

Functional Plant Biology

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Foreword

Review: Evolution of plant water relations research in Australia

David Doley

405–414

This review traces early water relations research in Australia, which emphasized functional similarities between plant species, and their survival mechanisms in stressful Australian environments. Functional variation within and between populations of wild plant species has received less attention, but offers opportunities for increased understanding and more effective management of this resource.

Viewpoint: Assessing the carbon sequestration potential of mesic savannas in the Northern Territory, Australia: approaches, uncertainties and potential impacts of fire

Richard J. Williams, Lindsay B. Hutley, Garry D. Cook, Jeremy Russell-Smith, Andrew Edwards and Xiayong Chen

415–422

Tropical savannas represent a large potential carbon sink, but are subject to frequent fire. Fire is likely to affect productivity and carbon sequestration potential, via effects on biomass and carbon emissions. The authors have estimated a Net Biome Productivity of $-1 \text{ t ha}^{-1} \text{ y}^{-1}$ for a mesic savanna in Northern Australia, and discuss the implications of this estimate for land use management.

Mini-review: Rooting depth and plant water relations explain species distribution patterns within a sandplain landscape

Philip K. Groom

423–428

Groundwater use is emerging as an important issue. This mini-review details how the rooting and water use strategies of species from Banksia woodlands on the Swan Coastal Plain, Western Australia, influence other aspects of plant water relations, and how these relate to the distribution of species with respect to water availability.

Convergence in hydraulic architecture, water relations and primary productivity amongst habitats and across seasons in Sydney

Catriona Macinnis-Ng, Kate McClenahan and Derek Eamus

429–439

These authors looked at hydraulic conductivity, Huber value, xylem embolism and minimum leaf water potential in plants from four habitats near Sydney. They found relationships amongst these parameters that held across habitats, and show that these relationships are driven by the cost-efficiency of sapwood. A conceptual model explaining seasonal and habitat differences in water relations is presented.

Leaf water use efficiency differs between *Eucalyptus* seedlings from contrasting rainfall environments

Matthew J. Searson, Dane S. Thomas, Kelvin D. Montagu and Jann P. Conroy

441–450

Eucalyptus species native to xeric environments are possibly so successful because of leaf level adaptations, such as increased leaf thickness, that enhance photosynthetic capacity and optimise water use efficiency. These authors investigate various morphological traits and physiological properties in three contrasting *Eucalyptus* species to assess the success of these adaptations.

Terpene deployment in *Eucalyptus polybractea*; relationships with leaf structure, environmental stresses, and growth

Drew J. King, Roslyn M. Gleadow and Ian E. Woodrow

451–460

This paper describes the relationships between secondary metabolism, drought stress, growth and leaf morphology in a natural population of *Eucalyptus polybractea*. Variation in terpene content was related to specific leaf area, but not to water stress, nutrient concentration or other secondary metabolites. Growth was related to secondary metabolites, but not to water stress or nutrients.

Seasonal responses of xylem sap velocity to VPD and solar radiation during drought in a stand of native trees in temperate Australia

Melanie J. B. Zeppel, Brad R. Murray, Craig Barton and Derek Eamus

461–470

Water use by trees is influenced by soil and atmospheric water content, solar radiation and tree size. These authors aim to understand predictors of transpiration, their modification and the interplay between them, with an analysis of xylem sap flow in Australian tree species. The questions posed are fundamental to a quantitative understanding of tree water consumption in Australian landscapes.

The impacts of leaf shape and arrangement on light interception and potential photosynthesis in southern beech (*Nothofagus cunninghamii*)

Stephen O. Kern, Mark J. Hovenden and Gregory J. Jordan

471–480

These authors explored the implications of leaf morphology and arrangement on light reaching the leaves of *Nothofagus cunninghamii*. Self-shading was strongly dependent upon branch angle, and genotypic differences in branch angle resulted in differences in light exposure, potential carbon assimilation and exposure to excess PPFD.

