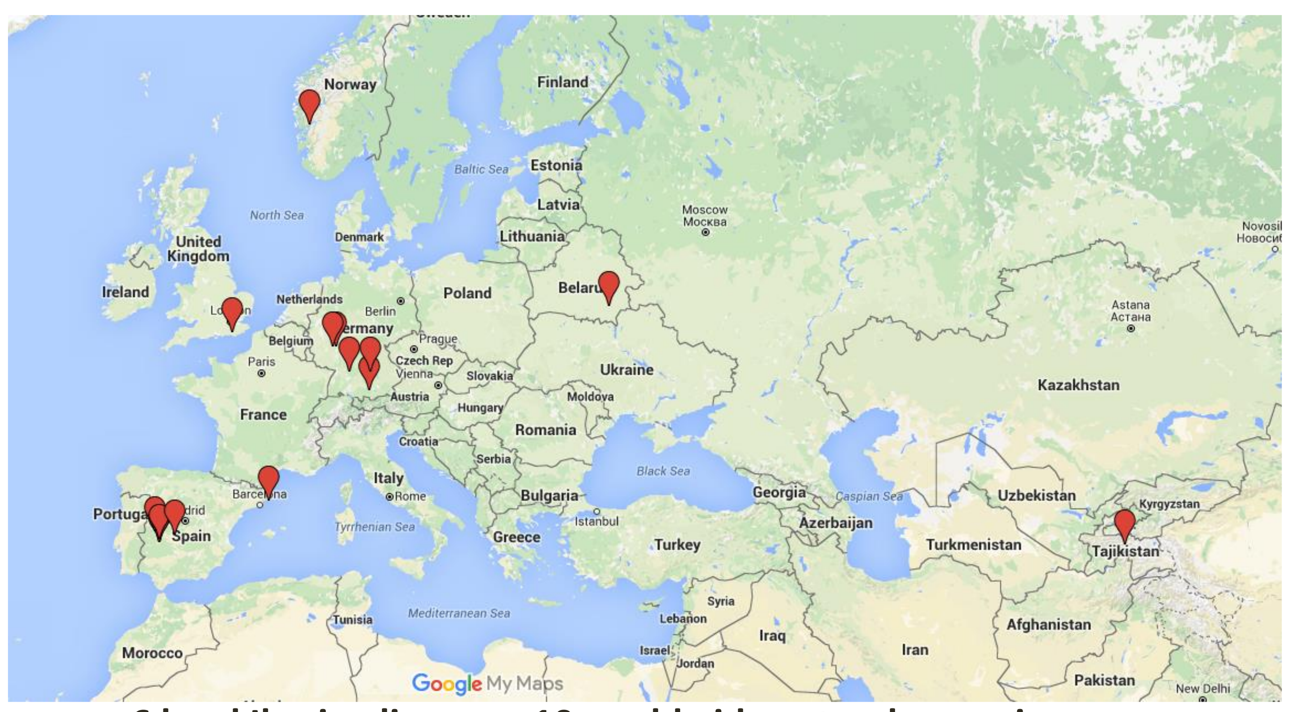
unPAK

Introduction

- Understanding of natural variation and stress tolerance in Arabidopsis can be applied across plant species[3]
- Root system architecture (RSA) and aboveground phenotypes are responsive to nutrient variation[4]
- Genetic variation in plasticity may be influenced by geographic origin[1,6]
- Typically these ideas are addressed at the seedling stage without information about ecological soil history

Study Populations

Do geographically close yet distinct populations respond to the same treatments in similar ways in both roots and shoots?



