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Radiation Interception and Use Efficiency of Two Rice Cultivars 'Dasan' and 'Hwasung' under Different N Levels

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질소시용량에 따른 다산벼와 화성벼의 광차단 및 이용효율 변화

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Objectives

The radiation use efficiency(RUE) is a parameter that represents the ability of a crop canopy to convert intercepted solar radiation to dry matter. The radiation use efficiency (RUE) is often a crucial component of crop growth models and can vary with crop type and environment. The objectives of this experiment were to determine the radiation interception and use efficiency for two types of rice cultivar, Tongil type of 'Dasan' and Japonica type of 'Hwasung' and examine the changes of RUE with nitrogen fertilization rate.

Materials and Methods

The two rice cultivars, 'Dasan' and 'Hwasung' were transplanted(25-day old seedlings) at hill spacing of 30×15cm on 19 May, 2000. Nitrogen fertilization levels were 12, 24, and 36kg N/10a. The incoming global solar radiation and photosynthetically active radiation(PAR) and the PAR transmitted through the canopy were measured at an interval of 10-minute throughout the rice growing season with data logger(Campbell inc., Model CR10). Dry matter weight and leaf area index were measured periodically. The extinction coefficient(K), intercepted PAR, and transmittance(τ) were calculated with the following equations:

$$K = -\frac{\text{LN}(\text{PAR}_b/\text{PAR}_0)}{\text{LAI}}$$

$$\tau = \exp(-K \cdot \text{LAI})$$

$$\text{PAR}_{\text{int}} = (1 - \tau)\text{PAR}_0$$

Where LAI is leaf area index(m² leaf m⁻² ground), PAR₀ is the daily total incident PAR flux and PAR_b is the daily total PAR flux which reaches the soil.

Results and Discussion

- ◇ Until the maximum tillering stage the K values were increased with rice growing, being higher in 'Hwasung' than 'Dasan'. From maximum tillering stage to heading the K values for the two cultivars were constant at about 0.4 and after heading the K-values increased abruptly, being much higher in 'Hwasung' than 'Dasan'.
- ◇ The intercepted PAR's showed no significant difference between the two cultivars and

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reached about 90% at heading in the plot of 12kg N/10a.

◊ RUE values for 'Dasan' were 2.39, 2.43 and 2.84g/MJ of intercepted PAR for 12kg N, 24kg N, and 36kg N/10a fertilization rate, respectively. The respective RUE's for 'Hwasung' were 2.48, 2.47 and 2.55g/MJ.

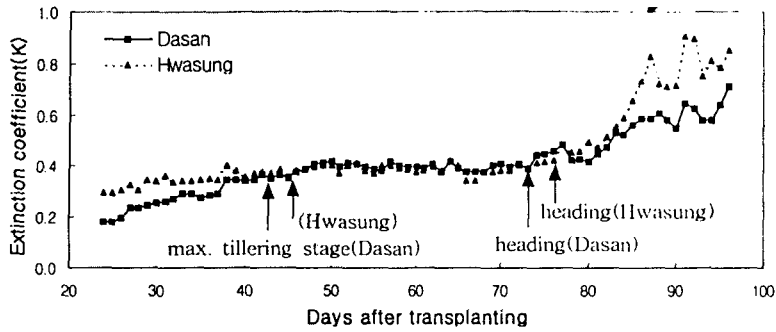


Fig. 1. The temporal changes of K values for two cultivars 'Dasan' and 'Hwasung' during rice growing season under 12kg N/10a fertilization.

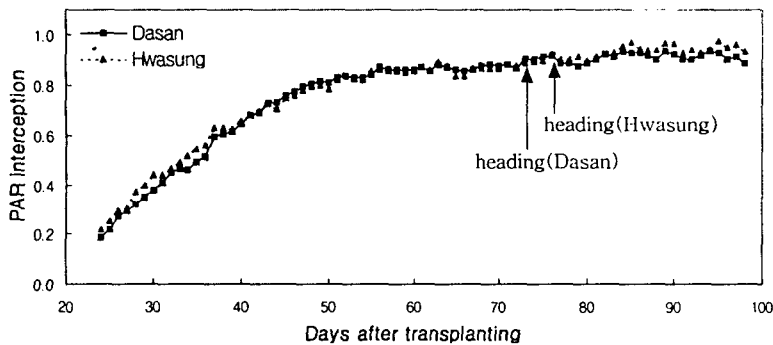


Fig. 2. The temporal changes of PAR interception during rice growing season under 12kg N/10a fertilization.

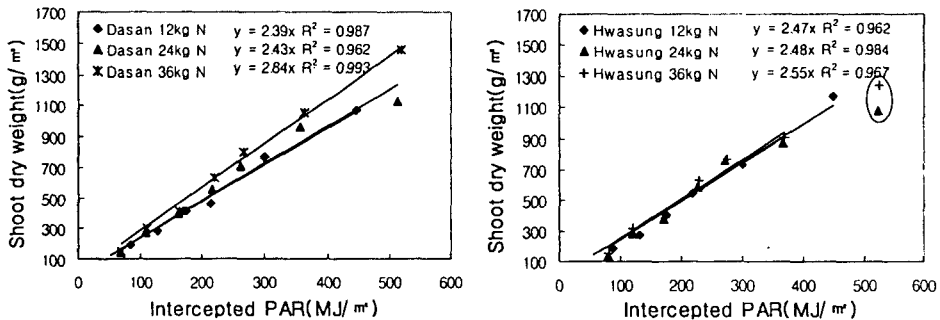


Fig. 3. The relationship between the cumulative PAR intercepted by canopy and the shoot dry weight of two rice cultivars 'Dasan'(left) and 'Hwasung'(right).