LIPIDOMICS TO IDENTIFY NOVEL SALINITY TOLARANCE MECHANISUMS IN BARLEY ROOTS

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Salinity in Australia

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Valley of Salt Salinity in the Western Australian wheat-belt near Bruce

Reference: CSIRO ScienceImage

Abiotic stress affects agricultural productivity in Australia?

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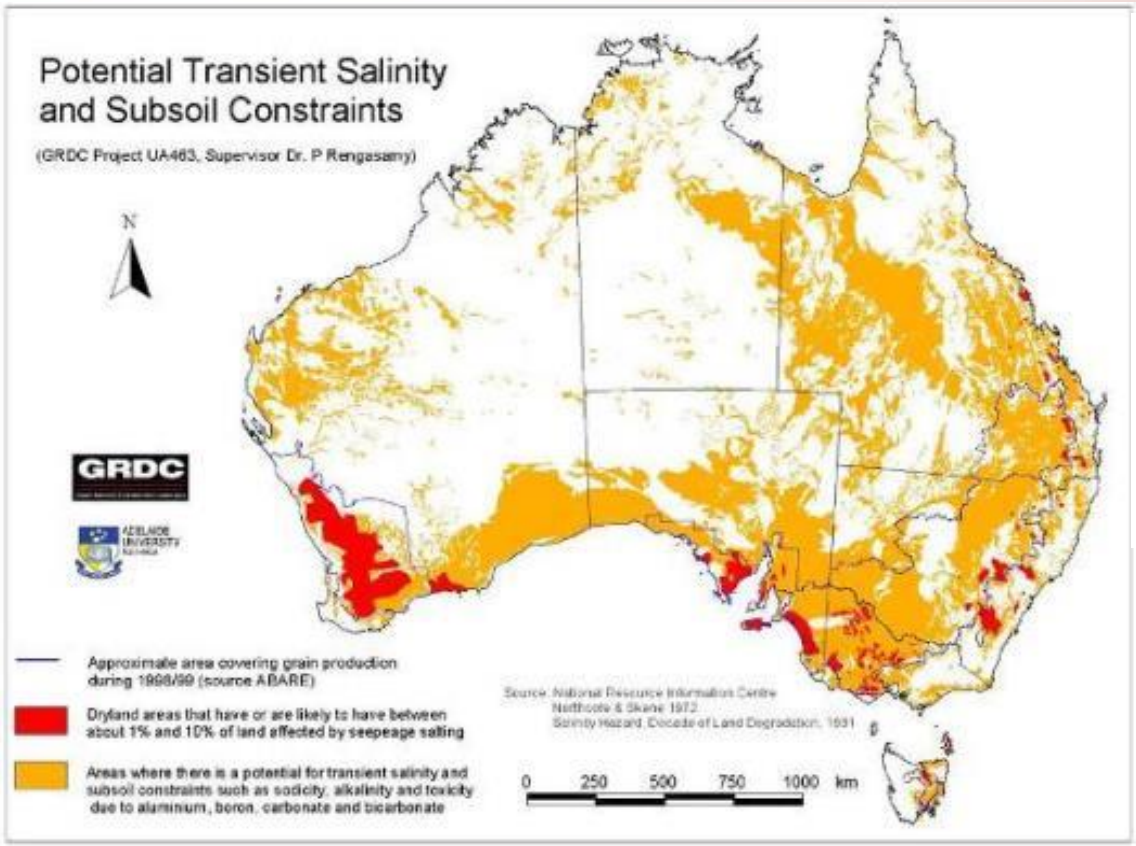
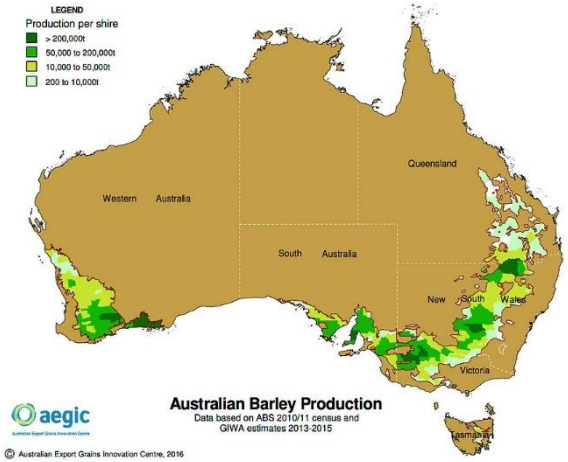
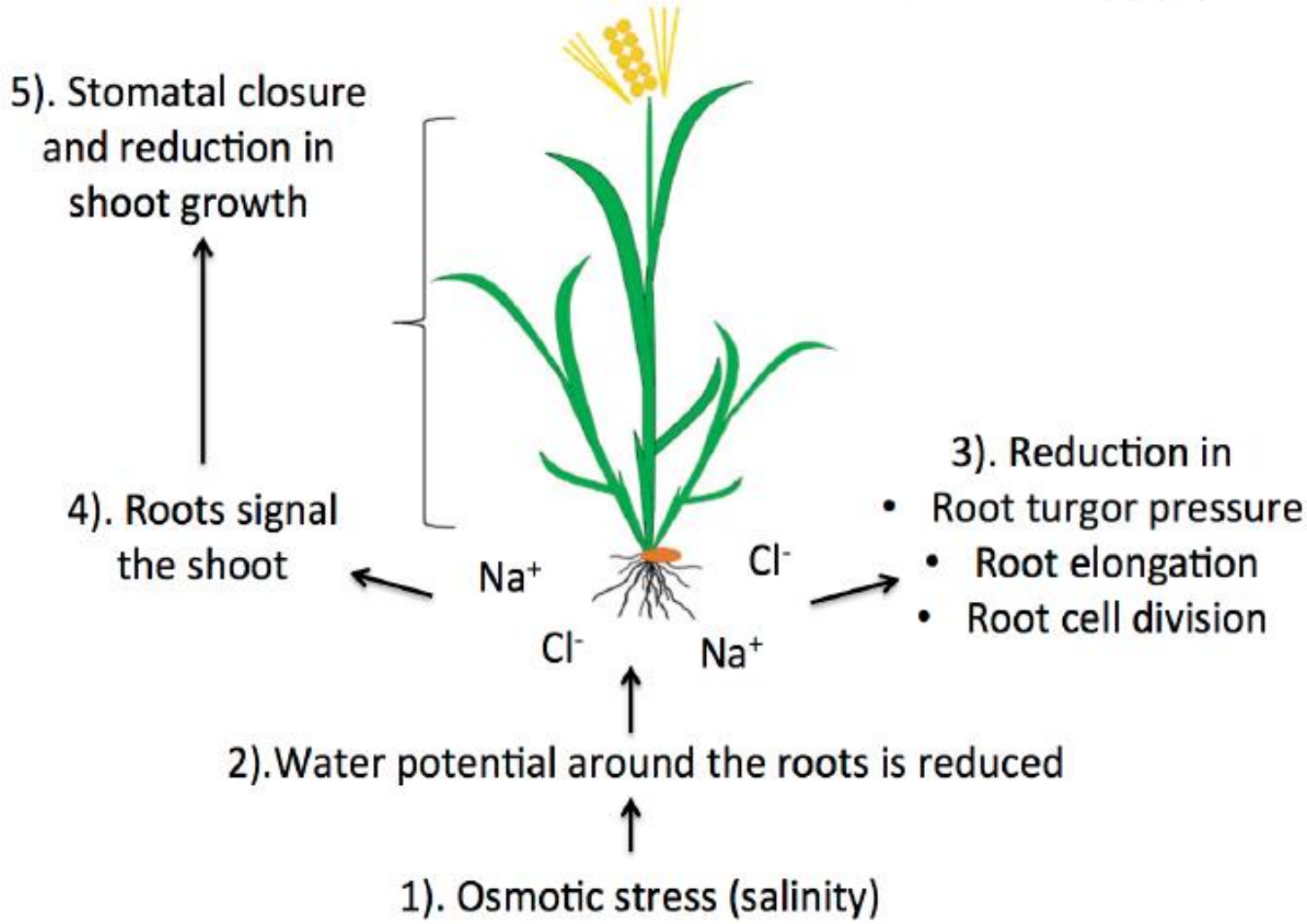




- Australian wheat belt significantly affected by salinity
- Barely is the second highest grain produced in Australia
- **In danger: Australian wheat and Barley exports worth ~ $6 billion p.a.**

