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03h. Plant and crop physiology and crop modelling

RESPIRATION SENSITIVITY TO NIGHT TEMPERATURE AND INCOMING LIGHT INTENSITY IN RICE AND ITS IMPACT ON BIOMASS PRODUCTION

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Purpose:
Performance of irrigated rice in the tropics is questioned under future climate change scenarii, mostly due to the projected increase in temperature. Peng et al. (2004) reported a stronger correlation of the reduction in yield with the increase in night temperature than with the reduction in radiation over a series of 12 dry season crops in the tropics. The objectives of this study were to (i) quantify the sensitivity of respiration to night temperature and light intensity and (ii) evaluate whether any variation of respiration would have a significant impact on overall biomass.

Approach and methods used:
Data were collected on two tropical genotypes contrasted in their ability to produce biomass (cv. N22 and one indica hybrid) grown in the greenhouse (Cirad, Montpellier) and in the field (IRRI, Philippines). To minimize risk of gas leakage and increase the stability of the CO_2 signal, leaf respiration was measured with a large (up to 140 cm² of sampling area, GFS-3000, Walz) rather than a small (6 cm^2 of sampling area, Li 6400, LiCor) cuvette. The range of measured leaf respiration was confirmed as consistent when compared to that measured with a homemade system working at the whole plant level.

Key results:
The increase in night temperature per se, from 21 to 26°C in a greenhouse during the whole crop cycle, was the driver of an average increase in respiration of 17 to 31 % for N22 and hybrid, respectively. In contrast, a reduction of 90 % of incoming light during the day preceding the night of measurement induced a reduction in respiration of 51 to 56 %, for N22 and hybrid, respectively. Furthermore, the temperature response curve of respiration increased linearly with its slope modulated by the quantity of incoming light received the previous day, but was not affected by plant acclimation to temperature.

Synthesis and Applications:
The cost of respiration in terms of cumulated biomass over the whole crop cycle was evaluated to 10 to 20 % of the total biomass, with a negligible effect of the increase of temperature which questions the hypothetical role of respiration in the yield reduction reported by Peng et al. (2004).