

Functional Plant Biology

Contents

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Review: Evolution along the crassulacean acid metabolism continuum

Katia Silvera, Kurt M. Neubig, W. Mark Whitten, Norris H. Williams, Klaus Winter and John C. Cushman

995–1010

Crassulacean acid metabolism (CAM), a specialized mode of photosynthetic assimilation of atmospheric CO₂ that improves water use efficiency, is present in close to 6% of vascular plant species. This review discusses the requirements and drivers of CAM evolution, summarises the currently known prevalence and taxonomic distribution of CAM among vascular plants, and explores the molecular genetic basis of CAM evolution.

Review: Cryo-scanning electron microscopy (CSEM) in the advancement of functional plant biology: energy dispersive X-ray microanalysis (CEDX) applications

Margaret E. McCully, Martin J. Canny, Cheng X. Huang, Celia Miller and Frank Brink

1011–1040

The location and quantification of cell- and tissue-specific elements in undisturbed functioning plants by cryo-analytical SEM reveal complexities of function not found before. New insights and potential future investigations are documented for plant management of salt uptake, toxic elements, phosphate and silicon distribution, and biomineralisation. Requirements for reliable quantification are included.

Examination of pre-industrial and future [CO₂] reveals the temperature-dependent CO₂ sensitivity of light energy partitioning at PSII in eucalypts

Barry A. Logan, Carolyn R. Hricko, James D. Lewis, Oula Ghannoum, Nathan G. Phillips, Renee Smith, Jann P. Conroy and David T. Tissue

1041–1049

In response to increasing growth [CO₂] and temperature, *Eucalyptus saligna* and *E. sideroxylon* meet increased demands for the products of electron transport via adjustments in light energy partitioning – not through acclimation of the capacity for photosynthetic electron transport or light absorption – with compensatory adjustments in levels of photoprotective energy dissipation.

Photosynthesis and water-use efficiency of seedlings from northern Australian monsoon forest, savanna and swamp habitats grown in a common garden

Kim A. Orchard, Lucas A. Cernusak and Lindsay B. Hutley

1050–1060

Islands of monsoon rainforest and *Melaleuca* swamp punctuate vast tracts of savanna in monsoonal northern Australia. We grew seedlings of species from each of these habitats in a common garden. Monsoon forest species displayed leaf traits geared toward shade tolerance, whereas swamp species favoured a strategy of high transpiration and low water-use efficiency.

Shoot architecture, growth and development dynamics of *Vitis vinifera* cv. Semillon vines grown in an irrigated vineyard with and without shade covering

Dennis H. Greer, Chris Weston and Mark Weedon

1061–1070

Shade covering reduces temperatures of vines in hot climates but loss of light might impact on vine growth. Our study revealed the total amount of biomass of shaded shoots declined about 20% but in proportion between leaves, stems and bunches. Shading delayed expansion of the leaves but, by way of compensation, leaves became much larger.

Cover illustration: Rossioglossum ampliatus, a strong crassulacean acid metabolism (CAM) orchid species from Panama, is being used as a model for the study of the molecular evolution of CAM within the Orchidaceae (see Silvera *et al.* pp. 995–1010). *Rossioglossum ampliatus* is commonly known as the turtle orchid and is a member of the Subtribe Oncidiinaea that grows throughout Central America, Colombia, Ecuador, Peru and Venezuela. Photo by Katia Silvera.

Ethylene production under high temperature stress causes premature leaf senescence in soybean Maduraimuthu Djanaguiraman and P. V. Vara Prasad	1071–1084	High temperature stress increased tissue ethylene production rate and triggered premature leaf senescence through enhanced production of reactive oxygen species in soybean. Application of 1-methyl cyclopropene under high temperature stress conditions delayed premature leaf senescence by enhancing antioxidant enzyme activity, resulting in increased photosynthetic rates, greater filled seed number and seed weights.
Distribution of thermogenic activity in floral tissues of <i>Nelumbo nucifera</i> Nicole M. Grant, Rebecca A. Miller, Jennifer R. Watling and Sharon A. Robinson	1085–1095	The floral tissues of <i>N. nucifera</i> (receptacle, stamens and petals) all produce heat, that is, they are thermogenic. The alternative oxidase pathway of respiration is most likely the source of this heat production and carbohydrates rather than lipids are the fuel. The significance of petal and staminal heating may be important for increased reproductive success.
Desiccation of leaves after de-submergence is one cause for intolerance to complete submergence of the rice cultivar IR 42 Timothy L. Setter, Panatda Bhekasut and Hank Greenway	1096–1104	One surprising consequence of complete submergence in rice is severe water deficits following de-submergence. Evidence is presented that water deficits are an important cause rather than result of injury for submergence intolerant cultivars. These findings help explain links between tolerance to submergence and water deficits in molecular research on rice.