# Functional Plant Biology

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## Contents

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### Foreword

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.

### Review: Evolution of plant water relations research in Australia

*David Doley*  
405–414

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.

### 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

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.

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

*Philip K. Groom*  
423–428

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.

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

*Catriona Macinnis-Ng, Kate McClanahan and Derek Eamus*  
429–439

These authors investigated various morphological traits and physiological properties in three contrasting *Eucalyptus* species to assess the success of these adaptations.

### 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.

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Cover illustration: Linocut by Kaye Marsh, Toowoomba, Qld.
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.

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.

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.

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.

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.

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.

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.
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 Mg$^{2+}$ 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.