

Functional Plant Biology

Contents

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Review: Stable oxygen isotope composition of plant tissue: a review

Margaret M. Barbour

83–94

Barbour has made a substantial contribution to the fields of isotope theory and biochemical physiology, for which she was awarded the New Zealand Society of Plant Biologists' Outstanding Physiologist award 2006. This paper provides a concise review of the latest mechanistic understanding of stable isotope effects that control the oxygen isotope composition of plant organic material, and describes some of the applications of measurements of oxygen isotope composition of plants.

Hypothesis: Air embolisms exsolving in the transpiration water – the effect of constrictions in the xylem pipes

Martin J. Canny, Jed P. Sparks, Cheng X. Huang and Michael L. Roderick

95–111

A hypothesis derived from Bernoulli's Theorem that air content of the xylem should decrease sharply at sunrise is confirmed in a time domain reflectometry record of the wood of *Pinus* over 125 summer days. The authors use similar reasoning to explain declining flow of water perfused through detached plant organs, and departures from Poiseuille's Law.

Contrasting responses by respiration to elevated CO₂ in intact tissue and isolated mitochondria

Dan Bruhn, Joseph T. Wiskich and Owen K. Atkin

112–117

This study addresses the question of whether elevated CO₂ concentrations directly inhibit mitochondrial respiration in plants, and advances our understanding of the regulation of mitochondrial electron transport. The authors measured the redox poise of the ubiquinone pool in mitochondria titrated with increasing concentrations of CO₂ to identify the point at which elevated CO₂ concentration inhibits respiration. They show that HCO₃⁻, rather than CO₂, inhibits cytochrome *c* oxidase, but that the effect was not translated into an inhibitory effect at the tissue level.

*Leaf anatomy, gas exchange and photosynthetic enzyme activity in *Flaveria kochiana**

Erika A. Sudderth, Riyadh M. Muhaidat, Athena D. McKown, Ferit Kocacinar and Rowan F. Sage

118–129

The eudicot genus *Flaveria* possesses species demonstrating a wide range of biochemically intermediate states between fully expressed C₃ and C₄ modes of photosynthesis, making it an important model for understanding the evolution of the C₄ pathway in eudicots. Sudderth *et al.* have characterised the photosynthetic pathway of the recently described species, *Flaveria kochiana*, and find that it is a perennial species with a highly efficient C₄ cycle.

Cover illustration: Nothofagus menziesii in Waitutu Forest, New Zealand. Stable oxygen isotopes can help determine sources of plant water and plant regulation of water loss (see Barbour, pp. 83–94). Photo by Neil Fitzgerald (<http://www.neilfitzgeraldphoto.co.nz/>).

Black coloration in leaves of *Ophiopogon planiscapus* 'Nigrescens'. Leaf optics, chromaticity, and internal light gradients

Jean-Hugues B. Hatier and Kevin S. Gould 130–138

Black-pigmented leaves rarely occur in nature. This paper compares the optical properties of black and green foliage. The authors quantify leaf pigments, enumerate leaf colour, and examine light-transmission profiles of near-isogenic black and green leaves of *Ophiopogon planiscapus*. The exceptionally dark colour is attributable to luxuriant concentrations of anthocyanins and chlorophylls. While the black pigmentation restricts transmission of green light to the upper mesophyll, it has little effect on the distribution of red and blue wavelengths within the leaf.

ASP53, a thermostable protein from *Acacia erioloba* seeds that protects target proteins against thermal denaturation

Linda Mtwisha, Jill M. Farrant, Wolf Brandt, Caswell Hlongwane and George G. Lindsey 139–149

Mtwisha *et al.* describe the purification and characterisation of a late embryogenesis abundant-like, cupin-domain-containing protein from seeds of the Camel Thorn tree (*Acacia erioloba*). This protein has some unique and interesting properties, including a high level of thermal stability and the capacity to protect other proteins against thermal denaturation. The abundance of this protein in seeds may account for their ability to survive the extreme high soil temperatures of the African summer.

Potassium and sodium relations in salinised barley tissues as a basis of differential salt tolerance

Zhonghua Chen, Meixue Zhou, Ian A. Newman, Neville J. Mendham, Guoping Zhang and Sergey Shabala 150–162

A large-scale glasshouse experiment was conducted to evaluate physiological responses of barley to salinity. Plant salt tolerance was also evaluated by non-invasive microelectrode measurements of net K^+ flux from roots of 3-day-old seedlings after treatment with 80 mM NaCl. K^+ efflux from epidermal root cells was highly correlated with whole-plant measures of salt tolerance, suggesting that the ability to maintain a high K^+/Na^+ ratio is a key feature of salt tolerance in barley.