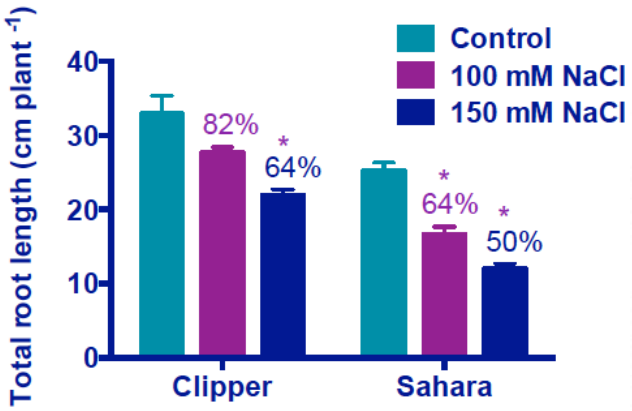
Rengasamy (2002) Aust. J. Exp. Agric. 42: 351-361

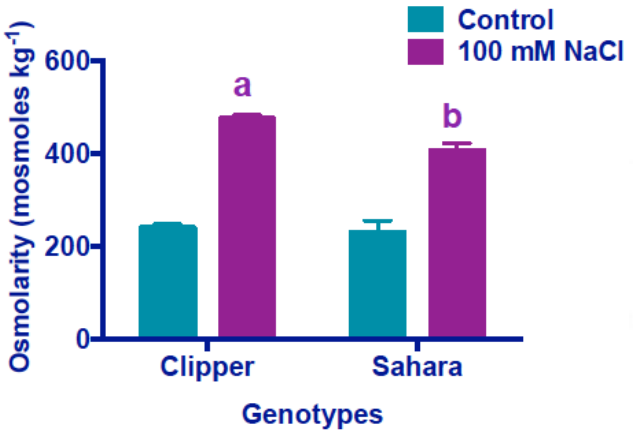
Effect of salt stress on plants



Roy et al, 2012

Effect of salt stress on roots





Control Salt

CSIRO PUBLISHING
Functional Plant Biology
http://dx.doi.org/10.1071/FP12290

Genetic variation in the root growth response of barley genotypes to salinity stress

Megan C. Shelden[A,F], Ute Roessner[A], Robert E. Sharp[D], Mark Tester[B] and Antony Bacic[C]

Clipper- Commercial Australian cultivar (tolerant to salt -better root growth under salt stress)
Sahara - North African landrace (sensitive to salt -reduced root growth under salt stress)

Study Design

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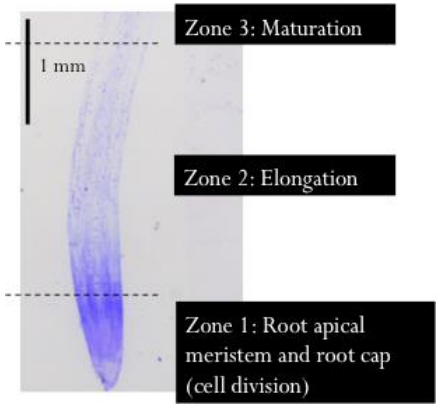

Barley Cultivars: Clipper and Sahara

↓

Growth and Treatment on Agar Plates

↓

Root Tissue Harvest
(3 Zones: Root Cap, Elongation and Maturation Zone)

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Lipid and FA Analysis

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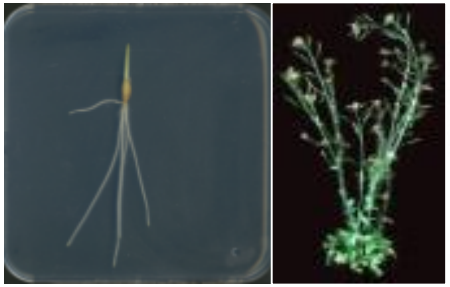
Data Analysis and Statistics

