

Functional Plant Biology

Contents

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Early detection of *Psa* infection in kiwifruit by means of infrared thermography at leaf and orchard scale

**Wouter H. Maes, Peter E. H. Minchin,
William P. Snelgar and Kathy Steppe**

1207–1220

Pseudomonas syringae pv. *actinidiae* (*Psa*) the causal agent of bacterial canker of kiwifruit, has become a worldwide threat for the kiwifruit industry. In this work, we show that *Psa* can be detected at early stages of infection both at leaf and canopy scale using infrared thermography. At leaf scale, this method will be able to assist fundamental research of infection mechanisms; at canopy scale, the method could be used to identify regions of *Psa*-infection to be pruned out to prevent further devastating spread of the disease.

Do wide crowns in arid woodland trees reflect hydraulic limitation and reduction of self-shading?

**Martín Escoto-Rodríguez, José M. Facelli
and Jennifer R. Watling**

1221–1229

In arid lands many trees develop broad crowns that affect many ecological interactions, but how that form is acquired is unresolved. We measured crown shape and carbon isotope ratios. We found that upper branches suffered more water stress than laterally spreading branches, and that lower branches were affected by self-shading. When lower and upper branches are stressed, lateral spreading at middle crown become the best alternative for growth. These results advance our understanding of crown development in trees.

Drought tolerances of three stem-succulent halophyte species of an inland semiarid salt lake system

**Victoria A. Marchesini, Chuanhua Yin,
Timothy D. Colmer and Erik J. Veneklaas**

1230–1238

Tecticornia species are dominant in saline habitats differing in the frequency and intensity of drought and flooding. In controlled conditions, the comparative response of three species to drying soil was remarkably similar, despite their distribution at opposite ends of a water availability gradient. Combined osmotic and matrix components of soil water potential during drought stress in drying saline soils have important implications for the understanding of physiological tolerance mechanisms and habitat requirements of salt lake halophytes.

Seedling mortality during biphasic drought in sandy Mediterranean soils

**Stephen M. Benigno, Kingsley W. Dixon
and Jason C. Stevens**

1239–1248

Increasing drought events may further exacerbate the currently high seedling mortality patterns observed in restoration programs. This paper demonstrates a catastrophic decrease in physiological resilience of three Mediterranean tree species during the seedling establishment phase to successive droughts. An understanding of plant functional requirements through critical development stages will enable restoration practitioners to overcome high failure rates and improve biodiversity outcomes generally.

Development of a diurnal dehydration index for spring barley phenotyping

**Pablo Rischbeck, Peter Baresel, Salah Elsayed,
Bodo Mistele and Urs Schmidhalter**

1249–1260

Breeding for drought tolerance is important for improving yield stability in agriculture in the coming decades. A new approach for precise, high-throughput and low-cost optical measurement of drought stress in barley was developed. This may enable the identification of drought tolerant varieties in field trials.

Cover illustration: Function of WRKY transcription factors in cellular defense during leaf rust infection in wheat (see Kumar *et al.* pp. 1295–1309). Image by Dhananjay Kumar.

