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Boron Distribution Shows Sodium Distribution in Rice Leaves to be Independent of Transpiration

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Abstract

Rice grown under saline conditions takes up sodium relative to its water use. Earlier work found higher concentrations of sodium in the stem tissues than in the leaves, although the leaf sodium load was thought to be correlated with transpirational water loss. Since the stems are bulk leaf sheaths, the question remained if we observed an artefact or a preferential retention of sodium in the leaf sheaths. Sodium, like boron, is translocated acropetal with the transpiration stream and should, just like B, which is not phloem mobile in rice, accumulate at the end points of transpiration i.e. in the leaf blades. In a hydroponic system, two lowland rice genotypes were subjected to two levels of salinity (0 and 60 mmol). Four times, in intervals of ten days leaves were sampled in the order of appearance, separated in blades and sheaths, and analyses for Na and B content. Cumulative transpirational water losses were calculated for individual leaves based on leaf area and transpiration measurements. Genotypes differed in sodium and boron uptake as well as water loss. In all cases total Na and B content was linearly correlated with water loss. B accumulated almost exclusively in the leaf blades, whereas Na accumulated preferentially in the leaf sheaths resulting in low Na contents in the leaf blades of the tolerant genotype and a 50 % share of Na in the leaf blades of the sensitive genotype. Retaining large shares of the Na taken up in the leaf sheaths is an important tolerance mechanism as it protects photosynthetically active leaves blades from salinity damage. In rice, B distribution can be used to determine the amount of water loss and the site at which it occurs.

Keywords: Boron, distribution and uptake, leaf development, potassium, rice, salinity, sodium, transpiration, water loss

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