↓

Data Integration and Biological Interpretation

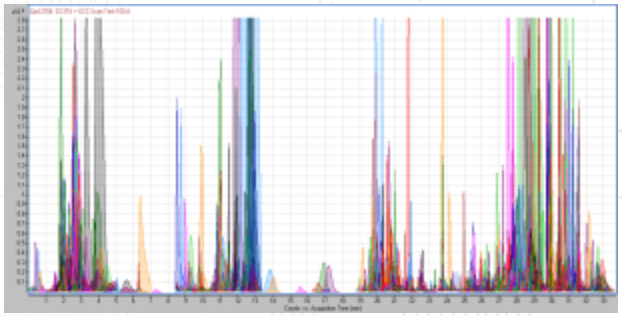
Lipidomics approach



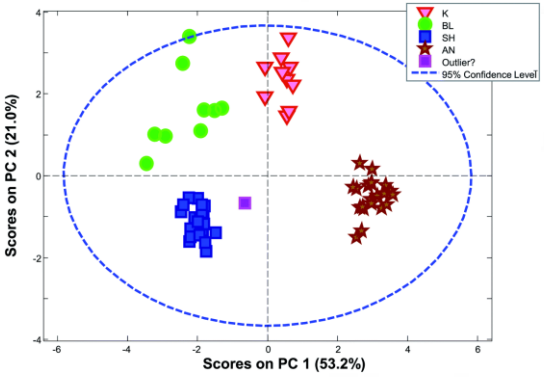
Tissue of interest

Quench

Homogenization

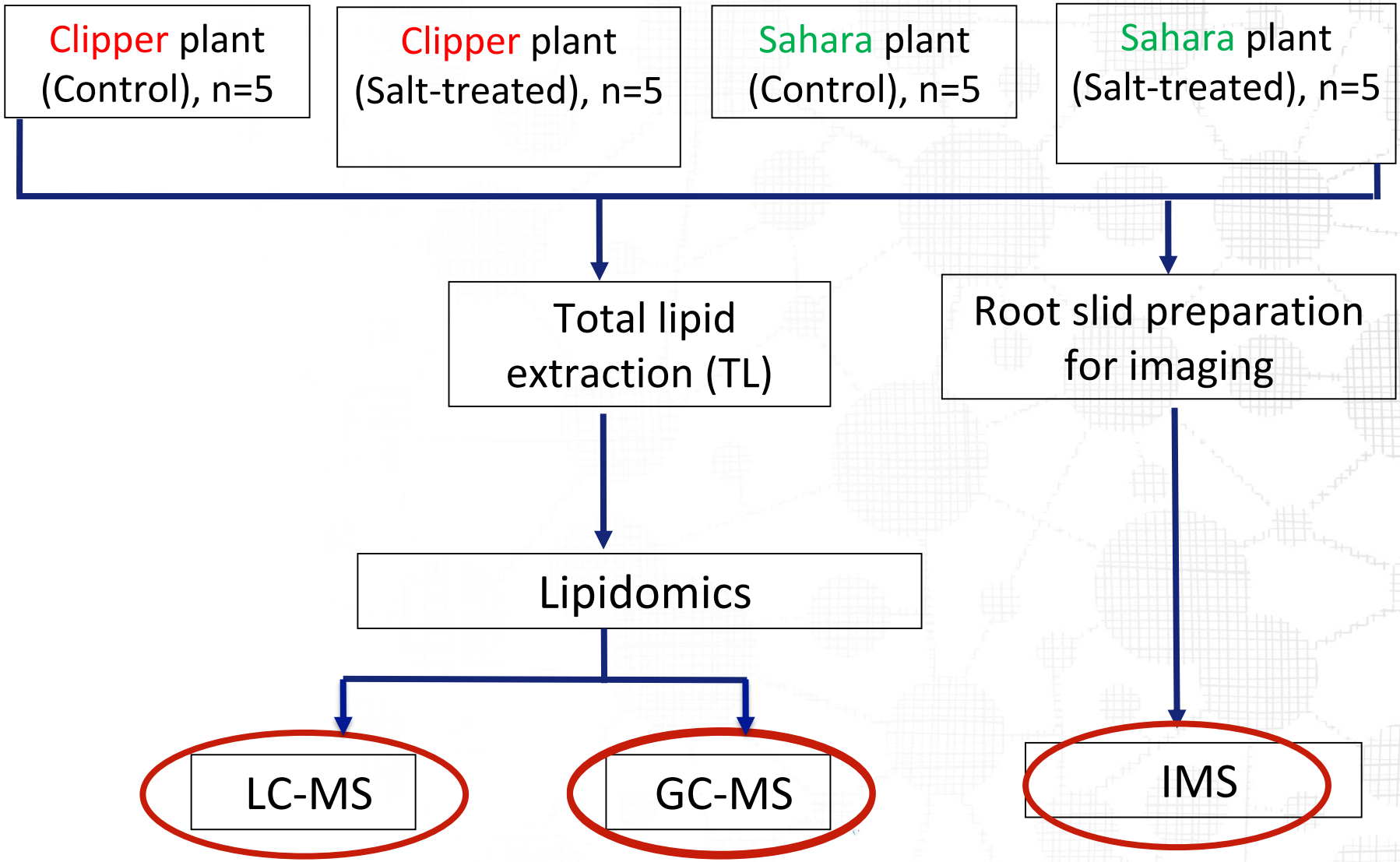


Lipid analysis



Data interpretation

Lipid analysis workflow



Targeted Fatty Acid Analysis – GC-MS

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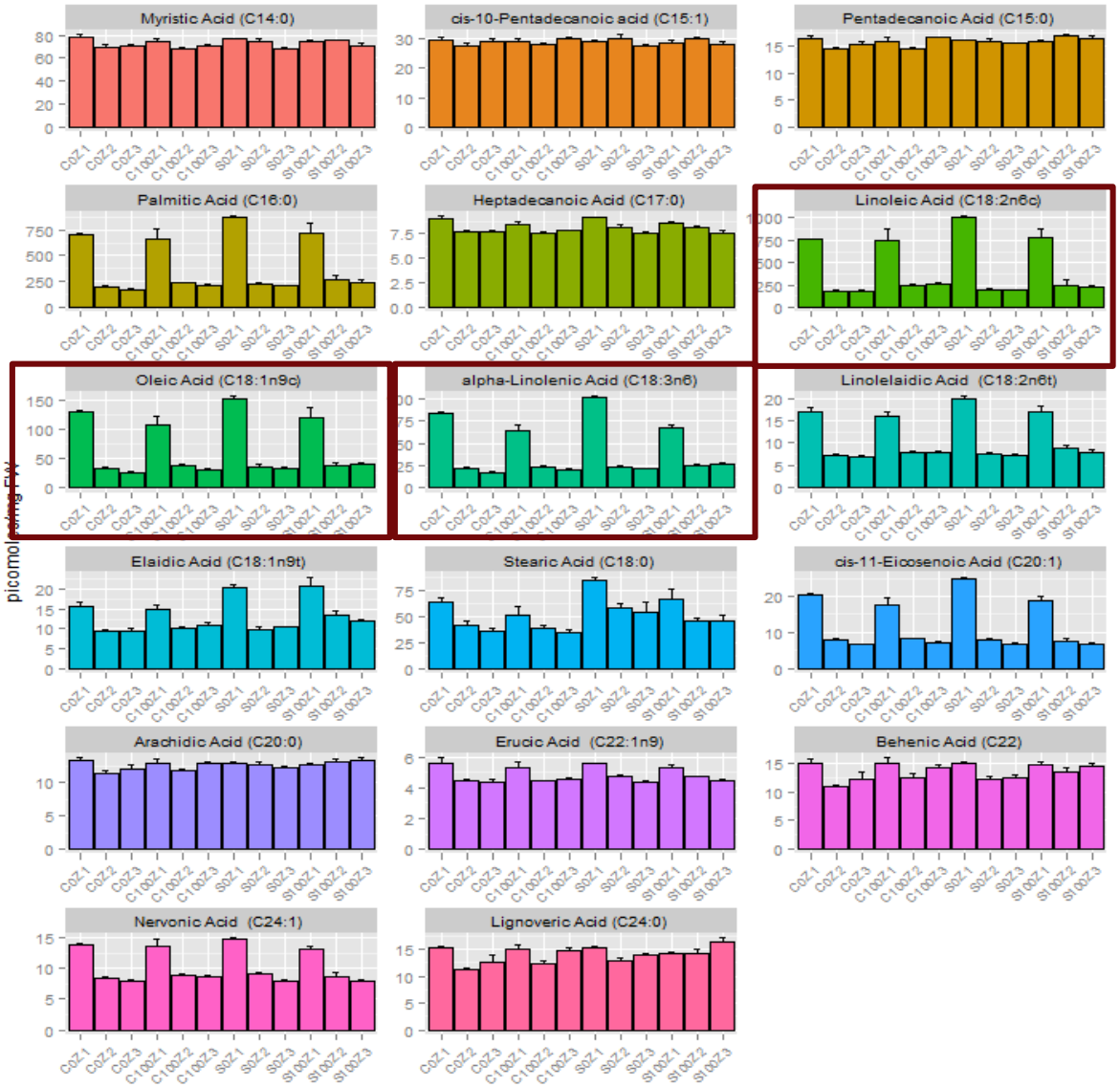
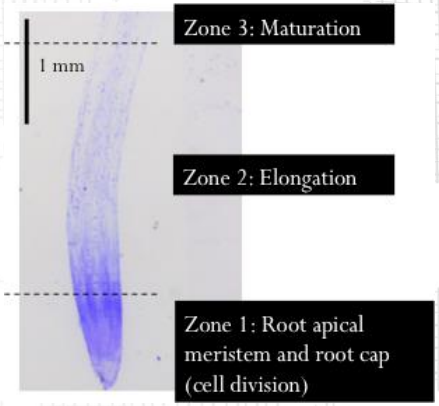


C- Clipper
S - Sahara
Z – zone
0 - no salt
1- salt treated



Targeted Lipid Analysis – LC-MS
Clipper and Sahara (zone I+2 +3)

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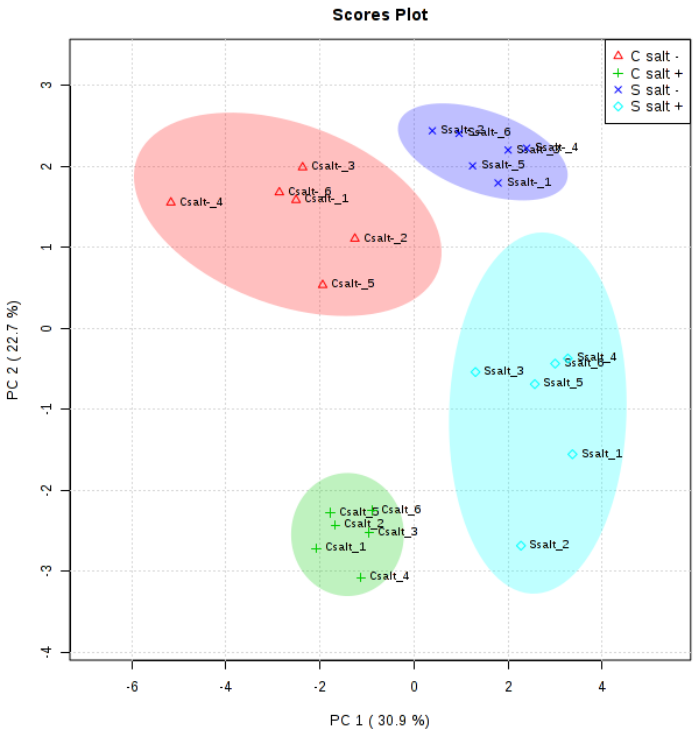