6 local Iberian lines 10 worldwide natural accessions

Methods

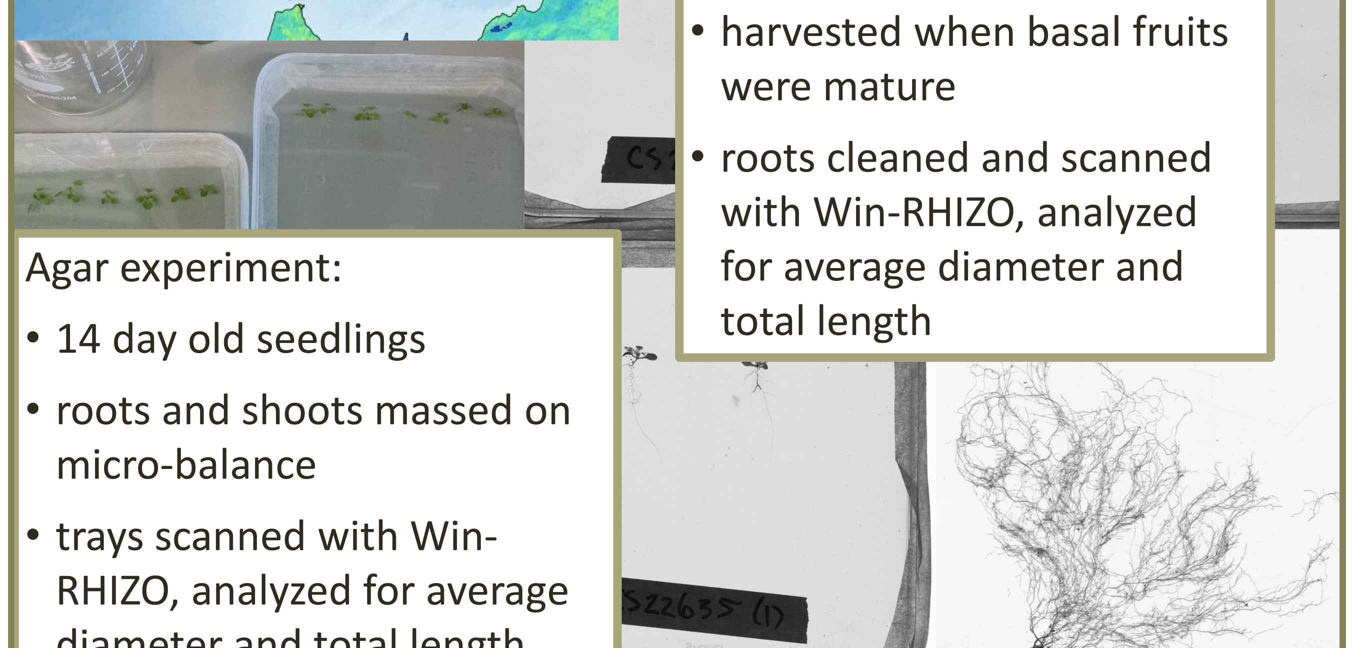
Seed stock selected and planted in December 2014

Greenhouse Nutrient Treatments: **Promix**, **Hoagland's**, **Low Phosphorous**, **Low Nitrogen**

Agar experiment: complete nutrient medium

Greenhouse experiment:

- bolting date, rosette diameter, fruit number, height
- harvested when basal fruits were mature
- roots cleaned and scanned with Win-RHIZO, analyzed for average diameter and total length



Agar experiment:

- 14 day old seedlings
- roots and shoots massed on micro-balance
- trays scanned with Win-RHIZO, analyzed for average diameter and total length

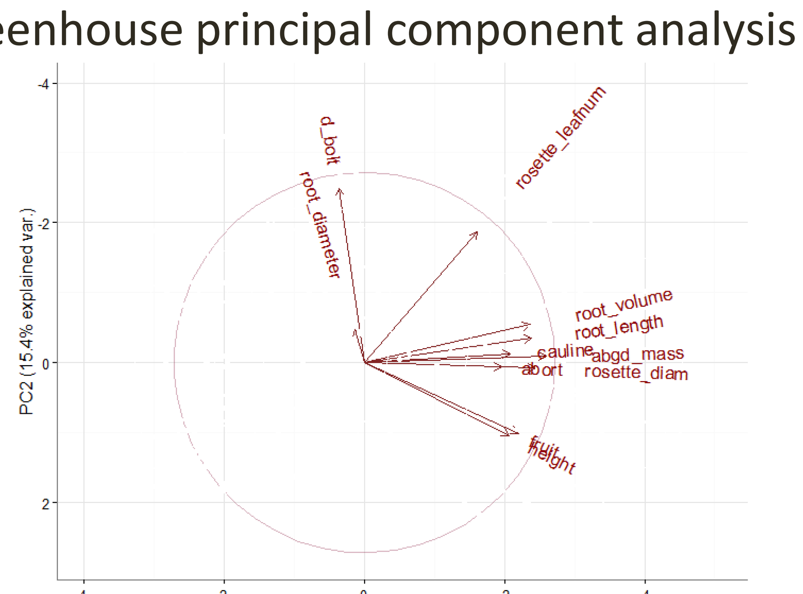
Trait integration varies by population and environment

