Mapping the osmotic component of salinity tolerance in *Arabidopsis thaliana*

Mariam Awlia¹, Sónia Negrão¹, Klára Panzarová², Stuart J. Roy³ & Mark Tester¹

Mariam Awlia
mariam.awlia@kaust.edu.sa

¹ The Salt Lab, Center for Desert Agriculture, KAUST, Kingdom of Saudi Arabia
² PSI (Photon Systems Instruments), Drasov, Czech Republic
³ Australian Centre for Plant Functional Genomics and the University of Adelaide, Australia

<http://saltlab.kaust.edu.sa/>

Introduction

- Plant growth rates seem to rapidly decline upon salt stress and are independent of salt accumulation in the shoot (the “osmotic component”, *sensu* Munns & Tester, 2008).
- Traits changing in rapid response to salt stress include: *growth arrest* and *stomatal closure*, plus a decrease in *photosynthetic activity*.

Plant Material

- Col-0 vs. C24** (protocol optimisation)
- Growth conditions (photon irradiance, temperature)
  - Watering regime (testing its effect on salt stress)
  - Fluorescence protocol (comparing parameters)

Col-0 and C24 were chosen due to their:

- Close genetic relation
- Intrinsically different responses to salinity (Schmöckel *et al.*, 2015)

RGB image of plants on day 9 after salt imposition (Exp. 1)

Methods

- Stage of salt imposition:** 1.10 growth stage
- Salt treatments:** 0 and 250 mM NaCl
- Salt sensed by plants:** 100 mM NaCl due to field capacity
- Watering regime:** Watering to weight (to 60% of field capacity)
- Method of imposition :** Saturation method for 1 hour
- Salt treatment duration:** Add salt once, monitor for 7 days

Boyes *et al.* (2001)

PlantScreen phenotypic measurements

Pixel counts & greenness types	RGB imaging unit
Fluorescence signatures, such as NPQ, quantum yield & light curve	Chlorophyll fluorescence imaging unit
Temperature (stomatal closure)	Thermal imaging unit

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Results of Col-0 vs. C24

Exp. 1: Growth conditions Osmotic tolerance index (OsmTol) = $RGR_{(salt)} / RGR_{(control)}$

RGR reduction upon salinity was evident in Col-0 & C24 under the tested conditions.

Exp. 2: Watering regime (80%, 60%, 40% of field capacity)

The 60% watering regime resulted in RGR reduction without risk of drought.

Exp. 3: Fluorescence protocol (quenching analysis & light curve analysis)

Quenching analysis: Stressed plants have lower quenching capacity upon salinity.

Light curve analysis: PSII operating efficiency is decreased in higher light upon salinity.

Exp. 3: Greenness analysis

Conclusions

- Clear growth reduction upon stress was evident and quantified.
- Watering to 60% water holding capacity shows clear salt effect.
- RGR from “area” data provides a measure of osmotic tolerance.
- “Greenness” can be used as an indicator of osmotic tolerance.
- “Chlorophyll fluorescence” signatures alter upon salt stress.

Future perspectives

- High-throughput phenotyping of *A. thaliana* HapMap population (350 ecotypes) at PSI Phenotyping Research Center to measure and analyse more parameters affected by salinity.
- Genome-wide association (GWAS) mapping to identify QTLs contributing to the osmotic component of salinity tolerance.

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