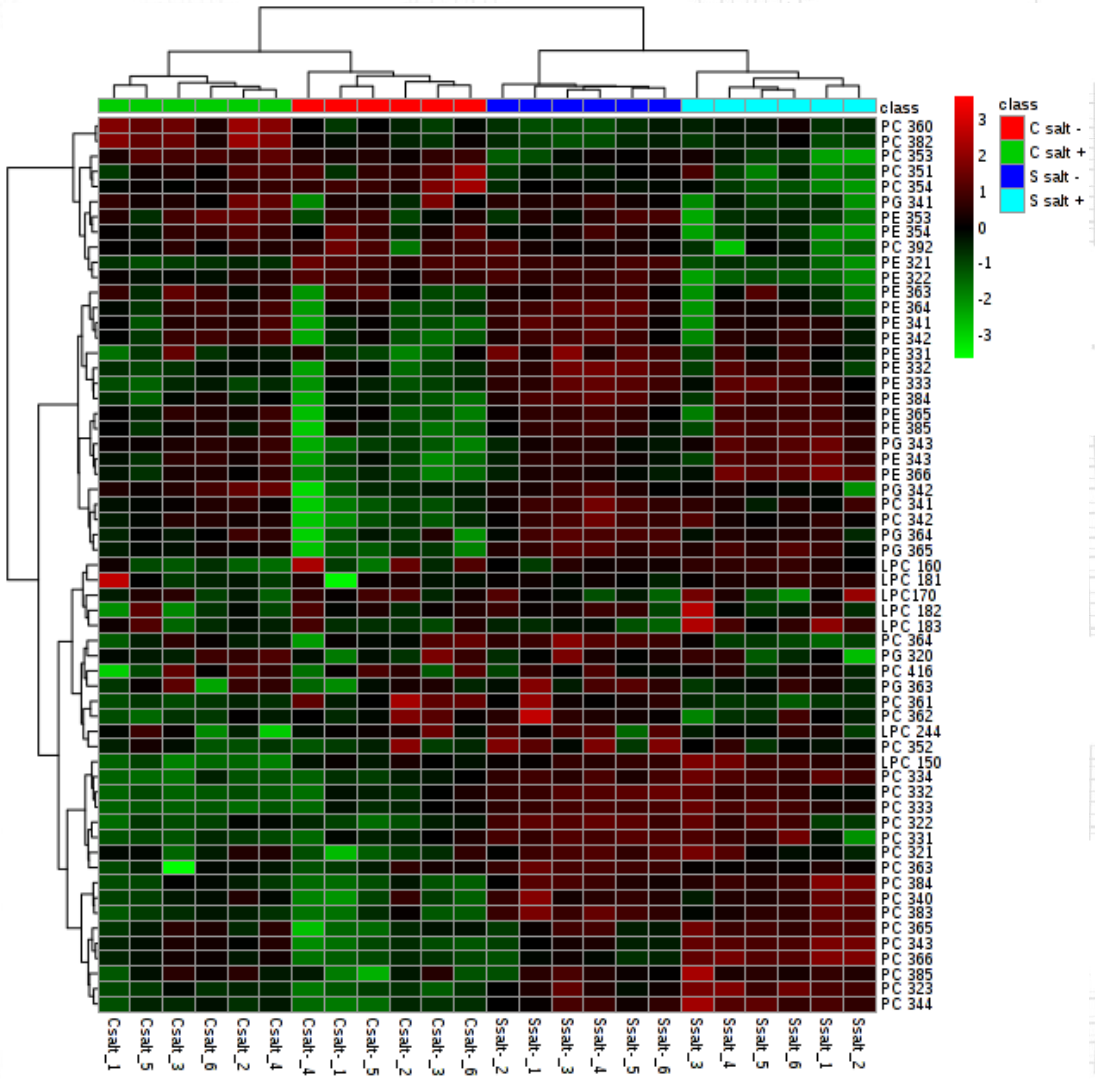

PCA & heat map for the targeted phospholipid data

Total lipid analysis in salt treated roots – Untargetted & targeted LC-MS analysis

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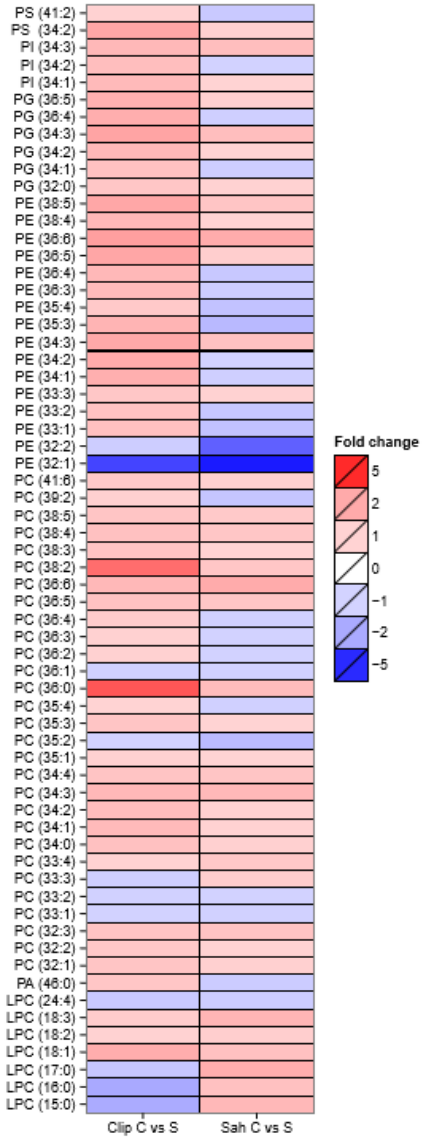

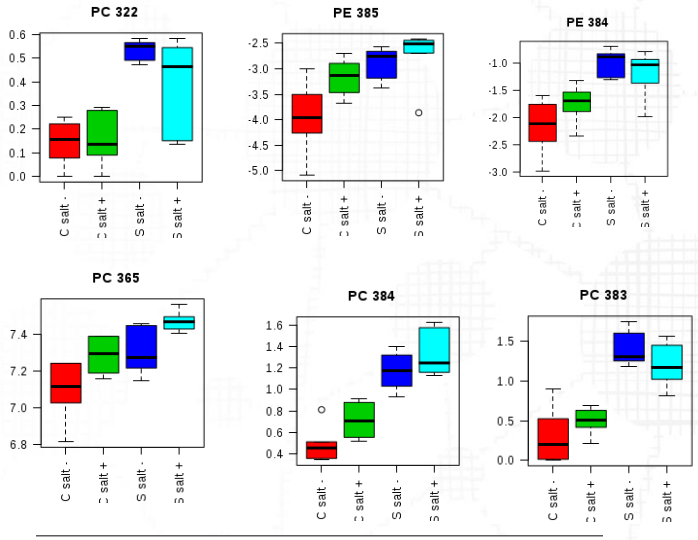

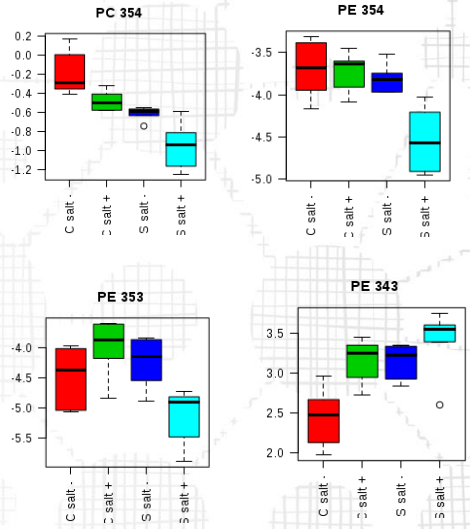

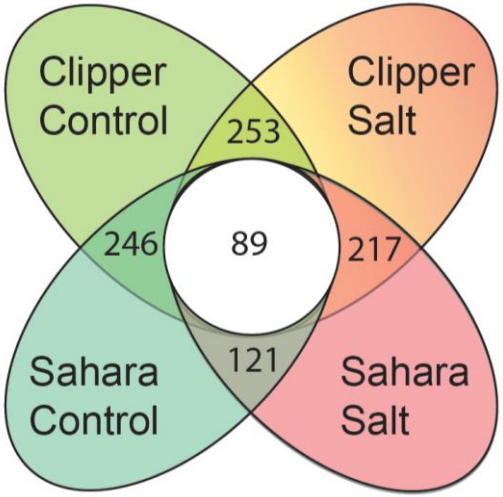

Natera et al, 2016, Funct Plant Biol

Oxidative defence metabolites induced by salinity stress in roots of Salicornia herbacea

