Comparing phenotyping systems for salinity tolerance in Quinoa (*Chenopodium quinoa*) across phenological stages

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BACKGROUND

- Globally increased pressure of soil salinity in agriculture
- Diversify cropping systems with salt tolerant crops like quinoa to increase productivity in marginal environments

→ Need for reliable phenotyping systems to identify salt tolerant accessions

HYDROPONICS VS. GREENHOUSE (SOIL)

HYDROPONIC SCREENING
14 days NaCl treatment
300mM from 6-leaf stage
→ Sampling & harvest
→ Main index: Biomass

Traits assessed
Na^+, K^+, K^+/Na^+-ratio
water content,
stomatal conductance,
osmolality

Salt Tolerance Index
=
$Trait_{salt}/Trait_{control}$

GREENHOUSE SCREENING
14 days NaCl treatment
400mM from 10-leaf stage
→ Sampling
→ Harvest at maturity
→ Main index: Single Plant Yield

Biomass maintenance vs. single plant yield as a salt tolerance index

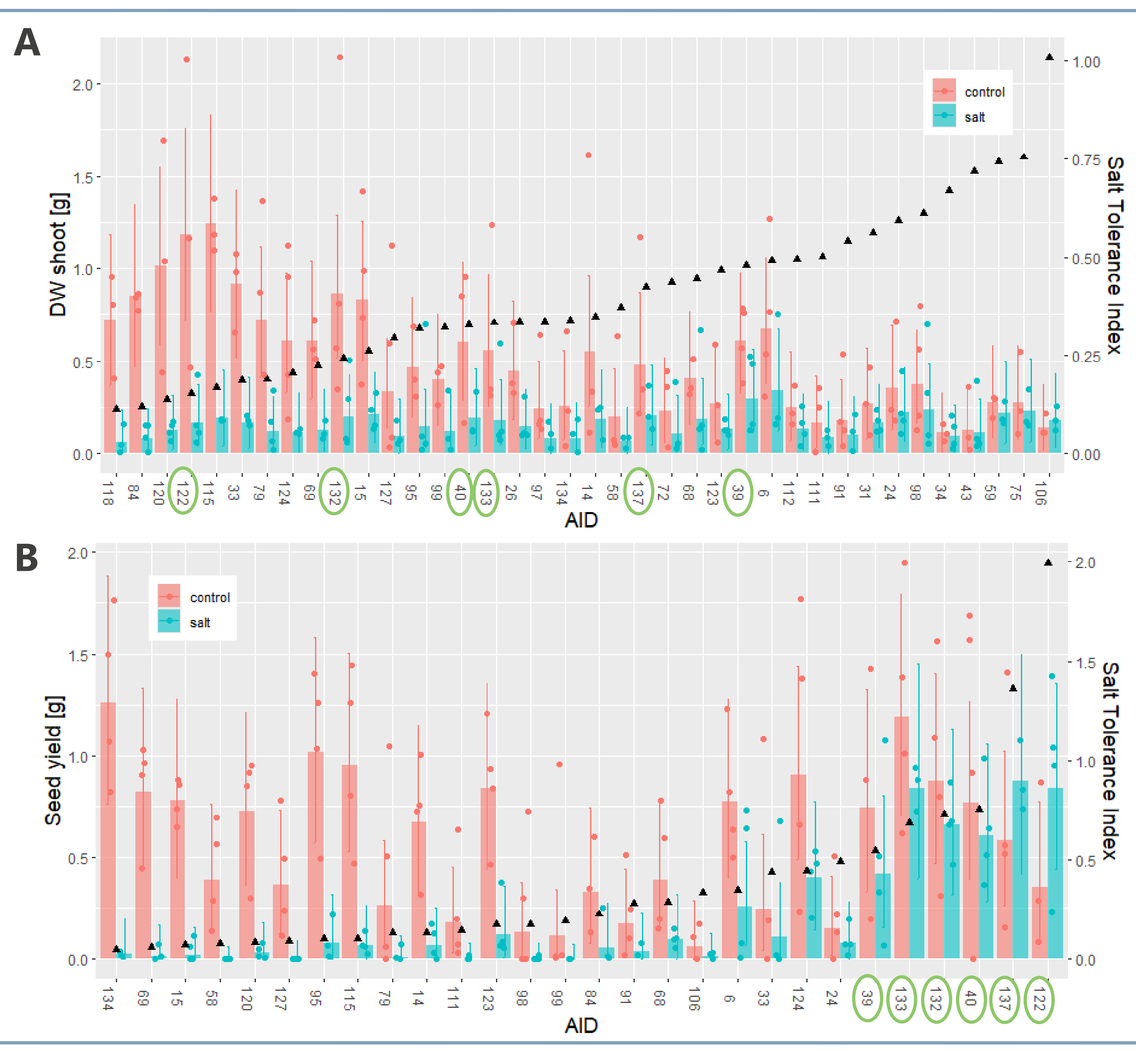
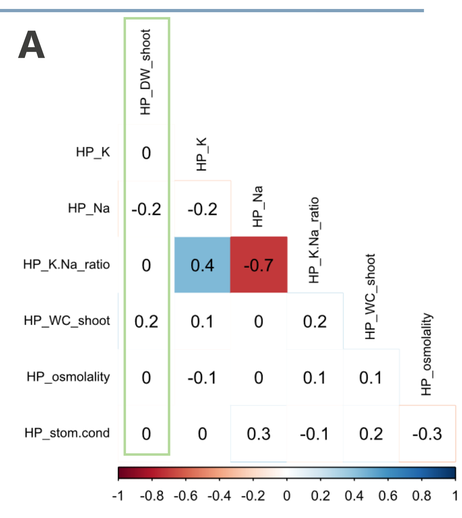


