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"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

The role of ionic and osmotic stress on the response of rice to salinity stress

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Abstract

More than half of the world's population rely on rice (*Oryza sativa* L.) as an essential daily staple. Despite growing demand, agricultural land in key rice producing areas is being degraded due to a combination of urbanization, soil salinization, and erosion. Soil salinization is typically the result of poor agricultural practice in arid areas. However, increasingly it is also a problem in some of the world's wettest regions due to sea level rise. This threatens rice production, as rice is a highly salt-susceptible crop. Salinity stress relates to two processes, an initial osmotic shock that leads to reduced water uptake by the roots, followed by a toxic accumulation of ions within the plant. The effect of the separate phases on rice plant growth remains unexplored and may even differ significantly between rice varieties. As a result, the determination of the respective contributions of ionic and osmotic phases to the overall effect of salinity could provide greater insight into mechanisms underlying salinity tolerance. Our objective was to differentiate and measure the osmotic and ionic components of salinity using polyethylene glycol-6000 (PEG) and NaCl treatments of different severities in a greenhouse experiment conducted at the University of Hohenheim. We used three rice varieties (IR4630, IR31785, IR64), each with strongly contrasting salt tolerance mechanisms, and subjected them during their vegetative stage to different levels of salinity and osmotic stress. Biomass, leaf area, SPAD, PRI, ion content (Na^+, Cl^-, K^+) on a plant and organ level, leaf relative water content, leaf turgor, photosynthesis, and transpiration at a leaf and canopy level were measured after one and then two weeks of salinity and osmotic stress. The comparison of osmotic to salinity treatments, which were osmotically equivalent, will indicate the extent of the contribution of osmotic and ionic components to salinity stress and allow us to identify the aspects of plant growth on which either one has the greatest influence. The potential effect of variety will also be shown.

Keywords: Ionic vs. osmotic stress, rice, salinity stress

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