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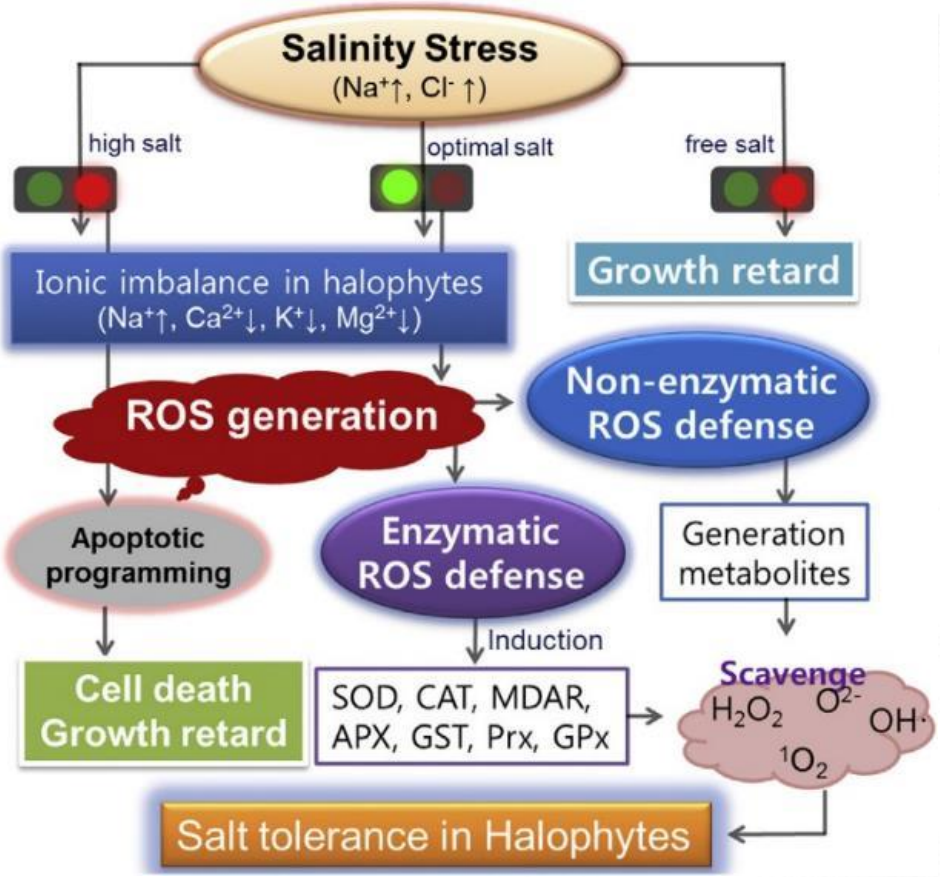
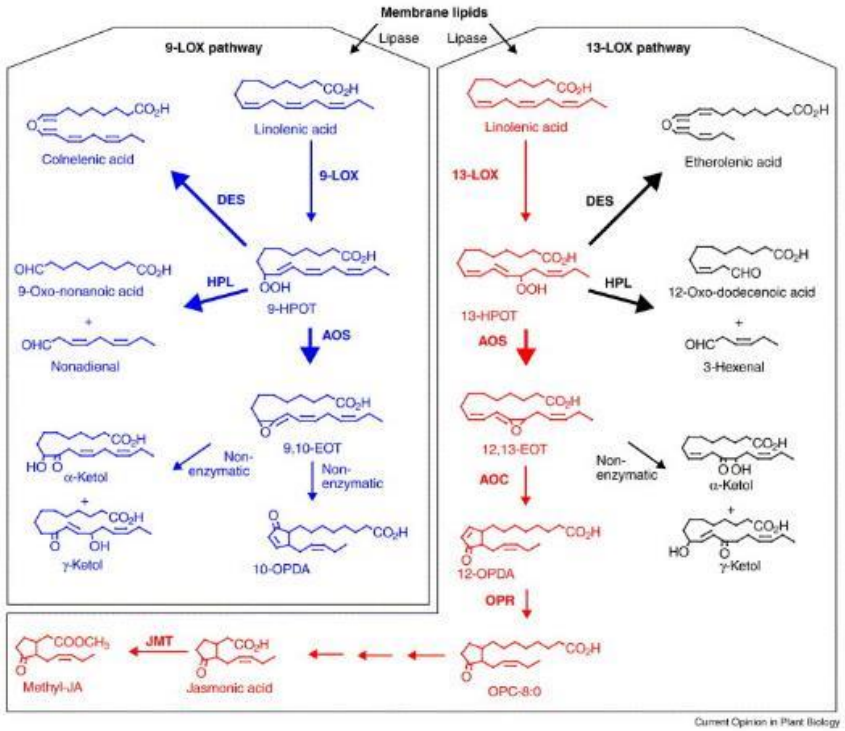


Oxylipin metabolism in response to stress in plants



Ref: Seung Jae Leea, Journal of Plant Physiology 206 (2016)

Ref: Gregg Howe and Anthony L Schimiller -Current Opinion in Plant Biology, 2002, 5(3) 230-236

Oxidized lipid analysis in salt treated Barley roots (Clipper- tolerant to salt stress)

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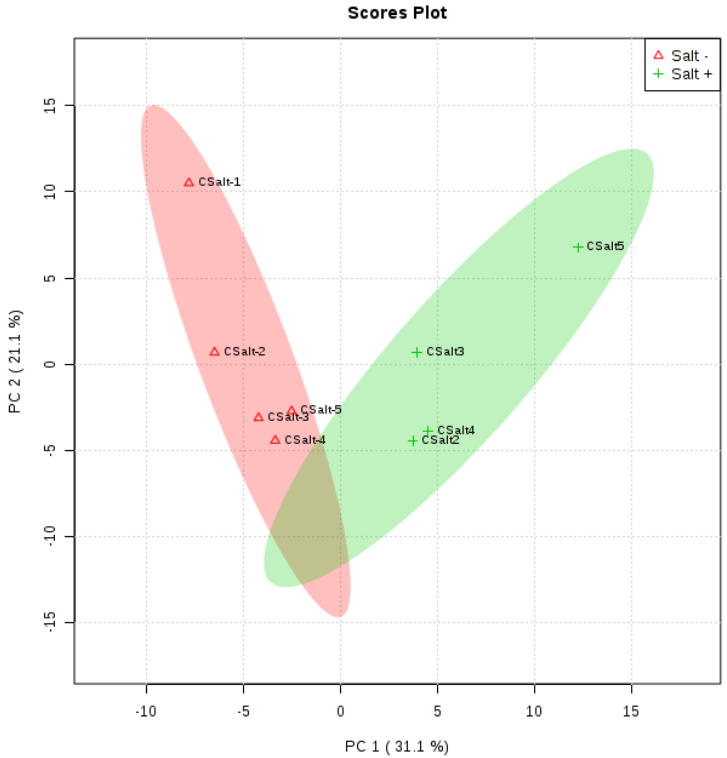

