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N Diagnosis in Rice Leaves by Photochemical Reflectance Index and Spad

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Abstract

Plants are often subjected to abiotic stresses. Of these stressors, nitrogen deficiency is important in many natural vegetations and agricultural production systems. In order to apply the appropriate amount of N fertiliser, the Chlorophyll Meter (SPAD) is widely used as an N diagnosis tool in crops. An alternative approach of non-destructive measurements is the photochemical reflectance index (PRI), a normalised difference index using two narrow reflectance bands at wavelength of 531 nm and 570 nm. This study focused on the comparison of measurements with the PlantPen PRI-200 handheld PRI device, the Minolta SPAD-502 chlorophyll meter, and chlorophyll fluorescence and gas exchange parameters using the GFS-3000 (Heinz Walz GmbH, Germany).

Cold-tolerant rice cultivar Chhomrong was grown in a hydroponic systems using Yoshida nutrient solution of pH 5.5 with different N levels (0.18, 0.36, 0.71, 1.43, 2.86, 4.28, 5.71 mM N) in a greenhouse at the University of Hohenheim, Germany from August 2009 to October 2009. After 41 and 57 days in Yoshida solution, fully developed youngest leaves were measured and harvested. SPAD and PRI values reflected the leaf N status, with SPAD and PRI values ranging between 29 and 46 and 0.08 and 1.14, respectively. Both diagnosis tools proved to be reliable indicators of severe nitrogen deficiency. Gas exchange measurements indicated that non-photochemical quenching parameters were significantly affected by N levels and PRI values were negatively correlated with NPQ. Light-saturated CO_2 assimilation rates and maximal carboxylation rates were positively correlates with N-supply. It is concluded that PRI and SPAD can be used to predict the leaf N status, however SPAD readings failed to indicate early symptoms of N deficiency. The PRI may be better suited in this regard.

Keywords: Chlorophyll, non-photochemical quenching, photochemical reflectance index, rice

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