Relationsship between transpiration, ion uptake and distribution in salt stressed irrigated rice

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Background and Objectives

Controlling uptake and distribution of sodium is a major trait for salt resistance in rice.

For both, B and Na, transpiration is thought to be the main driving force of distribution within the plant. Both elements should thus accumulate in transpiring plant parts, contrasting to the distribution of the phloem mobile K.

It was the objective of this study to determine:

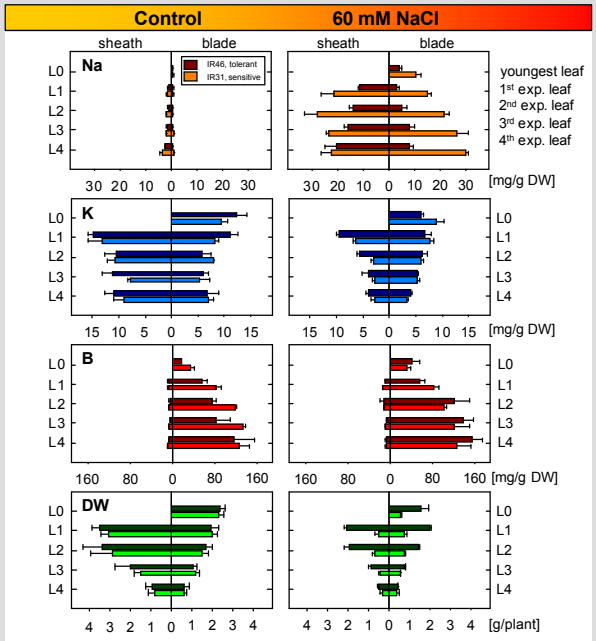
- whether B distribution can be used as indicator for transpiration driven ion distribution
- whether the Na content of leaf blades is indicative of transpirational history

Conclusions

- **B is an indicator for the transpirational history of individual rice leaf blades**
- **Rice has a mechanism to immobilize Na in leaf sheath tissue, which delays Na accumulation in leaf blades**
- **The ability to immobilize a large share of Na in leaf sheaths is genotype specific and represents a trait for salinity resistance**
- **Relative Na accumulation in leaf sheaths was lower in a high transpiring genotype, suggesting an influence of the speed of xylem sap movement**

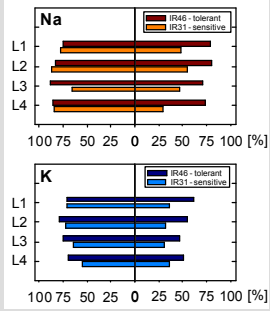
Results

I. Ion concentrations and dry weight at final sampling



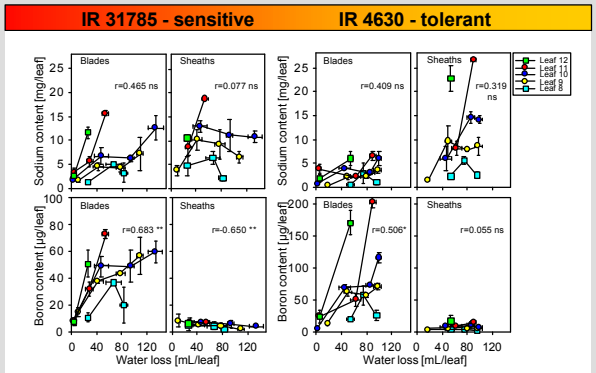
- B and Na concentrations increased from emerging leaf to lower leaf positions, contrary to K
- B accumulated only in transpiring leaf blades, but not in leaf sheaths
- Contrary, Na concentrations were similar or higher in leaf sheaths compared to blades
- High salt decreased K and increased Na concentrations especially in leaf sheaths

II. Share of Na and K in leaf sheaths



- High salt decreased the share of Na in leaf sheaths of the sensitive, but not of the tolerant cultivar
- The tolerant cultivar also maintained a larger share of K in leaf sheaths

III. Relation between water loss and ion content of individual leaves

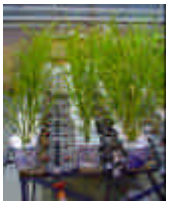


- B content correlated with the water loss of individual leaf blades
- Na content did not correlate with water loss of individual leaf blades

Materials and Methods

Growth conditions:

- Rice cultivars:
  IR 4630-22-2 salt (tolerant, low transpiring)
  IR 31785-58-1-2-3-3 (salt sensitive, high transp.)
- hydroponics for 80 days in greenhouse
- salinity levels: 0 and 60 mM NaCl (induced after 40 d)



Measurements:

- transpiration rates and leaf areas of individual intact leaves in 10d intervals
- elemental analysis of leaf sheaths and blades, by leaf position, in 10 d intervals
- Na and K: flame photometry
- B: miniaturized curcumine method

Sampling scheme:

- each individual leaf corresponded to a known leaf position at each sampling date