# No Escape: The Influence of Substrate Sodium on Plant Growth and Tissue Sodium Responses

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## Abstract

As an essential micronutrient for many organisms, sodium plays an important role in ecological and evolutionary dynamics. Although plants mediate trophic fluxes of sodium, from substrates to higher trophic levels, we know relatively little about plants' comparative growth and sodium accumulation responses to variation in substrate sodium. We carried out a systematic review to examine how plants respond to variation in substrate sodium concentrations. We compared growth and tissue-sodium responses among 107 populations (67 species in 20 plant families), broadly expanding beyond the agricultural and model taxa for which several generalizations previously have been made. We hypothesized a priori response models for each population's growth and sodium accumulation responses as a function of increasing substrate NaCl. We used BIC to choose the best model. Additionally, using a phylogenetic signal analysis, we tested for phylogenetic patterning of growth and sodium accumulation responses across plant taxa. The influence of substrate sodium on growth differed across taxa, with most populations experiencing detrimental effects at high concentrations. Irrespective of growth response, tissue concentrations of sodium for most taxa increased as sodium concentrations in the substrate increased. We found no strong associations between growth and types of sodium accumulation responses across taxa. Our phylogenetic signal analyses found that evolutionary history helps predict the distribution of total plant growth responses across the phylogeny, but not sodium accumulation responses. Our study suggests that saltier plants in saltier soils may prove to be a broadly general pattern for sodium across plant taxa. Regardless of growth responses, sodium accumulation mostly followed an increasing trend and did not have any evident association with growth responses as substrate sodium levels increased. Finally, plant adaptations to substrate sodium vary with a degree of phylogenetic conservatism.

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