

# Functional Plant Biology

## Contents

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Review:  $\beta$ -Substituting alanine synthases: roles in cysteine metabolism and abiotic and biotic stress signalling in plants

*Jibran Tahir and Paul Dijkwel*

307–323

Cysteine is amino acid containing sulfur. Enzymes involved in cysteine metabolism are widely conserved among species. Besides its basic function in protein synthesis, cysteine biosynthesis has been reported to help survival and fitness. This review argues how specialisation and divergence in the catalytic activities of the enzymes involved in cysteine metabolism mediate stress tolerance in plants and other species.

Review: Ozone damage, detoxification and the role of isoprenoids – new impetus for integrated models

*Supriya Tiwari, Rüdiger Grote, Galina Churkina and Tim Butler*

324–336

Productivity of agricultural and forest ecosystems decreases with increasing ozone concentration, but estimating economic losses is still challenging. Here we review the mechanisms of ozone impacts on physiological and biochemical processes with a focus on induced and constitutive defence responses. We found that current models neglect induced detoxification capacity and need to be complemented with feedback responses in order to capture the response to environmental changes.

Dynamic responses of photosynthesis and the antioxidant system during a drought and rehydration cycle in peanut plants

*Ana Furlan, Eliana Bianucci, María del Carmen Tordable, Aleysia Kleinert, Alexander Valentine and Stella Castro*

337–345

This work highlighted the importance of studying the reversibility of drought stress in plants. The results revealed that peanut plants exposed to a drought and rehydration cycle showed the capacity to recover at 3 days after rehydration in terms of photosynthesis and antioxidant system activity. The resilience of plants is a crucial aspect to be considered in order to improve productivity in natural environments experiencing intermittent drought.

Floating and submerged leaves of *Potamogeton nodosus* exhibit distinct variation in the antioxidant system as an ecophysiological adaptive strategy

*Nisha Shabnam and P. Pardha-Saradhi*

346–355

Phenotypic plasticity facilitates heterophyllous aquatic plants to display distinct ecophysiological adaptations. During an evaluation of ecophysiological adaptations, it was discovered that floating leaves of *Potamogeton nodosus* possess better photosynthetic efficiency and a superior antioxidant system compared with submerged leaves. A superior antioxidant system enables floating leaves to withstand high light intensity-induced photodamage to a significantly higher extent than submerged leaves.

*Cover illustration:* Functional network of  $\beta$ -substituting alanine synthase (BSAS) proteins in S-assimilation and cysteine metabolism in *Arabidopsis thaliana* (Tahir and Dijkwel, pp. 307–323). The figure shows the pathways and enzymes involved in sulfur assimilation and cysteine, methionine and thiol biosynthesis and homeostasis. BSAS enzymes are coloured in purple; enzymes in other pathways (associated with cysteine metabolism) are coloured in red. The metabolites synthesised by BSAS are assigned different font sizes depending on the subcellular pools of the respective metabolite. Dotted lines indicate putative channelling for transport of metabolites across subcellular compartments. Image by Jibran Tahir.

Chlorophyll fluorescence parameters allow the rapid detection and differentiation of plant responses in three different wheat pathosystems

***Olubukola O. Ajigboye, Louise Bousquet, Erik H. Murchie and Rumiana V. Ray***

356–369

Rapid diagnosis of biotic stress is important to optimise targeted disease control and protect crop yield. We used OJIP to determine changes in PSII photochemistry associated with plant disease and we identified specific chlorophyll fluorescence parameters related to infections by different wheat pathogens. OJIP is a sensitive technique useful as diagnostic tool in crop disease management and varietal breeding programs.

Leaf hydraulic vulnerability protects stem functionality under drought stress in *Salvia officinalis*

***Tadeja Savi, Maria Marin, Jessica Luglio, Francesco Petruzzellis, Sefan Mayr and Andrea Nardini***

370–379

This work addresses the eco-physiology of *Salvia officinalis*, a Mediterranean shrub thriving in extreme microclimate. The results provide knowledge on the co-ordination of water transport efficiency/safety of stem and leaves in a plant experiencing important root-to-leaf water potential gradients during summers. We highlight the importance of a deep understanding of plant physiological responses to drought that considers the overall adaptation mechanisms conferring.

Reducing rainfall amount has a greater negative effect on the productivity of grassland plant species than reducing rainfall frequency

***Eleanor V. J. Gibson-Forty, Kirk L. Barnett, David T. Tissue and Sally A. Power***

380–391

Climate change is likely to alter rainfall regimes across Australian grasslands, with a decrease in the frequency and magnitude of rainfall events anticipated. We have shown that reductions in the size of rainfall events were associated with large decreases in the productivity of representative local grassland species, while reduced frequency of events had relatively little impact. This suggests that changes in the total amount of rainfall will be a more important determinant of grassland productivity and composition than changes in the frequency of rainfall events under future climates.