

Functional Plant Biology

Contents

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Rapid communication: A comment on the quantitative significance of aerobic methane release by plants

**Miko U. F. Kirschbaum, Dan Bruhn,
David M. Etheridge, John R. Evans,
Graham D. Farquhar, Roger M. Gifford,
Keryn I. Paul and Anthony J. Winters**

521–530

Recently, Keppler *et al.* (2006) showed that plants release methane under aerobic conditions. These authors present two alternative methods for calculating aerobic methane emissions from plants, based on the original work of Keppler *et al.* (2006), but resulting in significantly lower estimates. They also show that the effect of aerobic methane emission by trees is very small compared with the carbon-sequestration benefit of planting trees.

Viewpoint: Isotopic fractionation by plant nitrate reductase, twenty years later

Guillaume Tcherkez and Graham D. Farquhar 531–537

Nitrate reductase (NR) reduces nitrate to nitrite, depleting nitrite in ^{15}N compared with substrate nitrate. The associated $^{14}\text{N}/^{15}\text{N}$ isotope effect was shown to be about 1.015 20 years ago but the relationships between the isotope effect and the mechanism of the reaction have not been examined recently. This paper provides an overview of isotopic aspects of this reaction and estimates the intrinsic N and O isotope effects. The authors challenge various assumptions of the nitrate reductase reaction.

High floral bud abscission and lack of open flower abscission in *Dendrobium* cv. Miss Teen: rapid reduction of ethylene sensitivity in the abscission zone

**Kanakpon Bunya-atichart, Saichol Ketsa and
Wouter G. van Doorn** 539–546

Abscission of plant parts is generally increased by application of ethylene, and hence delayed by ethylene antagonists. Auxin also acts as a regulator of abscission. These authors compare various cultivars and characterise abscission of *Dendrobium* open flowers and floral buds, with the goal of and improving postharvest performance. A clear reduction of abscission zone sensitivity to ethylene as flowers opened was seen in one cultivar.

Gibberellin-dependent induction of tomato extracellular invertase *Lin7* is required for pollen development

**Reinhard K. Proels, Mari-Cruz Gonzalez and
Thomas Roitsch** 547–554

The paper by Proels and Roitsch describes interesting data supporting the idea that gibberellins control pollen germination through their effect on invertase activity. The approach taken here is novel: an essential function of gibberellin-mediated regulation of an extracellular invertase, and thus of an apoplasmic phloem unloading pathway, for pollen tube growth has been established by complementing functional approaches.

Characterisation and immunolocalisation of a pollen-specific calmodulin-binding protein from rice

**Qiusheng Zhang, Jingjing Zhang, Daichang Yang,
Yangsheng Li, Shaoqing Li, Yingguo Zhu** 555–562

The mechanisms controlling pollen germination are poorly understood. This paper describes the cloning and characterisation of a rice gene (OsPCBP), which encodes a calmodulin-binding protein, as shown by protein sequence similarity with other known calmodulin-binding proteins and by calmodulin interaction assays using OsPCBP. Immunolocalisation demonstrates that OsPCBP is localised in the amyloplast and intine of pollen. After germination, much OsPCBP was observed in the pollen tube wall. The authors concluded that OsPCBP is important for starch accumulation and signal transduction processes.

Cover illustration: Two roles of vegetation in the CH_4 cycle: foliage of plants emits CH_4 under normal aerobic conditions, and soil bacteria, especially under undisturbed forests, oxidises CH_4 . (See Kirschbaum *et al.* pp. 521–530.)

Induction and accumulation of polyphenol oxidase activities as implicated in development of resistance against pearl millet downy mildew disease
S. Niranjana Raj, B. R. Sarosh and H. S. Shetty 563–571

This paper describes the involvement of polyphenol oxidase (PPO) in resistance to downy mildew. Enhanced biosynthesis and increased activity of enzymes is an important process in plant defence, and their presence can be used as a biochemical marker indicating resistance and/or susceptibility. The authors demonstrate that increased expression of PPO is correlated with increased pathogen resistance.

Cytokinin- and auxin-induced stomatal opening involves a decrease in levels of hydrogen peroxide in guard cells of *Vicia faba*
Xi-Gui Song, Xiao-Ping She, Jun-Min He, Chen Huang and Tu-sheng Song 573–583

This paper reports fascinating observations about the control of stomatal movement in response to auxin and cytokinin. The authors show that these hormones can lower intracellular H₂O₂ levels in guard cells, through different mechanisms, and that this is correlated with their effects on stomatal aperture. The results indicate that cytokinins initiate H₂O₂ scavenging mechanisms whereas auxins inhibit or restrain the production of H₂O₂. This helps our understanding of how these hormones modulate stomatal movement.

Combined transgenic expression of $\Delta 12$ -desaturase and $\Delta 12$ -epoxygenase in high linoleic acid seeds leads to increased accumulation of vernolic acid
Xue-Rong Zhou, Surinder Singh, Qing Liu and Allan Green 585–592

Oilseeds represent renewable sources of industrial raw materials, and therefore maximising the yields of fatty acids is critically important for economic viability. These authors combine two approaches: genetic mutations that decrease the conversion of the substrate to other products, and expression of additional genes that lead to enhanced synthesis of the substrate. The study emphasises the need for multifactorial approaches to increase the levels of target fatty acids.

Systemic *Potato virus X* infection induces defence gene expression and accumulation of β -phenylethylamine-alkaloids in potato
Annette Niehl, Christophe Lacomme, Alexander Erban, Joachim Kopka, Ute Krämer and Joachim Fisahn 593–604

This paper integrates metabolite profiles and gene expression data to elucidate response mechanisms in a compatible plant–virus interaction. The authors demonstrate that defence gene expression is activated upon systemic potato virus X infection of potato plants. They further show that while primary metabolism remains largely unaffected, β -phenylethylamine-alkaloids are substantially elevated upon infection. The authors suggest synthesis and extracellular polymerisation of hydroxycinnamic acid amides as part of a systemic defence response.

Research note: The five families of sucrose-phosphate synthase genes in *Saccharum* spp. are differentially expressed in leaves and stem
C. P. L. Grof, C. T. E. So, J. M. Perroux, G. D. Bonnett and R. I. Forrester 605–610

Grof *et al.* examine expression of the sucrose-phosphate synthase (SPS) gene family in sugarcane. This is the first paper to unravel SPS expression in sugarcane, where sucrose accumulates to high levels. Their results show clear differences in the relative expression of the various SPS gene families in different tissues or stages of development, supporting the view that SPS isoform function differs between species. This work leads the way to functional analysis of sucrose metabolism in various tissues.

Corrigendum to:

Avian gut passage reduces seed exit costs in *Sorbus aucuparia* (Rosaceae) as measured by a diametral compression test
Torbjørn R. Paulsen, Ommund Lindtjörn, Nils Roar Gjerdet and Göran Högstedt
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