Greenhouse principal component analysis

PCA for plants grown in sand treatments:
Populations and treatment were highly significantly different for both PC1 and PC2

PC1:
- population cov. est. 0.24 (0.10) p<0.01
- treatment F=1450.3 p<0.0001

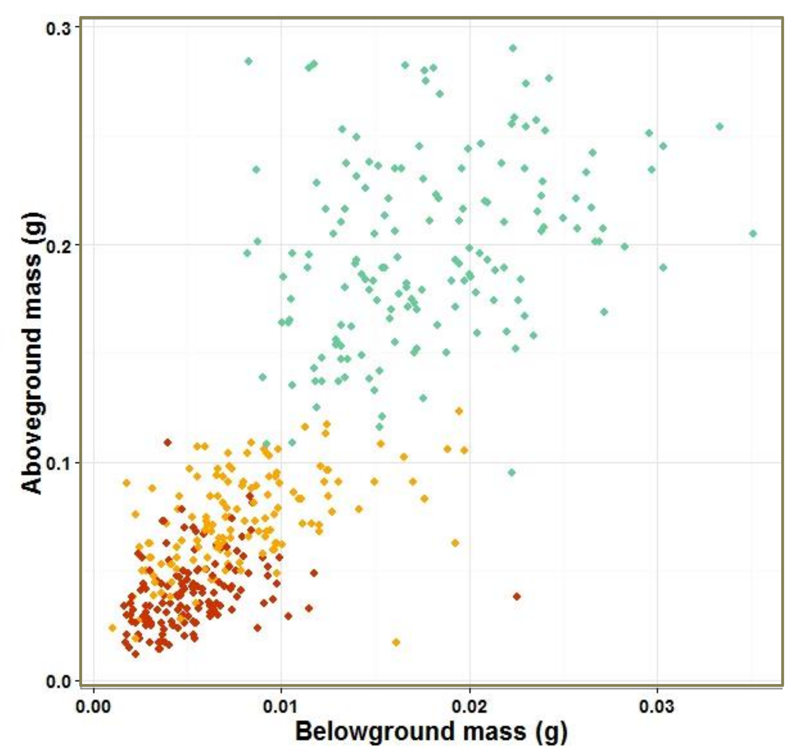
PC2:
- population cov. est 0.67(0.26) p<0.0001
- treatment F=10.81 P<0.0001



Results

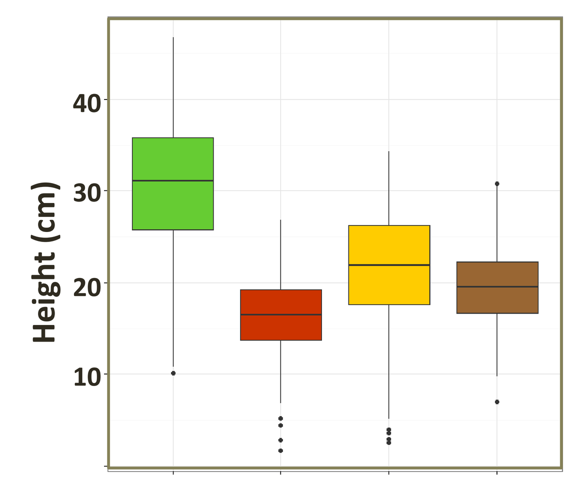
Plasticity to nutrient environments in trait means and trait relationships

