

Functional Plant Biology

Contents

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Goldacre Paper: The central role of the
VERNALIZATION1 gene in the
vernalization response of cereals

Ben Trevaskis

479–487

Many plants require a period of growth at low temperatures to trigger flowering – a process known as vernalization. This review examines the molecular pathways that control vernalization-induced flowering in temperate cereals, such as wheat and barley, highlighting the central role of the *VERNALIZATION1* gene.

Review: Viewing leaf structure and evolution
from a hydraulic perspective

Tim J. Brodribb, Taylor S. Feild and Lawren Sack

488–498

One of the most conspicuous attributes of any leaf is the complex array of plumbing that irrigates photosynthetic tissues. This review examines how recent advances in the study of leaf vein function cast a new light on the evolution of leaf structure, explaining diverse themes from the internal organisation of leaves to the rise of the angiosperms.

Review: Plants versus pathogens: an evolutionary
arms race

**Jonathan P. Anderson, Cynthia A. Gleason,
Rhonda C. Foley, Peter H. Thrall,
Jeremy B. Burdon and Karam B. Singh**

499–512

The frequent and varied interactions between plants and microbes are very important for natural and agricultural systems. Recent advances in our understanding of plant defence signalling, plant resistance (R) protein–pathogen effector interactions, symbiosis and the forces driving pathogen evolution are used to highlight the full scale evolutionary arms race between plants and microbes.

Isolation, phylogeny and evolutionary analysis
of *Pto*-type disease resistance gene analogues
from a *Cucumis hystris* introgression line
of cucumber (*C. sativus*)

**Hongjian Wan, Chuntao Qian,
Ahmed Abbas Malik, Zhenguo Zhao
and Jinfeng Chen**

513–523

Eight classes of serine/threonine kinases (STKs) were isolated from an introgression line of *Cucumis hystris*/*C. sativus*. Phylogenetic analysis revealed that six of them were *Pto*-type resistance gene analogues. Evolutionary analysis indicated that purifying selection played an important role in the evolutionary process.

Submergence tolerance in *Hordeum marinum*:
dissolved CO₂ determines underwater
photosynthesis and growth

Ole Pedersen, Al I. Malik and Timothy D. Colmer

524–531

Increases in the frequency and severity of floods are projected to adversely affect natural plant communities and crop systems. However, floodwaters differ markedly in dissolved CO₂, yet the effects of CO₂ on underwater photosynthesis of terrestrial plants have rarely been examined. Here, we show that dissolved CO₂ levels can determine submergence tolerance of terrestrial plants.

Cover illustration: Seasonal flowering responses of temperate cereals. Flowering of autumn-sown (vernalization-responsive) cereals is delayed before winter because neither daylength nor vernalization response pathways are active. During winter, plants are vernalized, promoting the transition to reproductive development and making plants competent to respond to long days. Subsequently, plants flower rapidly as days lengthen during spring (see Trevaskis pp. 479–487).

Metal-specific and NADPH oxidase dependent changes in lipoxygenase and NADPH oxidase gene expression in *Arabidopsis thaliana* exposed to cadmium or excess copper

Tony Remans, Kelly Opdenakker, Karen Smeets, Dennis Mathijsen, Jaco Vangronsveld and Ann Cuypers

532–544

NADPH oxidases are involved in ROS signalling and lipoxygenases in oxylipin signalling. In the context of early perception and signalling of heavy metal presence and toxicity in *Arabidopsis thaliana*, expression of the different members of these gene families was studied when plants were subjected to cadmium (Cd) or copper (Cu).

Variation in carbon content and size in developing fruit of *Actinidia deliciosa* genotypes

Simona Nardoza, Helen L. Boldingh, Annette C. Richardson, Guglielmo Costa, Hinga Marsh, Elspeth A. MacRae and Michael J. Clearwater

545–554

This study identifies the developmental processes contributing to variation in fruit quality traits (dry matter, flavour and fruit size) in green-fleshed kiwifruit, and compares them with the model for fruit development, the tomato. Kiwifruit differs from tomato in the timing and type of carbon stored in the fruit. High dry matter kiwifruit genotypes were characterised by a higher rate of starch accumulation than low dry matter genotypes, regardless of fruit size.

Disturbance is required for CO₂-dependent promotion of woody plant growth in grasslands

Beth R. Loveys, John J. G. Egerton, Dan Bruhn and Marilyn C. Ball

555–565

The relative effects of disturbance, competition for edaphic resources, thermal interference, and elevated [CO₂] on growth of snow gum (*Eucalyptus pauciflora*) seedlings in grasslands were studied under field conditions. The results reveal the complexity of competitive inhibition of plant growth in which ineffective competition for resources such as soil water enhances the vulnerability of the plant to abiotic stress, in this case frost.

Leaf hydraulic architecture and water relations of three ferns from contrasting light habitats

Maria A. Lo Gullo, Fabio Raimondo, Alessandro Crisafulli, Sebastiano Salleo and Andrea Nardini

566–574

The hydraulic architecture and water relations of three ferns adapted to shaded (*Woodwardia radicans* and *Dryopteris affinis*) or sunny (*Polystichum setiferum*) habitats were investigated. Leaf hydraulic resistance was lowest in *P. setiferum* and was coordinated with low rachis hydraulic resistance. Hydraulic adjustment of fern fronds appears as a key component of adaptation of Pteridophytes to contrasting light habitats.

How long does it take for different seeds to dry?

James P. Hill, Will Edwards and Peter J. Franks

575–583

We identify three models of seed moisture loss in 24 tropical plant species that produce desiccation-sensitive seeds. Seed mass could not predict the rate of moisture loss between species yet within species the time to a given state of desiccation could be predicted by seed mass for eight species.