

Functional Plant Biology

Continuing *Australian Journal of Plant Physiology*

Contents

Volume 32 Number 6 2005

*Rapid communication: Metabolic engineering of *Arabidopsis* to produce nutritionally important DHA in seed oil*

Stan S. Robert, Surinder P. Singh, Xue-Rong Zhou, James R. Petrie, Susan I. Blackburn, Peter M. Mansour, Peter D. Nichols, Qing Liu and Allan G. Green 473–479

This Rapid communication reports the first successful metabolic engineering of seeds to synthesise both EPA and DHA. Although EPA synthesis has been reported previously by other groups, these authors have used a different biosynthetic pathway to achieve EPA synthesis. Importantly, they have also introduced additional biosynthetic enzymes to convert EPA to DHA, the most nutritionally important long-chain polyunsaturated fatty acid. It is a notable feat of international interest that points to the eventual delivery of these dietary compounds through seed oils.

Review: Making the life of heavy metal-stressed plants a little easier

Priscila L. Grato, Andrea Polle, Peter J. Lea and Ricardo A. Azevedo 481–494

The contamination of soils and water with toxic heavy metals has created a major environmental problem, leading to losses in plant productivity and hazardous health effects. Exposure to toxic metals can intensify the production of reactive oxygen species, which are continuously produced in both unstressed and stressed plants cells. This review brings together the recent literature concerning heavy metal tolerance, generation of reactive oxygen species and antioxidant defence. The authors give an authoritative account of the topic and provide personal insights and perspectives.

Intermittent anoxia induces oxidative stress in wheat seminal roots: assessment of the antioxidant defence system, lipid peroxidation and tissue solutes

Danica E. Goggin and Timothy D. Colmer 495–506

Plants often encounter fluctuations in levels of soil O₂ due to soil waterlogging, both in space and in time, in agroecosystems and natural communities. This research explores the interaction of oxidative stress and oxygen deprivation in wheat seedling roots exposed to repeated cycles of anoxia–aeration, and provides an analysis of molecular and enzymatic changes in the antioxidant defence system. This is the first time that the effects of repeated anoxia–aeration cycles have been studied in plants.

Boron response in wheat is genotype-dependent and related to boron uptake, translocation, allocation, plant phenological development and growth rate

Monika A. Wimmer, Elias S. Bassil, Patrick H. Brown and André Läuchli 507–515

These authors investigated the mechanisms contributing to boron tolerance in wheat genotypes. Using the stable isotopes ¹⁰B and ¹¹B, they provide evidence that several mechanisms contribute to overall boron tolerance, even within a single species, and present arguments for the merits of different mechanisms in various environments. They also discuss the contribution of reduced uptake rates, differential translocation, allocation, growth rates and leaf morphology.

*Cover illustration: Flowers of *Arabidopsis thaliana* that will yield the first seeds to contain DHA following the transgenic expression of a multi-step fatty acid biosynthetic pathway (See Roberts *et al.* pp. 473–479).*

Serpins in fruit and vegetative tissues of apple (*Malus domestica*): expression of four serpins with distinct reactive centres and characterisation of a major inhibitory seed form, MdZ1b

Jørn Hejgaard, William A. Laing, Salla Marttila, Andrew P. Gleave and Thomas H. Roberts 517–527

Improved procedures for *in vitro* regeneration and for phenotypical analysis in the model legume *Lotus japonicus*

Ani Barbulova, Enrica D'Apuzzo, Alessandra Rogato and Maurizio Chiurazzi 529–536

Structural modifications induced by *Eutypa lata* in the xylem of trunk and canes of *Vitis vinifera*

Jérôme Rudelle, Stéphane Octave, Meriem Kaid-Harche, Gabriel Roblin and Pierrette Fleurat-Lessard 537–547

Diel and seasonal changes in fluorescence rise kinetics of three scleractinian corals

Ross Hill and Peter J. Ralph 549–559

Viewpoint: Consideration of apoplastic water in plant organs: a reminder

Ian F. Wardlaw 561–569

Serpins have numerous regulatory functions in animals, but metabolic roles in plants remain unknown. Cereal grain serpins are efficient, irreversible inhibitors of serine proteinases *in vitro*, and may function in defence. Little is known about eudicot serpins. These authors present an analysis of serpin gene expression in vegetative and fruit tissues of apple, and provide the first functional characterisation of a eudicot seed serpin.

Plant improvement by tissue culture and gene transfer is greatly aided by advances in techniques to induce direct somatic embryogenesis. This paper reports a sound and very useful improvement of the current *in vitro* method for regeneration and transformation of the widely used model legume *Lotus japonicus*. A novel approach resulting in somatic embryogenesis that appears compatible with the *Agrobacterium* transformation procedure is described.

The fungal pathogen *Eutypa lata* is a major cause of reduced longevity in vineyards throughout the world. This is the first study to examine the effect of *E. lata* towards the vascular tissue of naturally infected grapevines. Particular attention was given to vessel-associated cells (VACs), which have previously been shown to react to the presence of fungal pathogens. Infection by *E. lata* altered VAC structure in all tissues examined, although the effect was less pronounced in annual canes distant from the site of infection. Although eutypine induced the development of the transfer apparatus, other signals coming from the pathogen are also expected to be involved in VAC damage and degeneration.

Hill and Ralph explore the mechanisms of diel photosynthesis of corals. A novel approach to investigating photosynthetic activity was implemented by the measurement of fast polyphasic fluorescence rise kinetics. The role of anaerobiosis of coral tissue, induced by the animal host, is discussed, and its impact on the redox state of the plastoquinone pool in the symbiotic zooxanthellae is explored. This work aids our understanding of diel photosynthesis in coral.

There are many important methodological issues surrounding the determination of apoplastic water content (and solute concentration) in plants, so a thorough evaluation of these issues is very timely. The author makes a calculation of apoplastic water content based on the difference between the osmotic potential (OP) calculated from a moisture release curve, and the OP measured on expressed sap, and provides some timely cautions that are frequently not considered by researchers in plant water relations.