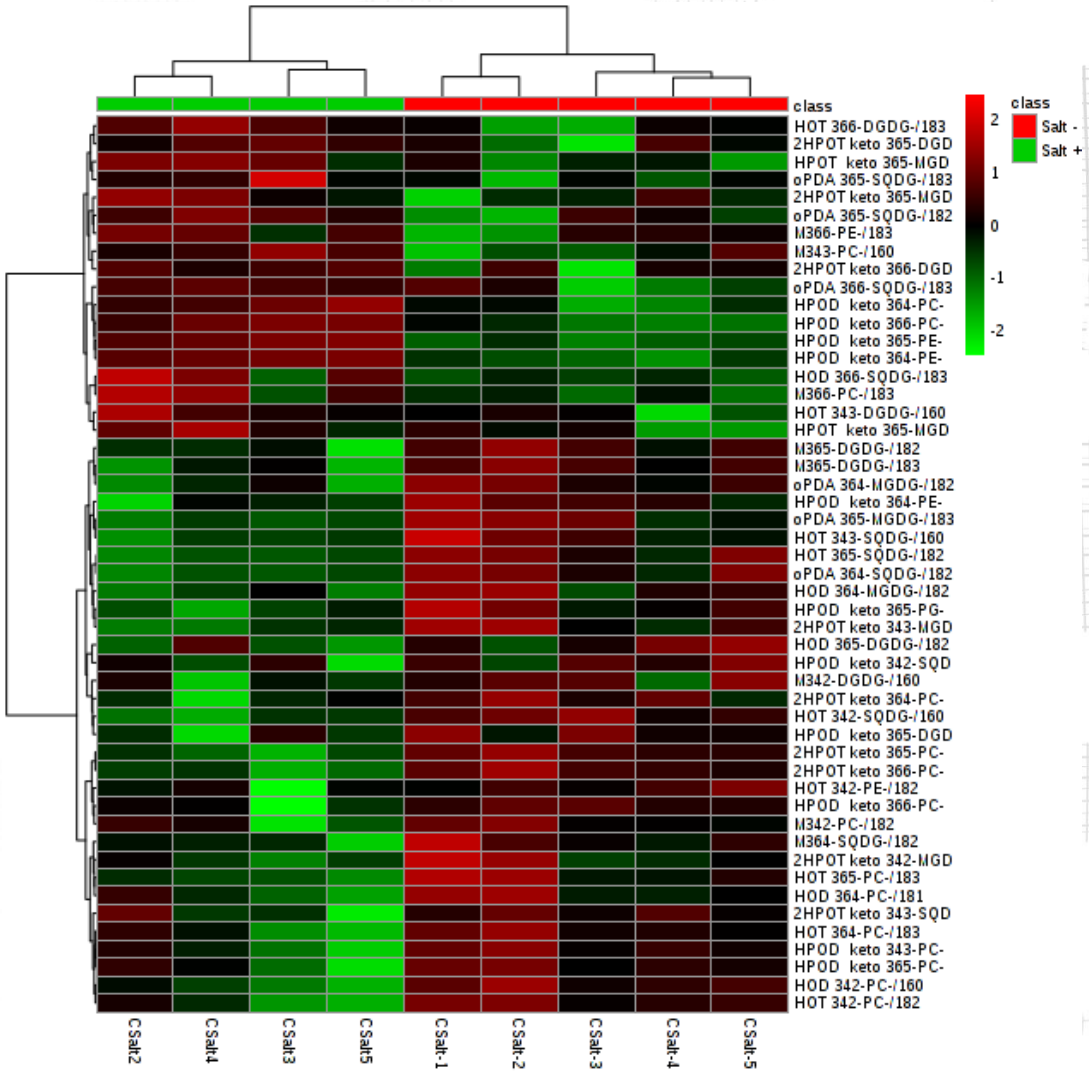

PCA & heat map for the targeted oxidised lipid data

Oxidized lipid analysis in salt treated Barley roots (Clipper- tolerant to salt stress)

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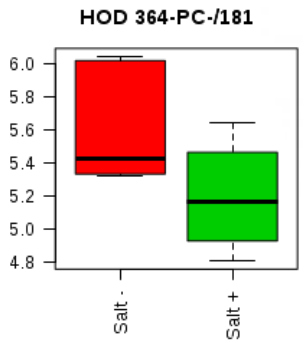
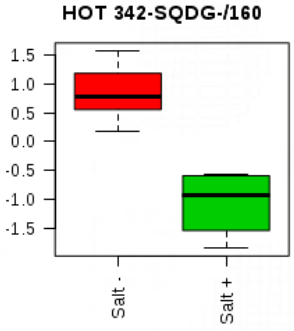
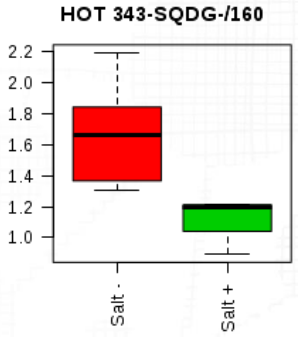
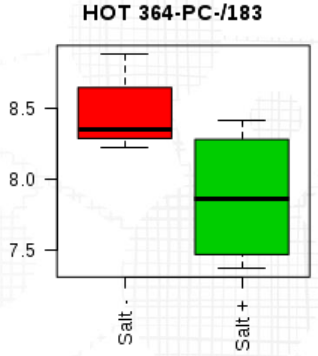
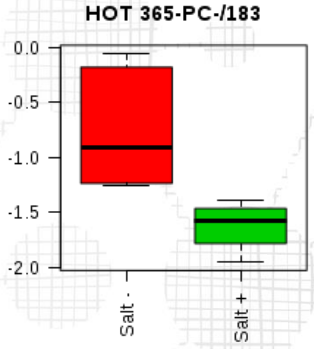
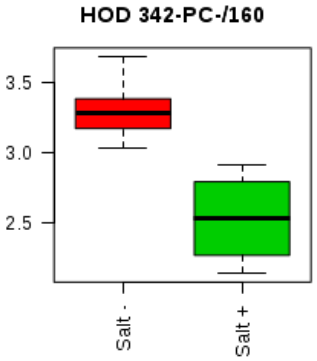


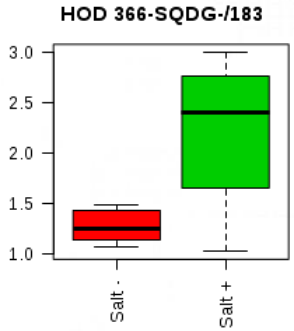


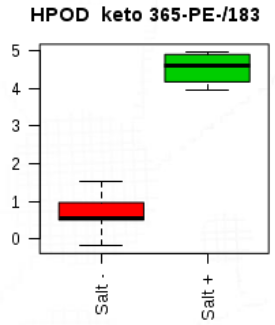


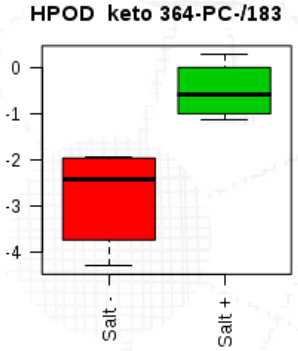


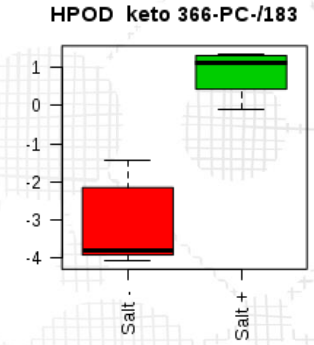


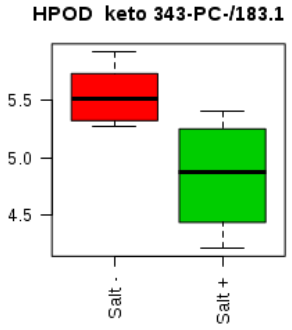


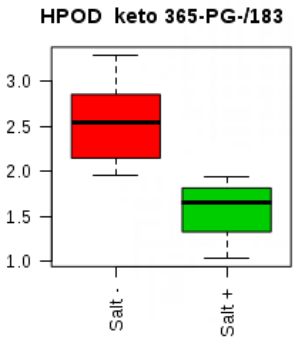


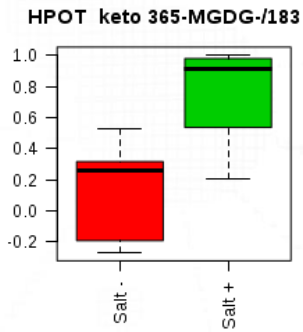


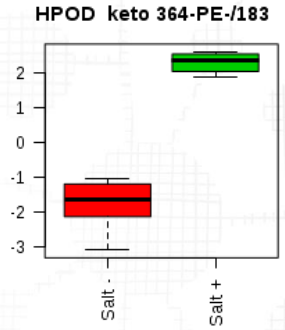


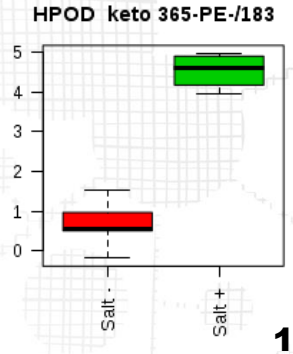






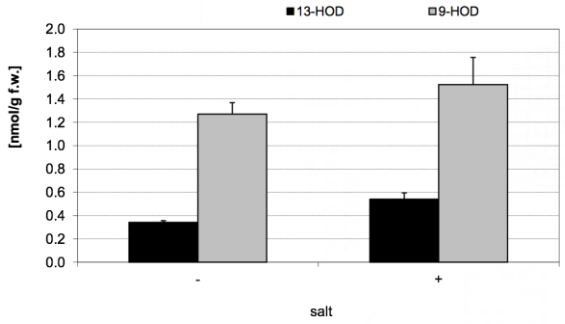


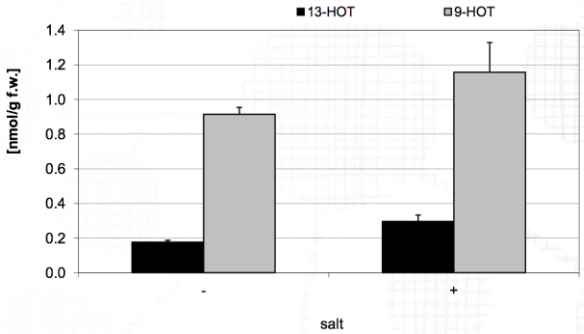


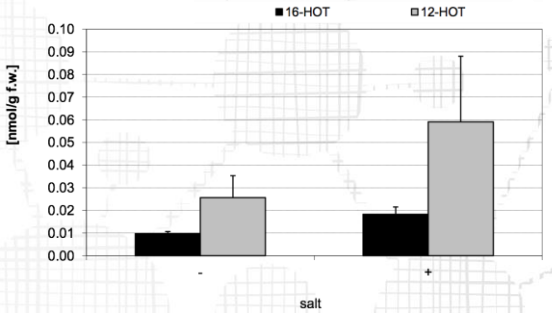


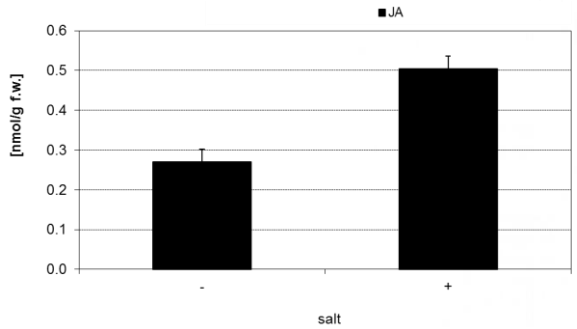
Oxylipin profiles in salt treated Barley roots (Clipper- tolerant to salt stress)