Aboveground and belowground mass and relationships vary by treatment



Low Phosphorous: spearman 0.52, p<0.0001
Low Nitrogen: spearman 0.43, p<0.0001
Hoagland's: spearman 0.35, p<0.0001

Plant height varies by treatment



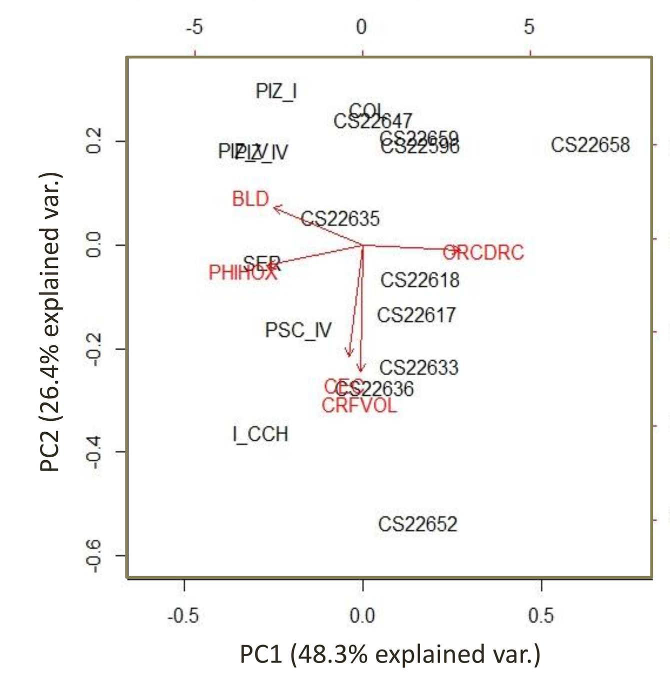
$F_{3,45}$=87.71 p<0.001

Treatments Color Key:	Hoagland's Low Phosphorous Low Nitrogen Promix

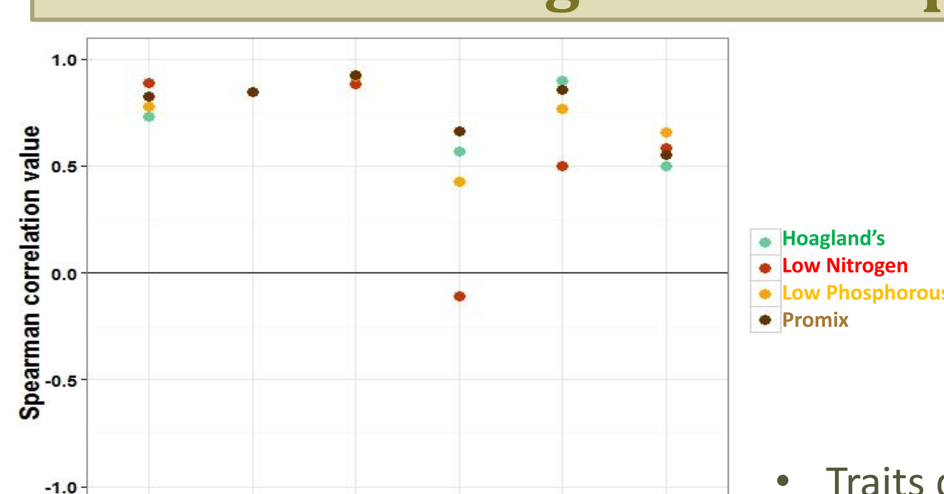
Soil quality of origins

Edaphic factors are predictive of integration and plasticity in seedling and adult plants

