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[TOP](#) > [Available Issues](#) > [Table of Contents](#) > [Abstract](#)

ONLINE ISSN : 1881-4212

PRINT ISSN : 0915-499X

Bulletin of the Institute of Tropical Agriculture, Kyushu University

Vol. 29 (2006) , No. 1 pp.39-53

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Is the parameter electron transport rate useful as a predictor of photosynthetic carbon assimilation rate?

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Abstract: We compared the photosynthetic carbon assimilation rate (A) and the simultaneously measured electron transport rate (ETR) through photosystem II in order to examine the reliability of the A estimation method based on the ETR values and A -ETR relationships under field conditions. We first compared the ETR with the A values, which were calculated using biochemical models, under different temperature conditions typical in August, November and February. We established the regression lines of A with ETR values at reference conditions (mean leaf temperature and leaf intercellular CO_2 partial pressure, C_i in each season). When leaf temperatures and C_i changed from the reference conditions according to diurnal changes in the environment, the relationship between A and ETR changed from the regression lines, but the error of the estimated A values was modest in each season's biochemical calculations. The correlation of A with the ETR values derived from the data in the field measurements was, however, too weak to precisely regress the A values based on the ETR values. This weak correlation would be due to the low leaf internal conductance in the measured leaves and large differences in physiological traits, such as temperature dependence, among the leaves. Thus, we concluded that in a field with spatially and temporally heterogeneous environmental conditions, A estimation based on the ETR values would be difficult.

Keywords: Electron transport rate, photosynthetic carbon assimilation rates, estimated A value, biochemical model, field-measured A -ETR relation

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To cite this article:

Yoshiyuki Miyazawa and Hisashi Yahata 2006 Is the parameter electron transport rate useful as a predictor of photosynthetic carbon assimilation rate? . *Bull. Inst. Trop. Agr., Kyushu Univ.* **29**: 39-53 .

JOI JST.JSTAGE/bit/29.39

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