<p>Response of floret fertility and individual grain weight of wheat to high temperature stress: sensitive stages and thresholds for temperature and duration</p> <p>P. V. Vara Prasad and Maduraimuthu Djanaguiraman</p>	1261–1269	<p>High temperature (HT) stress causes significant yield losses in wheat. The two periods most sensitive to short episodes of HT stress were identified as gamete development and fertilisation. Short episodes (5 days) of mean temperatures >24°C decreased floret fertility. Increasing duration (from 2 to 30 days) of HT stress (mean temperature of 30°C) linearly decreased floret fertility and individual grain weight.</p>
<p><i>Brachypodium distachyon</i>: a model species for aluminium tolerance in Poaceae</p> <p>Roberto Contreras, Ana M. Figueiras, Francisco J. Gallego and Cesar Benito</p>	1270–1283	<p>Aluminium (Al) toxicity is the main abiotic stress limiting plant productivity in acidic soils. <i>Brachypodium distachyon</i> (Bd) is a good model species for Al tolerance in Poaceae. The exudation of organic acids was involved in the Al tolerance of <i>Brachypodium</i>. An insertion was present in the promoter region of <i>BdALMT1</i> (Al-activated malate transporter) gene of tolerant diploid and allotetraploid plants.</p>
<p>Post-flood nitrogen and basal phosphorus management affects survival, metabolic changes and anti-oxidant enzyme activities of submerged rice (<i>Oryza sativa</i>)</p> <p>Priyanka Gautam, Banwari Lal, Rajagounder Raja, Mirza Jaynul Baig, Deepika Halder, Liza Rath, Mohammad Shahid, Rahul Tripathi, Sangita Mohanty, Pratap Bhattacharyya and Amaresh Kumar Nayak</p>	1284–1294	<p>Post-flood nitrogen and basal phosphorus application were evaluated on submergence tolerance of rice under clear and turbid water with submergence tolerant and susceptible cultivars. Urea spray and basal phosphorus improved survival, chlorophyll, non-structural carbohydrates and reduced shoot elongation and ethylene even in turbid water. Nutrient management options can provide opportunities for better survival and establishment of submerged rice, helping farmers to cope with the existing problems in flood-prone areas.</p>
<p>Functional characterisation of a WRKY transcription factor of wheat and its expression analysis during leaf rust pathogenesis</p> <p>Dhananjay Kumar, Anjali Kapoor, Dharmendra Singh, Lopamudra Satapathy, Ashwini Kumar Singh, Manish Kumar, Kumble Vinod Prabhu and Kunal Mukhopadhyay</p>	1295–1309	<p>The WRKY TFs has been a subject of intense research; however, their functional analysis in crops like wheat is still lacking. The molecular structure of a WRKY gene JX028549 was revealed and its spatio-temporal expression showed upregulation in response to the leaf rust pathogenesis. The results contribute towards understanding the structure and function of a wheat WRKY TF that can be used as a candidate gene to improve biotic stress tolerance.</p>
<p>Photoperiodic variations induce shifts in the leaf metabolic profile of <i>Chrysanthemum morifolium</i></p> <p>Katrine Heinsvig Kjaer, Morten Rahr Clausen, Ulrik Kræmer Sundekilde, Bent Ole Petersen, Hanne Christine Bertram and Carl-Otto Ottosen</p>	1310–1322	<p>Diurnal patterns in leaf primary metabolites are complex, and vary in relation to light intensity and photoperiodic variation. We demonstrate a coupling between diurnal patterns in leaf metabolites and leaf expansion, and that diurnal patterns of some metabolites are not affected by photoperiodic variation. The results enlighten the plasticity of primary metabolism and leaf expansion in an ever-changing environment.</p>
<p><i>Rhizobium</i>-induced elevation in xylem cytokinin delivery in pigeonpea induces changes in shoot development and leaf physiology</p> <p>Jean W. H. Yong, D. Stuart Letham, S. Chin Wong and Graham D. Farquhar</p>	1323–1335	<p>Pigeon pea, inoculated with <i>Rhizobium</i> strain IC3342, offers a novel system to study the role of xylem cytokinin in shoot development. With a 3-fold elevation in xylem cytokinin delivery to the shoot, various aspects of leaf physiology and shoot development were altered especially lateral bud outgrowth. Overall, xylem sap cytokinin appears to act as a pleiotropic regulator of plant development.</p>

Vigour reduction in girdled peach trees is related to lower midday stem water potentials

Sergio Tombesi, Kevin R. Day, R. Scott Johnson, Rebecca Phene and Theodore M. DeJong

1336–1341

Trunk girdling (horticultural practice used to increase fruit size) reduces vegetative shoot growth although there appears to be higher availability of carbohydrates above the girdle in girdled trees. This research indicates that early spring scaffold girdling decreased stem water potential above the girdle suggesting that early spring girdling not only influences phloem flow (that is interrupted by girdling) but also decreases xylem flow. The decreased stem water potentials appear to be directly related to reductions in vegetative shoot growth and explain why early spring girdling reduces shoot growth. It is hypothesized that early spring girdling affects xylem flow because the girdling process interrupts cambial activity and the production of new xylem however girdling may also influence root activity.