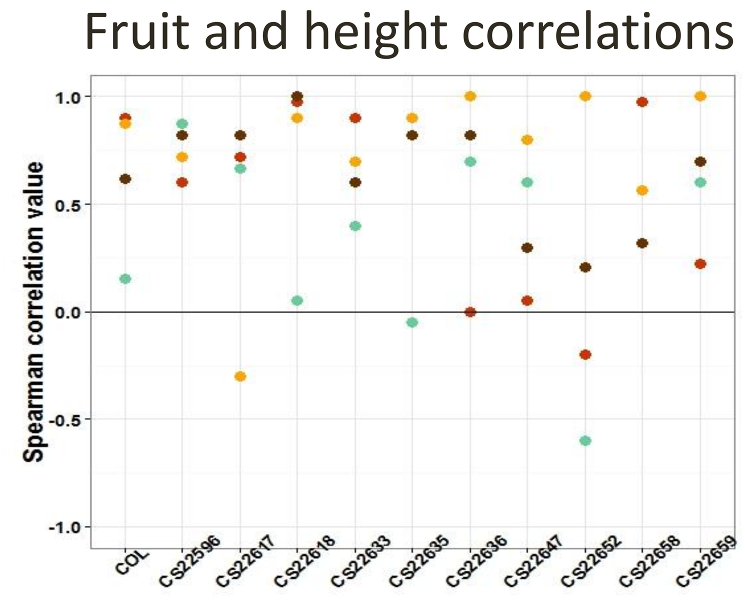
Soil principal component analysis



Genetic and environmental variation in aboveground traits: variation in integration and plasticity in lines with differing soil histories

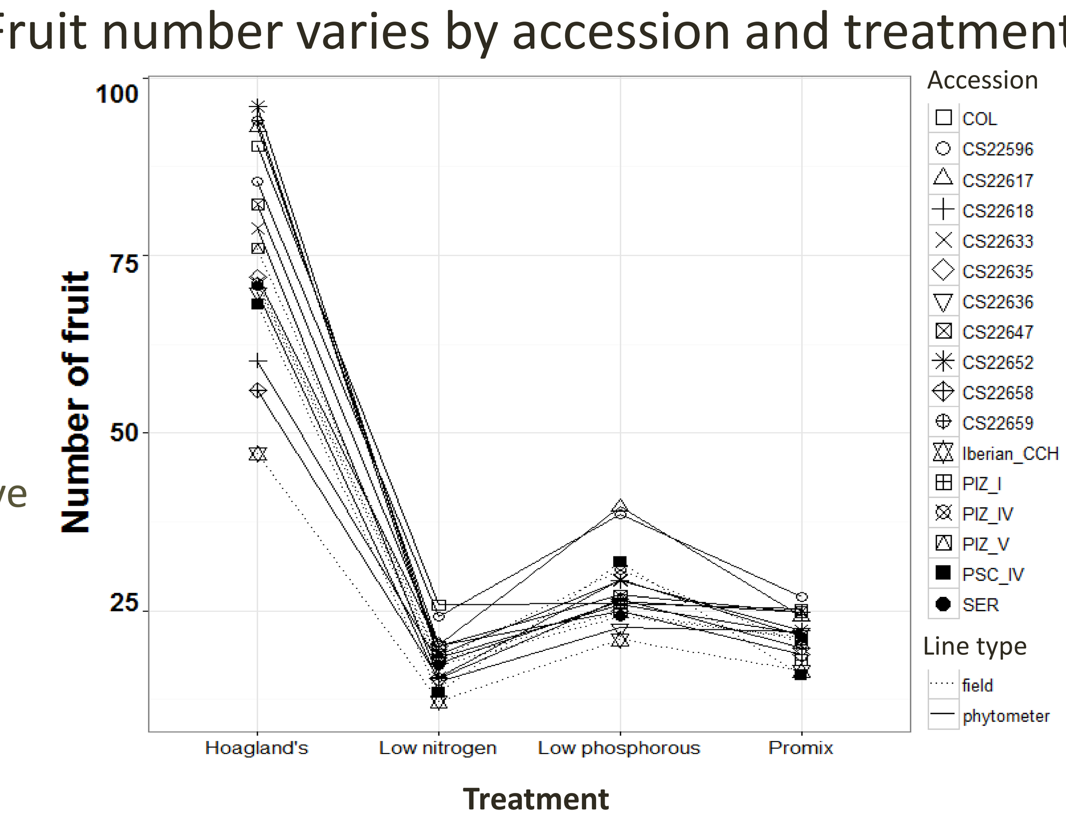


Fruit and height correlations



- Traits do not vary independently
- Interrelated functions have the potential to influence evolution[2,5]
- Populations from similar soils have similar correlations

