

Diagnosis of Rice Leaf N Status by Photochemical Reflectance Index (PRI) and Chlorophyll Index (SPAD)



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Introduction

Simple handheld devices to measure chlorophyll index (SPAD) and photochemical reflectance index (PRI) at leaf level are used for non-destructive and rapid diagnosis of crop N status (abiotic stresses). This N status is closely related to leaf performance in terms of CO₂ assimilation rate and the consumption of electrons during the photosynthetic dark-reactions. PRI values have been shown to be correlated with the PSII photochemical efficiency. Low N supply is expected to decrease photochemical quenching and to increase the energy dissipation as indicated by changes in PRI values under variable N supply. In this study we analyzed the relationship between PRI, SPAD and NPQ (non-photochemical quenching related to thermal energy dissipation) values of rice plants grown under different N levels.



Conclusions

- SPAD is a better indicator of leaf N status than PRI (Fig 1).
- NPQ correlates negatively with SPAD and PRI values (Fig 2).
- Changes in NPQ at high N levels are not reflected in corresponding changes in SPAD and PRI (Fig 2).

Results and Discussion

Fig 1. Relationship between PRI, SPAD and N supply

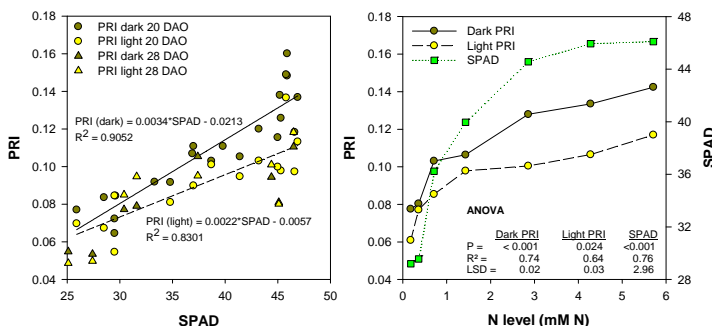
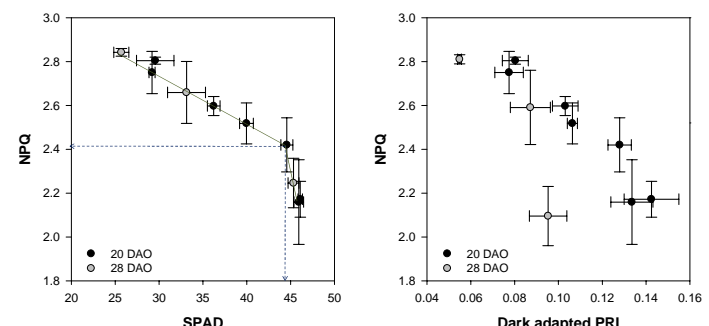


Fig 2. Relationship between NPQ, SPAD and PRI



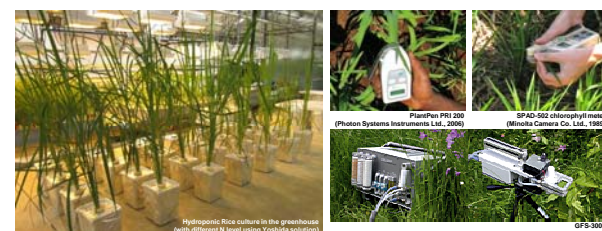
- Dark- and light-adapted PRI values and SPAD values increased with increasing N supply.
 - N effects on epoxidation of xanthophyll cycle and chlorophyll pigments content.
- Dark adapted PRI values are higher than light adapted PRI values.
 - Light induced de-epoxidation of xanthophyll cycle pigments.

- NPQ increased with decreasing SPAD and PRI values.
 - Lower leaf N induces higher energy dissipation as heat.
- PRI values reflected NPQ 20 DAO but not 28 DAO.
 - Remains unexplained at the moment.
 - Does PRI depends on leaf structure, leaf position, leaf age, leaf optical properties, and position of source light ?

❖ DAO (days after onset of treatments)

Materials and Methods

- Rice variety Chhomrong was cultured in a hydroponic system using Yoshida solution.
- Plants were supplied with seven N levels (0.18, 0.36, 0.71, 1.43, 2.86, 4.28, 5.71 mM N) replicated three times in 1 liter pots, maintained at pH 5 to 5.5.
- Air temperature (35 C / 20 C day/night), relative humidity (30% / 75% day/night), light intensity at least 400 μmol m⁻² s⁻¹ PPFD and photoperiod of 12 hr (8:00 hr – 20:00 hr).
- SPAD-502 chlorophyll meter, PlantPen model PRI 200 and GFS-3000 were used to take measurements 20 and 28 days after onset of N treatments (DAO).



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