

Functional Plant Biology

Contents

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*Review: Hormone signalling and root development:
an update on the latest *Arabidopsis thaliana* research*

Jose Manuel Perez-Perez 163–171

This timely review of a very quickly evolving area of plant biology provides an excellent update on the basic molecular events shaping root patterning and growth in *Arabidopsis*, and highlights the value of techniques such as genomic tools for understanding root development. The review summarises our current knowledge about the crosstalk between root growth regulators and hormone signalling pathways, and their implications for primary root development.

Significant transpirational water loss occurs throughout
the night in field-grown tomato

**Mairgareth A. Caird, James H. Richards and
Theodore C. Hsiao** 172–177

Caird *et al.* compare nighttime leaf conductance and water loss in tomato cultivars and related species in the greenhouse and in the field. The authors use three methods spanning leaf to canopy scales to assess the importance of nighttime transpiration. They conclude that in the field nighttime water loss can account for a significant proportion of daily water loss without carbon gain, and weigh this cost against possible benefits of nighttime transpiration, such as enhanced nutrient acquisition.

A model of daily mean canopy conductance for
calculating transpiration of olive canopies

**Francisco Orgaz, Francisco J. Villalobos,
Luca Testi and Elias Fereres** 178–188

This paper addresses the methods available for calculating canopy transpiration in orchards, with particular reference to olives. The authors propose an alternative to the complex biometeorological models and empirical estimations currently used to calculate transpiration. They use the Penman–Monteith equation on a daily basis, coupled with a model of bulk daily canopy conductance to obtain transpiration of olive groves with differing levels of ground cover.

Drought-adaptive attributes in the Seri/Babax hexaploid
wheat population

**Juan Jose Olivares-Villegas, Matthew P. Reynolds
and Glenn K. McDonald** 189–203

Olivares-Villegas *et al.* report a study of physiological and agronomic traits associated with drought adaptation in a bread wheat population. The authors identify canopy temperature, a complex secondary trait consistently associated with higher performance, as the most drought-adaptive trait. This trait can be easily measured in the field and will be useful for breeders as a selection criterion for identifying high-yielding wheat genotypes and as a predictor of yield performance under drought stress.

Cover illustration: Top left: confocal image of the distal portion of a mature embryo showing root patterning in the wild type (WT). Bottom left: expression of the DR5::GFP reporter in a 3-day-old primary root (red, propidium iodide; green, GFP signal), which reveals the auxin response maximum. Top right: WT primary root treated for 24 h with the auxin transport inhibitor NPA shows re-patterning at the stem cell niche region. Bottom right: cross section of the root meristem in the scr-4 mutant showing the characteristic single layer of ground tissue (see Perez-Perez pp. 163–171).

Photosynthetic responses of three C₄ grasses of different metabolic subtypes to water deficit

**Ana E. Carmo-Silva, Ana S. Soares,
Jorge Marques da Silva, Anabela Bernardes da Silva,
Alfred J. Keys and Maria Celeste Arrabaça** 204–213

Water deficit was rapidly imposed in three C₄ grass species belonging to different metabolic subtypes. The effects on leaf relative water content, net photosynthesis, stomatal conductance, chlorophyll *a* fluorescence and carboxylating enzyme activities were determined. The authors conclude that net photosynthesis in *Cynodon dactylon* lost water more rapidly than *Paspalum dilatatum* and *Zoysia japonica*, but its photosynthesis was more resistant to severe dehydration.

Research note: Energy partitioning in photosystem II complexes subjected to photoinhibitory treatment

Dmytro Korniyev and Luke Hendrickson 214–220

Chlorophyll *a* fluorescence measured *in vivo* is frequently used to study the role of different processes influencing the distribution of excitation energy in photosystem II (PSII). Currently several contrasting energy partitioning methodologies exist, all of which are flawed or difficult to measure. This Research note addresses these issues by satisfying rate constant criteria when leaves contain photoinactivated PSII complexes and during partial reduction of the Q_A pool during illumination.

Amelioration of detrimental effects of waterlogging by foliar nutrient sprays in barley

**Jiayin Pang, John Ross, Meixue Zhou,
Neville Mendham and Sergey Shabala** 221–227

Pang *et al.* investigate mechanisms of alleviation of detrimental effects of waterlogging by foliar application of nutrients. They show that foliar nutrient sprays improved growth of barley plants under waterlogged conditions and that the improvement was related to better plant nutrition as well as accumulation of auxin at the shoot base, which resulted in increased development of adventitious roots.

Evaluation of the differential osmotic adjustments between roots and leaves of maize seedlings with single or combined NPK-nutrient supply

**Christoph Studer, Yuncai Hu and
Urs Schmidhalter** 228–236

Nitrogen, phosphorus and potassium are applied singly or in combination to maize plants under drought stress, to evaluate their effects on osmotic adjustment and turgor maintenance in roots and leaves. Specifically, the authors investigate the hypothesis that roots adjust osmotically better than shoots, which promotes root growth under drought. They conclude that optimal nutrition resulted in greater turgor maintenance in roots, facilitating better root growth and promoting overall plant growth under drought conditions.

Growth and development of the facultative root hemiparasite *Rhinanthus minor* after removal of its host

**Fan Jiang, Leila Timergalina, Guzel Kudoyarova,
W. Dieter Jeschke and Wolfram Hartung** 237–245

The work described in this paper is based on the novel idea that the facultative hemiparasite *Rhinanthus minor* gains many of the benefits of attaching to the host in the first few weeks, and can revert to the physiological state of a non-parasitic plant in the absence of signals from the host. Removal of the host shoot from the *Rhinanthus*/barley association results in normal growth and development of the host-free attached *Rhinanthus*, with normal diurnal stomatal behaviour and abscisic acid and cytokinin relationship.