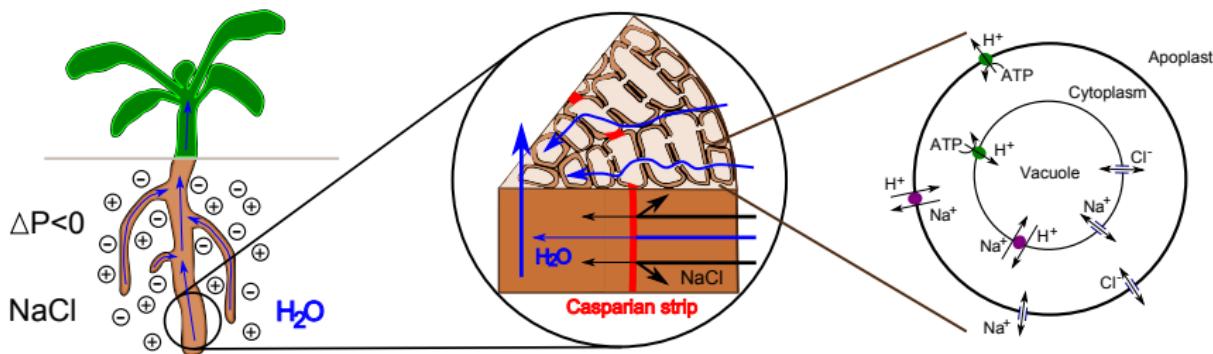


Whole-of-plant study of water and salt transport: A mathematical modelling approach

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Phenomics and
Bioinformatics
Research Centre



ACPFG
AUSTRALIAN
CENTRE FOR PLANT
FUNCTIONAL GENOMICS
PTY LTD

Australian Centre for Plant Functional Genomics



ACPFG Salt Focus Group:

- The aims of the Salt Group include:
 - Understanding salt tolerance mechanisms in Australian crop plants.
 - Using this knowledge to create varieties that can grow on saline soils.
- This requires identifying genes and transport processes involved in salinity tolerance in plants.

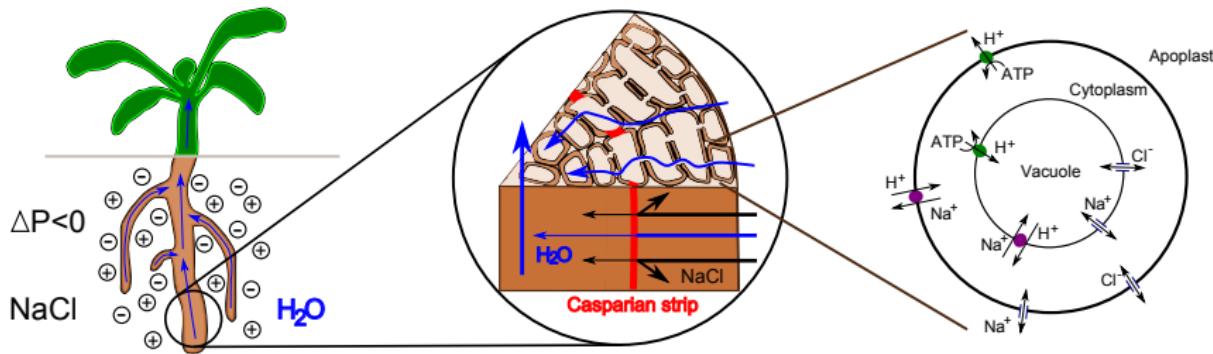


Salinity:

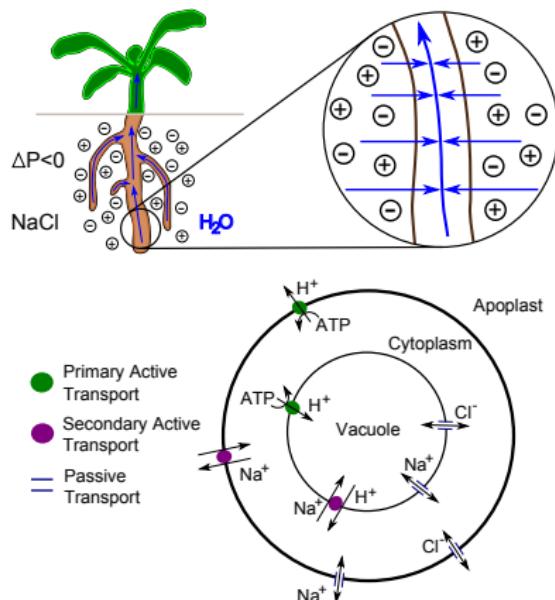
- High salinity affects **two-thirds** of Australian cereal crops.
- Estimated cost of \$200 million per year.
- Anticipated to become worse.

Whole-of-plant study of water and salt transport: A mathematical modelling approach

- Aim is to develop mathematical models of water and ion transport in plants.
- Apply these models to increase our understanding of a plant's response to salt stress.
- Focus of models: sodium (Na^+) transport.



Modelling salt transport



Root organ model

- Modelling uptake and transport of Na⁺ in plant roots
- Transport due to:
 - Electrochemical diffusion
 - Convection

Single cell model

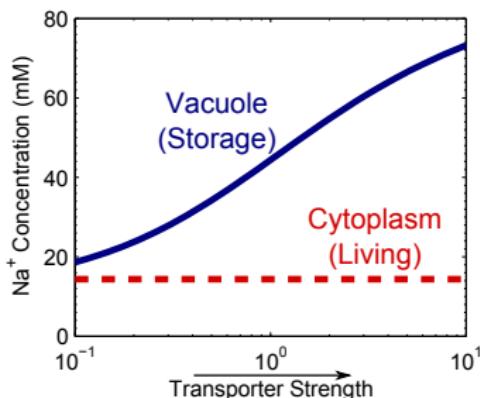
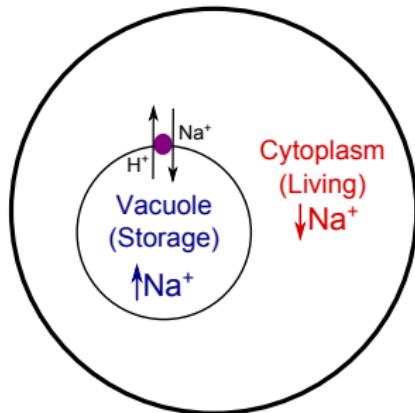
- Modelling transport of ions across plant cell membranes (via membrane transporters)

Foster & Miklavcic (2013), Journal of Theoretical Biology, v336, pp 132-143.

Foster & Miklavcic (2014) Journal of Theoretical Biology, v340, pp 1-10.

Foster & Miklavcic (2015) Journal of Theoretical Biology, Submitted

Example: Modelling salt transport in a single cell



- Biologists have identified a membrane transporter (●) that is involved in salinity tolerance.
- This membrane transporter may improve salinity tolerance by:
 1. Decreasing the level of Na^+ in the living cytoplasm, and/or
 2. Increasing storage of Na^+ which assists in water uptake into the cell
- Our model simulations suggest that improved salinity tolerance is achieved by the 2nd mechanism.

Industry Doctoral Training Centre

- Networking with other students
- Coursework
- Exposure to other areas of mathematics and statistics
- Applied problem
- Thank you!

