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“Development on the margin”

## Effects of Salt Stress in Rice Assessed by SPAD and a Hyperspectral Sensor

KAI SCHMIDT, CHRISTINE KREYE

*University of Bonn, Institute of Crop Science and Resource Conservation (INRES), Germany*

### Abstract

Abiotic and biotic stresses are perceived to increasingly constrain plant production. Screening methods that allow for early detection and discrimination of stresses may lead to better crop management or intervention strategies. Here, we tested the sensitivity of SPAD and non-imaging spectroradiometer measurements towards early symptoms of salt stress in rice. Salt stress (NaCl) of about  $6 \text{ dSm}^{-1}$  was induced to four weeks old rice plants (IR 64). For ten days, stressed and non-stressed control plants were monitored with both, a SPAD metre and a non-imaging spectroradiometer with contact probe and integrated light source. Measurements were taken on the two youngest fully developed leaves at daily intervals. SPAD measurements of salt stressed plants tended to be higher than of control plants; thus pointing at a higher chlorophyll concentration per unit leaf area. Also, the complete emergence of the latest fully developed leaf tended to be later in the salt stressed plants. The analysis of the hyperspectral signatures, hence the diagnosis of salt stress has been done by a two step procedure: In the first step a double Weibull model was fitted to the trajectories of the hyperspectral signatures, taken from stressed and unstressed plants. In the second step the resulting parameter vectors were analysed by a discriminant analysis. The combination of two statistical procedures contains a high discriminatory power and was suitable for a significant salt stress classification five days after stress application. Stress symptoms became more obvious in statistical terms as time increased. With respect to the treatment effect the resulting trajectories were significantly different in the small range of the red edge inflection point (REIP), salt stress induced a “red-edge shift”. In how far this significant difference determines one specific key parameter for salt stress, and if this parameter is dependant or independent of the simultaneously observed SPAD values still requires further research.

**Keywords:** Abiotic stress, discriminant analysis, hyperspectral signature, non-imaging spectroradiometer, Weibull model