Pigment dynamics during cold-induced photoinhibition of *Acacia melanoxylon*

Tim L. Watson, Dugald C. Close, Neil J. Davidson and Noel W. Davies

481–489

Watson *et al.* investigated long-term acclimation of photo- and pigment-chemistry in a naturally regenerating stand of *Acacia melanoxylon* and found that this species is susceptible to cold-induced photoinhibition under cool temperatures and moderate light intensities. Changes in pigment chemistry were associated with seasonal acclimation in thinned and unthinned stands. Operation of the photoprotective lutein-5,6-epoxide cycle was identified.

Cyanogenesis in tropical *Prunus turneriana*: characterisation, variation and response to low light

Rebecca E. Miller, Roslyn M. Gleadow and Ian E. Woodrow

491–503

Resource allocation to cyanogenic glycosides was investigated in the tropical rainforest species *Prunus turneriana*. In shade, no difference in cyanogenic glycoside concentration, or the proportion of nitrogen allocated to cyanogenic glycoside, was found, but allocation to older leaves was increased. This strategy may benefit seedlings that can only reach a reproductive stage following the creation of a canopy gap.

Cassowary frugivory, seed defleshing and fruit fly infestation influence the transition from seed to seedling in the rare Australian rainforest tree, *Ryparosa* sp. nov. 1 (Achariaceae)

Bruce L. Webber and Ian E. Woodrow

505–516

A high proportion of tropical rainforest species depend on animals for seed distribution. Cassowaries can disperse seeds over great distances, and *Ryparosa* seeds have been found in cassowary scats, in seed caches and scattered at distances up to 10 m from parent trees. This study quantifies the germination enhancement potential of the endangered cassowary on this rare plant species.

Nitrogen ecophysiology of Heron Island, a subtropical coral cay of the Great Barrier Reef, Australia

Susanne Schmidt, William C. Dennison, Gordon J. Moss, and George R. Stewart

517–528

Coral cays form part of the Australian Great Barrier Reef. Seabirds can deposit up to 1000 kg N ha⁻¹ year⁻¹ on coral cays. Schmidt *et al.* investigated how nitrogen sources are utilised by coral cay plants on Heron Island, N distribution within the cay, and whether seabird-derived N moves from cay to surrounding marine environments.

Screening broad beans (*Vicia faba*) for magnesium deficiency. I. Growth characteristics, visual deficiency symptoms and plant nutritional status
Yuda Hariadi and Sergey Shabala 529–537

Screening broad beans (*Vicia faba*) for magnesium deficiency. II. Photosynthetic performance and leaf bioelectrical responses
Yuda Hariadi and Sergey Shabala 539–549

Short communication: Leaf trait relationships in Australian plant species
Ian J. Wright, Philip K. Groom, Byron B. Lamont, Pieter Poot, Lynda D. Prior, Peter B. Reich, E-Detlef Schulze, Erik J. Veneklaas, Mark Westoby 551–558

Research note: Measuring variability in chlorophyll-fluorescence-derived photosynthetic parameters *in situ* with a programmable multi-channel fluorometer
John W. Runcie and Martin J. Riddle 559–562

Hariadi and Shabala studied the development of Mg deficiency, using broad bean as a case study, with the aim of comparing physiological characteristics as prospective tools for early diagnosis. For this purpose, the kinetics of leaf photosynthetic responses and changes in electrophysiological characteristics at a range of Mg levels were studied. The authors found that while few or no visual symptoms of Mg deficiency occur in broad bean leaves, leaf elemental analysis of Mg content was the most accurate indicator. For rapid screening, measurements of light-induced electrical changes on the leaf surface may be used. These surface potential changes were shown to reflect (at least, in part) movement of Mg²⁺ across the plasma membrane in response to light fluctuations.

Relationships between specific leaf area, photosynthetic capacity, dark respiration rate, leaf N and P, and leaf lifespan were quantified for 258 Australian plant species and compared with reported ‘global’ patterns. Variation among results for individual datasets was investigated and factors identified that contribute to the scatter in broad, cross-species relationships.

This paper reports an important technical advance in making multiple *in situ* measurements of chlorophyll fluorescence using a programmable and completely submersible custom-built fluorometer that incorporates a commercially available PAM unit. The fluorometer enables testing of significant differences in photosynthetic parameters, and provides the possibility of better statistical treatments.
