

Triose Phosphate Utilisation at the (Sub)Foliar Scale Is Modulated by Whole-plant Source-sink Ratios and Nitrogen Budgets in Rice

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Abstract : The triose phosphate utilisation (TPU) limitation to leaf photosynthesis is a biochemical process concerning the sub-foliar carbon sink-source (im)balance, in which photorespiration-associated amino acids exports provide an additional outlet for carbon and increases leaf photosynthetic rate. However, whether this process is regulated by whole-plant sink-source relations and nitrogen budgets remains unclear. We address this question by model analyses of gas-exchange data measured on leaves at three growth stages of rice plants grown at two-nitrogen levels, where three means (leaf-colour modification, adaxial vs abaxial measurements, and panicle pruning) were explored to alter source-sink ratios. Higher specific leaf nitrogen (SLN) resulted in higher rates of TPU and also led to the TPU limitation occurring at a lower intercellular CO₂ concentration. Photorespiratory nitrogen assimilation was greater in higher-nitrogen leaves but became smaller in cases associated with yellower-leaf modification, abaxial measurement, or panicle pruning. The feedback inhibition of panicle pruning on rates of TPU was not always observed because panicle pruning blocked nitrogen remobilisation from leaves to grains, and the increased SLN masked the feedback inhibition. The (sub)foliar TPU limitation can be modulated by whole-plant source-sink ratios and nitrogen budgets during rice grain filling, suggesting a close link between sub-foliar and whole-plant sink limitations.

Keywords : triose phosphate utilization, sink limitation, panicle pruning, oryza sativa

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