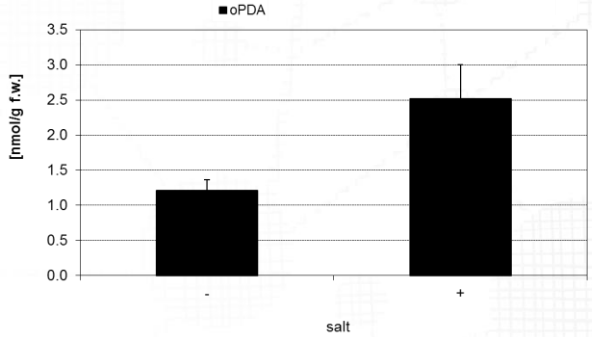
METABOLOMICS AUSTRALIA

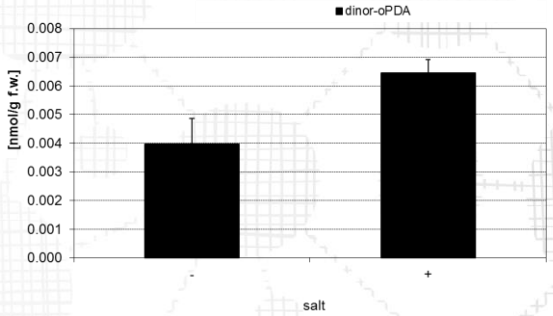


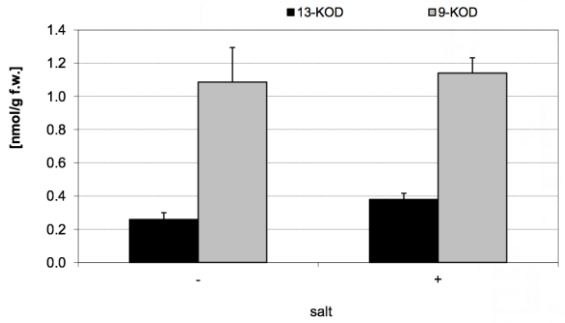


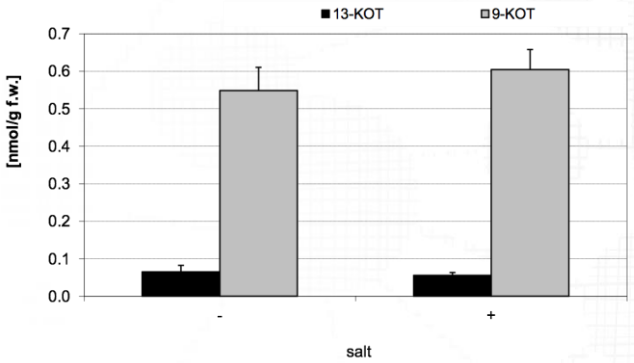








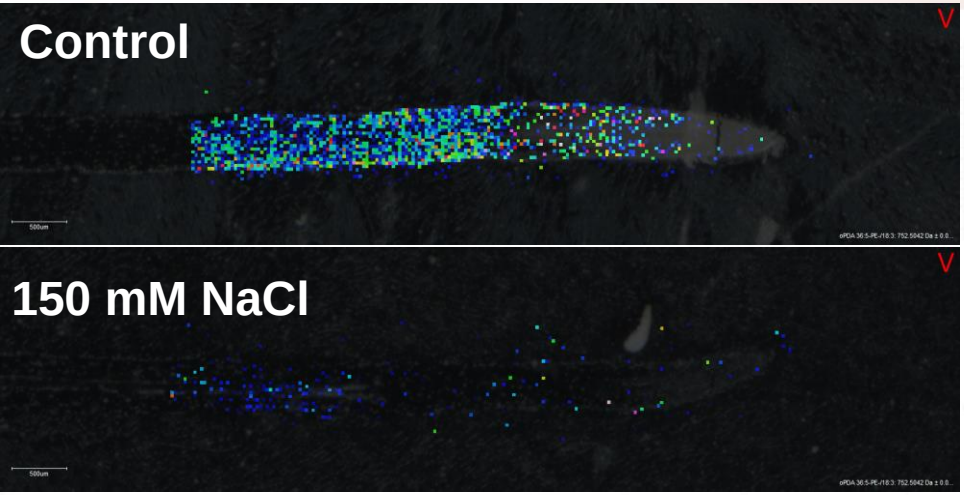




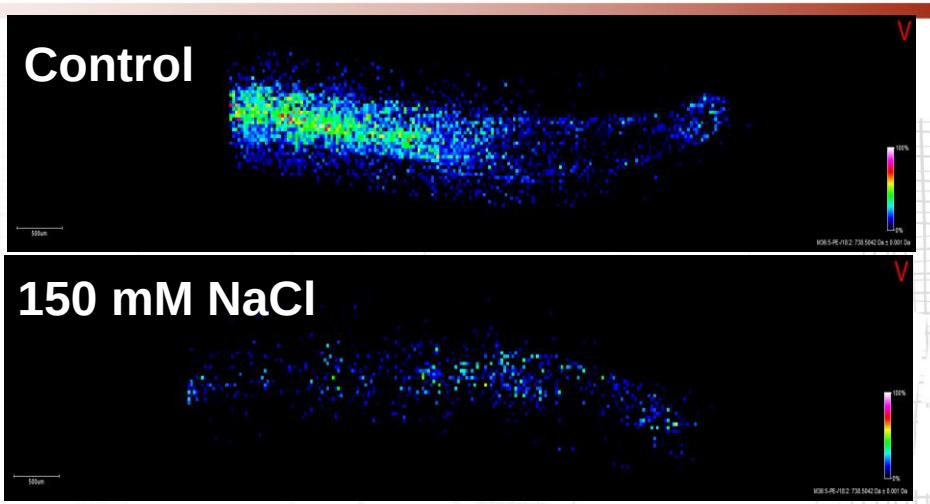
Ivo Feussner and Cornelia Herrfurth (Goettingen Uni)- Germany

Spatial distribution of lipid in salt treated Barley roots (Clipper- salt treated for 48 hours –positive mode IMS)

METABOLOMICS AUSTRALIA



OPDA PE(36:5)



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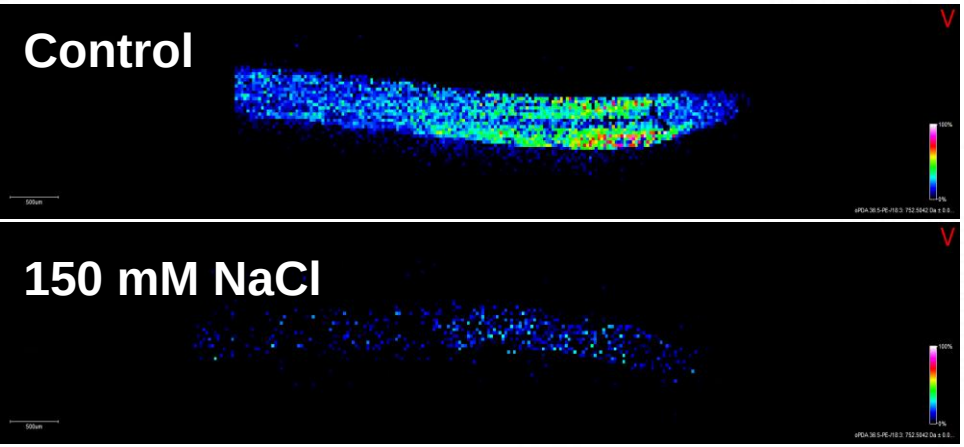

