

Functional Plant Biology

Continuing *Australian Journal of Plant Physiology*

Contents

Volume 32 Number 1 2005

Plant defence responses: what have we learnt from *Arabidopsis*?

Louise F. Thatcher, Jonathan P. Anderson and Karam B. Singh

1–19

This review of current genetic and genomic approaches to plant defence in the model plant, *Arabidopsis thaliana*, and outlines the key responses and signal transduction pathways activated upon pathogen attack. Emerging technologies for studying plant defence responses, and the resultant discoveries, are discussed. The authors highlight the complexity of *Arabidopsis* defence systems and acknowledge the challenge of transferring this new wealth of knowledge to crop plants. This question is addressed in more detail in the accompanying paper by Anderson *et al.* (see pp. 21–34).

Plant defence responses: conservation between models and crops

Jonathan P. Anderson, Louise F. Thatcher and Karam B. Singh

21–34

This companion to the review by Thatcher *et al.* (see pp. 1–19) examines the extent to which knowledge of plant defence systems gained from the model species, *Arabidopsis thaliana*, can be applied to enhancing defence responses in crop plants. This review uses tobacco, tomato and rice to illustrate the degree of conservation of defence signalling among diverse species, but the necessity to increase our understanding of the specific aspects of the defence response that cannot be studied by model systems is also emphasised.

Pest and disease protection conferred by expression of barley β -hordothionin and *Nicotiana alata* proteinase inhibitor genes in transgenic tobacco

Julia A. Charity, Peter Hughes, Marilyn A. Anderson, Dennis J. Bittisnich, Malcolm Whitecross and T. J. V. Higgins

35–44

Co-expression of two plant defence genes, a β -hordothionin from barley and a proteinase inhibitor gene from *Nicotiana alata*, in transgenic tobacco is described in this paper. These two genes with different modes of action were combined and expressed in transgenic tobacco lines, which were subjected to attack by pest (tobacco budworm) and disease (grey mould and bacterial wilt). The protective effects of the two proteins were additive, although the contribution of each gene to the effect was not equal.

Antioxidant defences in olive tree during drought stress: changes in activity of some antioxidant enzymes

Adriano Sofo, Bartolomeo Dichio, Cristos Xiloyannis and Andrea Masia

45–53

The activities of antioxidant enzymes were studied in two-year old olive trees subjected to a controlled water deficit. Activities of superoxide dismutase, ascorbate peroxidase, catalase, indoleacetate peroxidase and guaiacol peroxidase increased in relation to the severity of drought, while polyphenol oxidase activity declined. The ability of olive trees to up-regulate the enzymatic antioxidant system might be an important attribute for drought tolerance, potentially limiting cellular damage caused by active oxygen species during water deficit.

Cover illustration: Top panel: disease symptoms in *Arabidopsis* inoculated with different isolates of the root fungal pathogen *Rhizoctonia solani*. Bottom panel: a simplified schematic diagram of the defence signalling network highlighting conserved components between monocots and dicots. The background image shows lesions on *Arabidopsis* leaves caused by the fungal pathogen *Alternaria brassicicola*. (See Thatcher *et al.* pp 1–19 and Anderson *et al.* pp 21–34.)

A mutant of *Chlamydomonas reinhardtii* that cannot acclimate to low CO₂ conditions has an insertion in the *Hdh1* gene

**James E. Adams, Sergio L. Colombo,
Catherine B. Mason, Ruby A. Ynalvez, Baran Tural and
James V. Moroney** 55–66

This paper describes the characterisation of a *Chlamydomonas reinhardtii* mutant obtained by the insertional mutation techniques described in an earlier paper (Colombo *et al.* 2002, *Functional Plant Biology* **29**: 231–241). The mutant has a DNA insertion in a novel gene (*Hdh1*) that is likely to have hydrolase or phosphatase activity. *Hdh1* has not been described in any photosynthetic organism.

Functional compartmentation of C₄ photosynthesis in the triple-layered chlorenchyma of *Aristida* (Poaceae)

**Elena V. Voznesenskaya, Simon D. X. Chuong,
Nuria K. Koteyeva, Gerald E. Edwards and
Vincent R. Franceschi** 67–77

Species in the genus *Aristida* are C₄ plants, which have the unique feature of a double chlorenchyma sheath along with the mesophyll cells, unlike other C₄ species with Kranz anatomy, which have a single chlorenchyma sheath. Structural features, compartmentation of photosynthetic enzymes, and sites of starch biosynthesis are studied in this paper to elucidate the mechanism of C₄ photosynthesis and the functions of the two chlorenchyma sheaths in *Aristida*.

Carbon resource sharing and rhizome expansion of *Phalaris aquatica* plants in grazed pastures

**Brendan R. Cullen, David F. Chapman and
Paul E. Quigley** 79–85

This short communication describes the patterns of carbon resource sharing and rhizome development in *Phalaris aquatica*. ¹⁴C studies show that the primary tiller provides carbon resources to support the growth of subsequent tillers and to maintain the plant's crown. Carbon resource sharing between tillers arising from the same regenerative bud will enhance new tiller establishment, while C allocation to the old reproductive tiller probably supports the deep roots that are vital for summer survival.