Fruit number varies by accession and treatment

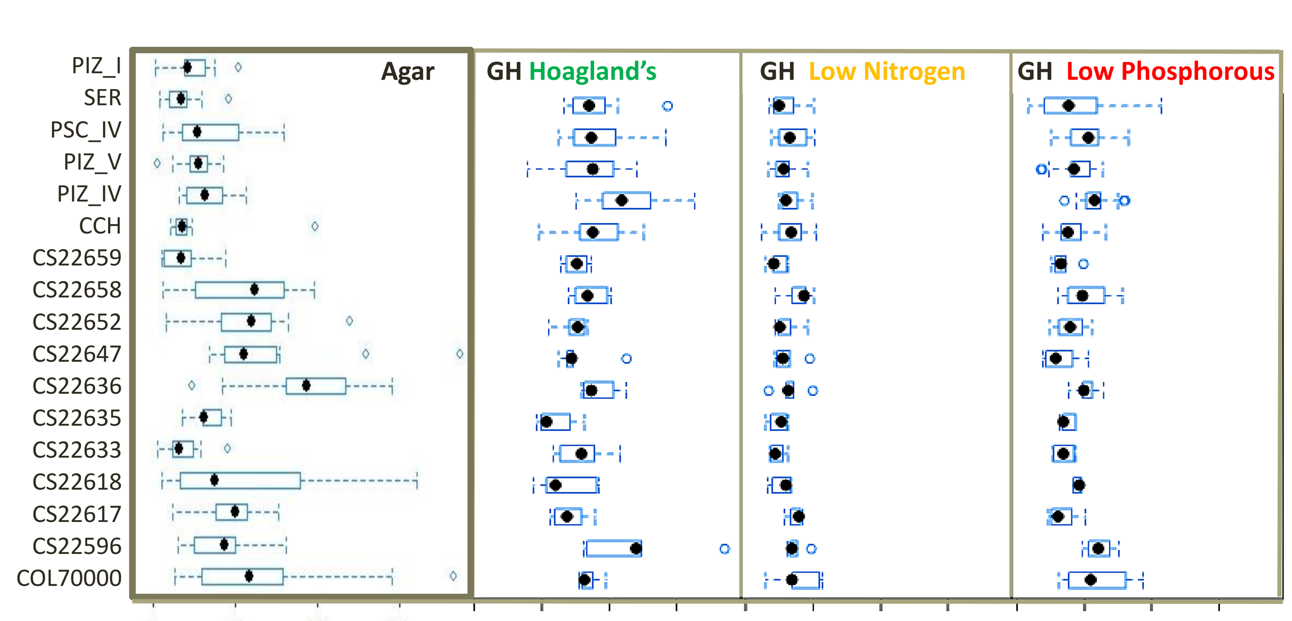


We found plasticity for fitness in total reproductive output ($F_{3,45}$=294.5, p<0.0001)

Significant variation in reproductive output:
- accession (covariate estimate 61.8±35, p<0.005)
- accession by treatment (covariate estimate 58.2±24.2, p<0.01)

Seedling root systems do not directly correlate with adult phenotypic variation and plasticity

Agar and greenhouse root length varies by accession



We detected genetic variation across accessions ($F_{16, 207}$ = 4.98 p<0.0001) in seedlings

We detected genetic variation across accessions (p<0.001), variation across treatments ($F_{2,30}$ = 227.6 p<0.001), and genetic variation for plasticity (p<0.0008) in mature plants

The effect of landscape level environmental variation is observed in population differentiation

Developmental stages need to be considered when evaluating root traits as patterns in RSA can vary by:
- life stage
- environment
- genotype

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Follow the unPAK project at arabidopsisunpak.org

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