Fig.1 **A) Shoot dry mass and respective salt tolerance index of different quinoa accessions** under salt (300 mM) and control treatment in a hydroponic system. **B) Single plant yield and respective salt tolerance index of different quinoa accessions** under salt (400 mM) and control treatment in a pot experiment. Bars indicate estimated marginal means and 95% confidence interval, backtransformed from square root scale. Black triangles indicate salt tolerance index. Accessions performing well regarding seed yield are marked green in both graphs.

- Accessions with the highest Salt Tolerance Index in the hydroponic system tend to have low biomass under control conditions → may not be desired for breeding
- High Salt Tolerance Index for seed yield in the soil based system is associated with stable and high performance in both conditions → candidate accessions for breeding

Correlation of salt tolerance indices across traits and experimental systems



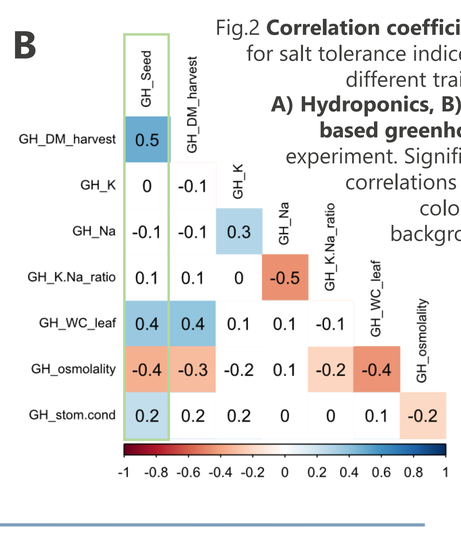


Fig.2 **Correlation coefficients** for salt tolerance indices of different traits in **A) Hydroponics, B) soil based greenhouse** experiment. Significant correlations with coloured background

Related indices between experiments	
Biomass (HP) vs. Seed Yield (GH, Soil)	-0.1
Biomass (HP) vs. Biomass (GH,Soil)	-0.3
K^+ content	0.1
Na^+ content	-0.1
K^+/Na^+ ratio	0.5
Water content	0
Osmolality	0.1
Stomatal conductance	0.6

Table 1 **Correlation coefficients** for salt tolerance indices of different traits **between experimental systems**

- Biomass index and seed yield index are not significantly correlated
- Ion related traits do not seem to influence biomass or seed yield indices
- Stomatal conductance index positively correlated between experiments

