

Functional Plant Biology

Contents

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Editorial: Changing times for *Functional Plant Biology*
Andrew Stammer

Cell death in grape berries: varietal differences linked to
xylem pressure and berry weight loss
Joanne Tilbrook and Stephen D. Tyerman 173–184

The authors have discovered that cell death occurs in the mesocarp of berries of two wine grape varieties late in development, but before normal harvest date. The onset of cell death corresponds to the beginning of weight loss in the variety that has a higher hydraulic conductance via the pedicel xylem. In contrast, a table grape variety that does not show cell death generates tension in the pedicel xylem. These observations indicate that there are variety-dependent strategies of water relations and ripening of grape berries that may be linked to the vitality status of the large mesocarp cells.

Improvement of *Torenia fournieri* salinity tolerance by
expression of *Arabidopsis AtNHX5*
**Le-Yi Shi, Hong-Qing Li, Xiao-Ping Pan,
Guo-Jiang Wu and Mei-Ru Li** 185–192

These authors investigated the potential role of *AtNHX5* in plant salt tolerance. Heterologous overexpression of *AtNHX5* in the flowering plant *torenia* resulted in enhanced ability of transgenic plants to withstand salt stress, improved the ability of transgenic plants to regenerate from leaf explants or branch, and made early flowering transgenic plants. They propose that *AtNHX5* functions not only in plant salt tolerance, but also in plant growth and development.

Novel pattern of foliar metal distribution in a manganese
hyperaccumulator
**Denise R. Fernando, Alan T. Marshall, Barbara Gouget,
Marie Carrière, Richard N. Collins, Ian E. Woodrow
and Alan J. Baker** 193–200

In this study, a novel foliar metal distribution pattern was discovered in the Mn hyperaccumulator *Garcinia amplexicaulis*. It is the third type of sequestration now known to occur among Mn hyperaccumulators. Qualitative *in situ* electron and proton microprobe X-ray imaging showed Mn to be localised relatively uniformly through the photosynthetic and non-photosynthetic layers of cryo-fixed leaf cross-sections. This contrasts with other hyperaccumulators, and demonstrates that Mn hyperaccumulation occurs via a unique variety of species-dependent foliar sequestration patterns. The Mn accumulator *Grevillea exul* and the hyperaccumulator *Maytenus fournieri* were similarly investigated here.

On the effect of heavy water (D₂O) on carbon isotope
fractionation in photosynthesis
Guillaume Tcherkez and Graham D. Farquhar 201–212

In their paper, Tcherkez and Farquhar investigate the effect of heavy water on internal conductance and net assimilation rate. They show that internal conductance is decreased to a modest extent, indicating that carbonic anhydrase activity is not limiting for photosynthesis. Photosynthesis is nearly two-fold lower in heavy water; the relationships with Rubisco's catalytic mechanism and its D/H isotope effect are discussed.

Cover illustration: Varietal differences in cell death in the pericarp of grape berries is linked to the water relations of the berry (see Tilbrook and Tyerman pp. 173–184). The intense green fluorescence is indicative of vital cells. Left image is LS section of a Sultana (Thompson Seedless) berry showing vital cells across the pericarp. The right image is a Chardonnay berry at a similar age and sugar content showing loss of cell vitality (scale = 10 mm). Sections and photography kindly prepared by Wendy Sullivan.

The sensitivity of photosynthesis to phosphorus deficiency differs between C₃ and C₄ tropical grasses

**Oula Ghannoum, Matthew J. Paul, Jane L. Ward,
Mike H. Beale, Delia-Irina Corol and
Jann P. Conroy**

213–221

This paper investigated the response of one C₃ and three C₄ grasses to phosphorus withdrawal from the growing medium. Changes in photosynthesis and growth were compared to leaf carbohydrate contents and metabolic fingerprints obtained using high resolution proton nuclear magnetic resonance (¹H-NMR). Compared to the C₃ counterpart, photosynthesis of the C₄ grasses had higher phosphorus use efficiency and lower inorganic phosphate requirement. Although each of the four grass species showed distinctive ¹H-NMR fingerprints, there were no differences in response that could be attributed to the C₄ biochemical subtypes.

Two separate UV-B radiation wavelength regions control expression of different molecular markers in *Arabidopsis thaliana*

**Irina Kalbina, Shaoshan Li, Georgi Kalbin,
Lars Olof Björn and Åke Strid**

222–227

This paper shows that at least two signal transduction pathways, controlled by two distinct UV-B wavelength regions, regulate gene expression as a result of absorption of UV-B radiation in plants. Fluence-response curves were obtained at nine wavelengths in the interval 280–360 nm for mRNA transcripts of four different genes in *Arabidopsis* using a high intensity deuterium radiation source and narrow bandwidth filters. Two of these genes were regulated by UV-B between 300 and 310 nm and the other two by UV-B at 280–290 nm.

Growth, nutrition, and soil respiration of a mycorrhiza-defective tomato mutant and its mycorrhizal wild-type progenitor

**Timothy R. Cavagnaro, Adam J. Langley,
Louise E. Jackson, Sean M. Smukler and
George W. Koch**

228–235

The mycorrhizal contribution to soil respiration was assessed over a 79-day period using continuously monitored soil respiration chambers. A genotypic approach was used to control for mycorrhizal colonisation, thereby avoiding non-specific effects of soil sterilisation on the heterotrophic component of soil respiration. While net soil respiration did not differ between the two tomato genotypes, root dry weight was lower in mycorrhizal roots, and respiration of mycorrhizal roots per unit dry weight was higher than nonmycorrhizal roots. Thus, contribution of mycorrhiza to soil respiration may indeed be significant.

A seed coat cyanohydrin glucosyltransferase is associated with bitterness in almond (*Prunus dulcis*) kernels

**Tricia K. Franks, Abbas Yadollahi,
Michelle G. Wirthensohn, Jennifer R. Guerin,
Brent N. Kaiser, Margaret Sedgley and
Christopher M. Ford**

236–246

In seeds of the Rosaceae, including almond, peach and apricot, bitterness has long been attributed to high concentrations of the cyanogenic glucoside, amygdalin. We isolated an almond glucosyltransferase (UGT85A19), which has properties consistent with its involvement – in the seed coat – with amygdalin synthesis. *In vitro*, this enzyme stereo-selectively glucosylated mandelonitrile to produce prunasin (the presumed immediate biosynthetic precursor of amygdalin), and comparison of its *in vivo* expression profile in bitter and non-bitter genotypes linked this enzyme to amygdalin accumulation. Evidently not a control point for development of bitterness, UGT85A19 may have additional roles in almond metabolism.

Research note: Micropropagation of *Eucalyptus polybractea* selected for key essential oil traits

**Jason Q. D. Goodger, Allison M. Heskes, Drew J. King,
Roslyn M. Gleadow and Ian E. Woodrow**

247–251

A protocol for the micropropagation of *Eucalyptus polybractea* (blue mallee) using axillary bud proliferation from lignotuber-derived explants is described. Three different ages of plants were used as explant sources: glasshouse-grown seedlings, field-grown saplings, and coppice of field-grown mature lignotubers. The age of the explant source did not appear to influence the success of micropropagation, and as a result older plants (for which key oil traits are known) can be selected as elite plants for multiplying selected genotypes via micropropagation.