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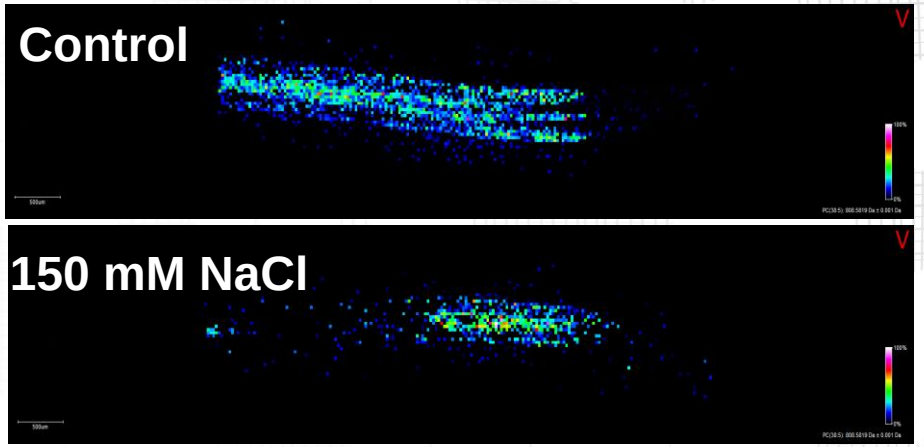
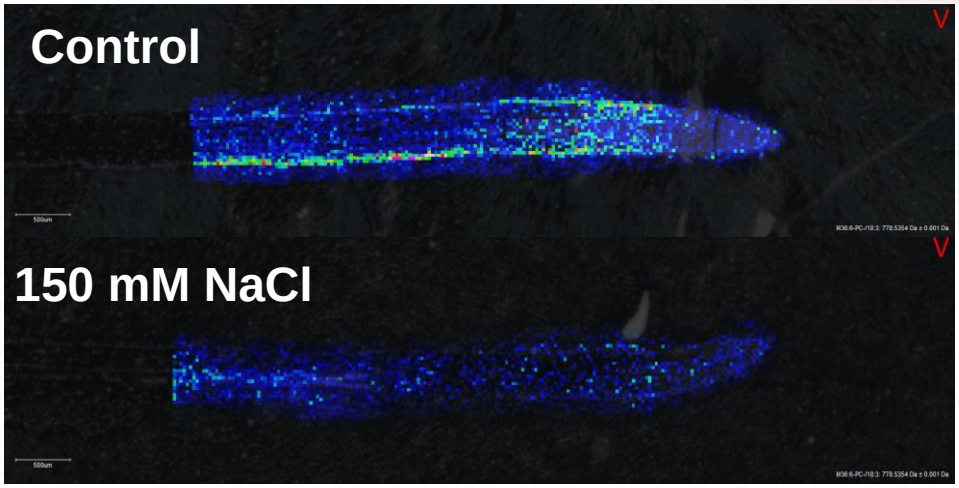


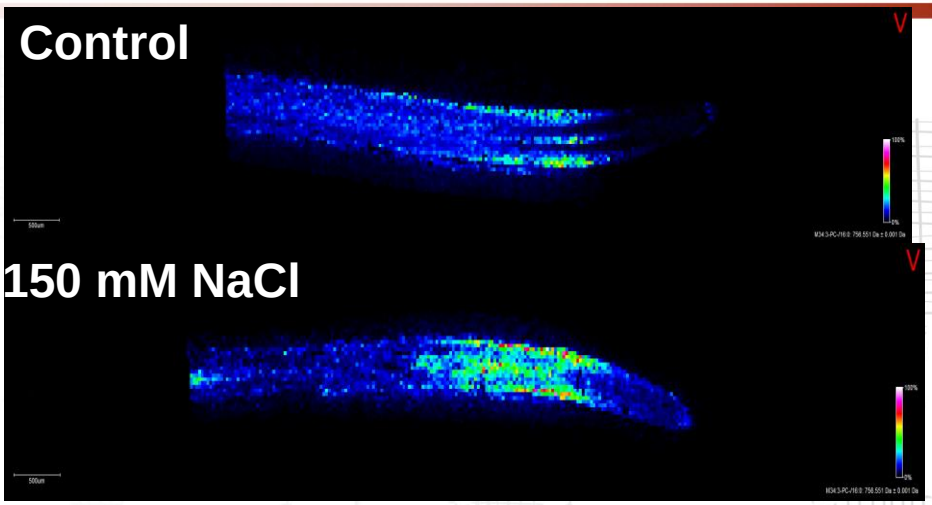
PC(38:5)

Spatial distribution of lipid in salt treated Barley roots (Clipper- salt treated for 48 hours – positive mode IMS)

METABOLOMICS AUSTRALIA



PC(36:6)



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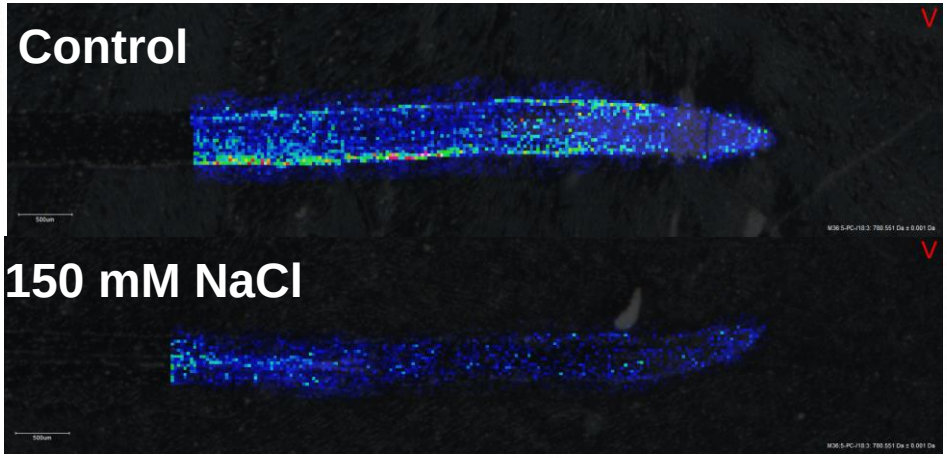

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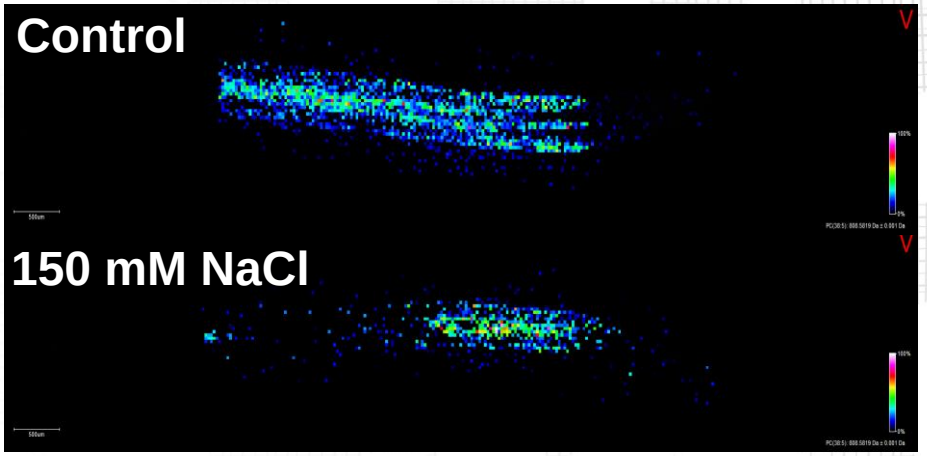

PC(38:5)

Summary

METABOLOMICS AUSTRALIA

- Lipid profile of barley roots shows significant difference between Clipper and Sahara cultivars.
- The Barley species tolerant to salt stress shows, PUFA contains PC and PE lipids and HPOD keto and HPOT keto oxidised lipids are increased and HOT and HOD oxidised lipids are decreased as response to salt stress.
- Oxidised lipids and oxylipins plays an important role of the defence mechanism against the salinity in Barley.
- Pathway mapping of oxidised lipid biosynthesis is important to investigate to understand further insight of the defence mechanism in Barely response to salt stress.

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Roessner lab

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