

# Functional Plant Biology

## Contents

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*Evans Review*: Energy-crises in well-aerated and anoxic tissue: does tolerance require the same specific proteins and energy-efficient transport?

**Hank Greenway and William Armstrong** 877–894

We review metabolic adaptations of plant tissues to severe reductions in energy-production ('energy-crises') that occur in various situations, including O<sub>2</sub>-deprivation during flood-events. We conclude that most major differences between tissues intolerant and tolerant to an energy-crisis are associated with only a few gene-proteins. These concern efficient energy production and energy-efficient-transporters, necessary to retain membrane integrity, essential to life.

*Review*: Trafficking to the seed protein storage vacuole

**Joanne R. Ashnest and Anthony R. Gendall** 895–910

Increasing global demand for high quality, plant-based proteins has driven a strong interest in the sorting and processing of seed storage proteins. This review summarises recent primary research findings regarding vacuolar trafficking and seed protein biology, in the context of established and novel paradigms. We also highlight several key gaps in the scientific understanding of these processes.

Exogenous spermidine enhances the photosynthetic and antioxidant capacity of rice under heat stress during early grain-filling period

**She Tang, Haixiang Zhang, Ling Li, Xia Liu, Lin Chen, Wenzhu Chen and Yanfeng Ding** 911–921

Frequency and intensity of high temperature negatively affects rice production in China and challenges food security, thus appropriate mitigation measures urgently need to be proposed. From the photosynthetic and antioxidant capacity aspects, exogenous spermidine effectively alleviates the adverse consequences of high temperature. Findings from this study may provide strategies in mitigating the challenges of global warming-induced yield loss and other possible relevant issues.

Calcium oxalate degradation is involved in aerenchyma formation in *Typha angustifolia* leaves

**Xiaomin Du, Xiaolong Ren, Lingli Wang, Ke Yang, Guiliang Xin, Guolun Jia, Xilu Ni and Wenzhe Liu** 922–934

The developing aerenchyma of *Typha angustifolia* is accompanied by calcium oxalate crystals (CaOx). The degradation of CaOx crystals causes high levels of H<sub>2</sub>O<sub>2</sub>, which is considered a key signalling molecule that triggers programmed cell death (PCD). It suggested that CaOx degradation is involved in the regulation of the PCD process of aerenchyma in *T. angustifolia* leaves.

Effects of nutrient supply on carbon and water economies of C<sub>4</sub> grasses

**Laura Rose, Robert Buitenwerf, Michael Cramer, Edmund C. February and Steven I. Higgins** 935–944

Whether plants can induce mass flow of nutrient-rich soil water via increased transpiration might influence their competitive strength. We tested the response of C<sub>4</sub> grasses to low nutrient availability at the roots but found no physiological indication of active mass flow induction. This can mean a competitive disadvantage of water-efficient C<sub>4</sub> plants to C<sub>3</sub> plants under high atmospheric CO<sub>2</sub>.

Cover illustration: Calcium oxalate crystals in *Typha angustifolia* leaves (see Du *et al.* pp. 922–934). Image by Xiaomin Du.

Does foliage metal accumulation influence plant–insect interactions? A field study of two sympatric tree metallophytes  
*Denise R. Fernando, Chaya S. Smith, Martin J. Steinbauer, Kevin Farnier, Simon J. Watson and Peter T. Green* 945–956

The defence capacity of metal-rich foliage in two rainforest tree species was examined via a field study. Plant–insect interactions associated with tree metallophytes remain poorly understood. Although there was no direct evidence here of metal defence, the study found indirect effects, and evidence of adaptation by a galling insect that exploits foliar metal. This field study revealed complex ecological relationships undetectable by controlled experiments.

Quantitative trait locus analysis of adventitious and lateral root morphology of barley grown at low and high P  
*Jingyi Guo, Guangdeng Chen, Xizhou Zhang, Tingxuan Li, Haiying Yu and Chunji Liu* 957–967

This research demonstrated the different growth dynamics in adventitious and lateral roots of barley in response to low-P stress and detected quantitative trait loci (QTLs) for them. Lateral roots play a role in P uptake in barley. The new QTL region *Cl-2H* had great potential for future genetic improvement of barley lateral root growth and may offer valuable clues for fine mapping in barley.

Leaf acclimation strategies to contrasting light conditions in saplings of different shade tolerance in a tropical cloud forest  
*Ana Quevedo-Rojas, Carlos García-Núñez, Mauricio Jerez-Rico, Ramón Jaimez and Teresa Schwarzkopf* 968–982

To survive, saplings of tree species in the understorey of tropical cloud forests must acclimate to sudden and gradual changes in the light environment. In an acclimation experiment, we found that species showed different strategies in leaf photosynthetic responses combining gas exchange, photoinhibition and other properties. Knowing these strategies could explain saplings' distribution along the light gradient and produce insights into species' requirements for forest management or restoration plans.