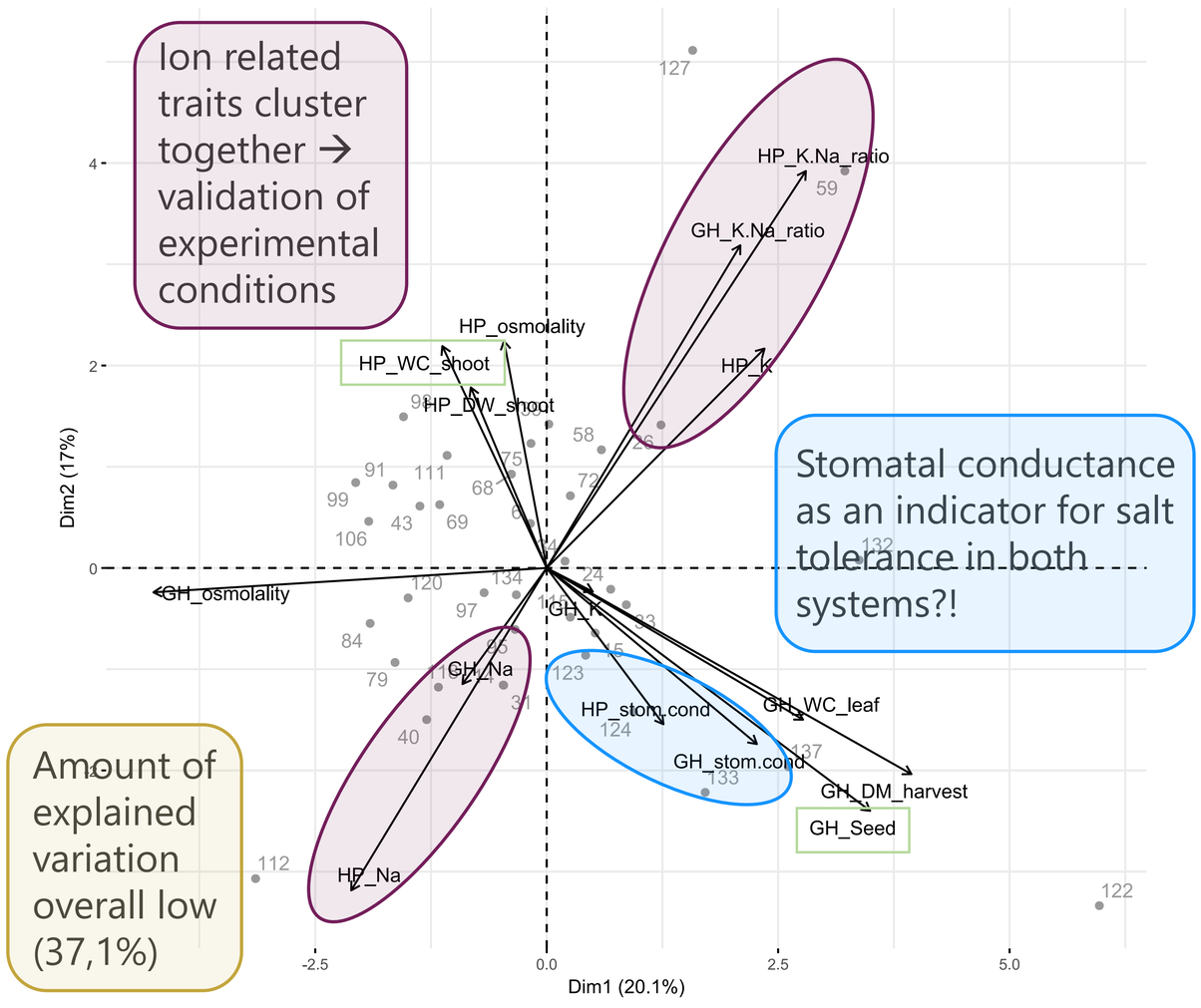


Fig.3 **PCA biplot** of salt tolerance indices per trait and accession in different experimental systems. HP = Hydroponics, GH = greenhouse (soil based pot experiment)

CONCLUSIONS AND OUTLOOK

- Different experimental settings conclude in different rankings for tolerance indices of the same trait
- Selecting based on seed maintenance or biomass maintenance will result in different accessions declared as „tolerant“
- Stomatal conductance as a potential trait for indirect selection
- Transfer of results from lab and greenhouse to the field has to be treated carefully

ACKNOWLEDGEMENTS

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