

Functional Plant Biology

Contents

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<p><i>Review: Environmental stress activation of plant long-terminal repeat retrotransposons</i> Ahmed M. Alzohairy, Jamal S. M. Sabir, Gábor Gyulai, Rania A. A. Younis, Robert K. Jansen and Ahmed Bahieldin</p>	557–567	<p>Abiotic and biotic stresses activate long-terminal repeat retrotransposons in photosynthetic eukaryotes. In this article, we reviewed the ways that retrotransposons are activated by environmental stimuli to affect restructuring and diversification of the host genome. We recommend the use of RNA-Seq data of other plant species (e.g. <i>Rhazya stricta</i>) to get a deeper view of activation patterns.</p>
<p>Variation in mesophyll conductance among Australian wheat genotypes Eisrat Jahan, Jeffrey S. Amthor, Graham D. Farquhar, Richard Trethowan and Margaret M. Barbour</p>	568–580	<p>Conductance to CO₂ diffusion within leaves (mesophyll conductance) forms a significant and variable limitation on photosynthesis but remains poorly understood. Here, mesophyll conductance was found to vary 2-fold among wheat genotypes, and to be positively related to photosynthetic rate. These results suggest that both photosynthetic rate and water-use efficiency could be improved through breeding for higher mesophyll conductance.</p>
<p>Spring barley shows dynamic compensatory root and shoot growth responses when exposed to localised soil compaction and fertilisation Johannes Pfeifer, Marc Faget, Achim Walter, Stephan Blossfeld, Fabio Fiorani, Ulrich Schurr and Kerstin A. Nagel</p>	581–597	<p>The effects of localised soil compaction plus nutrient availability on root system architecture (RSA) and root growth dynamics have scarcely been investigated. We investigated the impact of heterogeneous soil conditions on barley RSA, and root and shoot growth using split-root rhizotrons, and observed dynamic compensatory alterations, particularly in lateral root initiation. In loose compartments formation of lateral roots started earlier than in uniform treatments and was significantly increased in compacted compartments when only these compartments were fertilised.</p>
<p>Assessment of phloem mobility of xenobiotics in <i>Triticum aestivum</i> and <i>Brachypodium distachyon</i> Olena Zhivotovsky Castello, Andrew J. Bowling, Gerrit Deboer and Yelena Adelfinskaya</p>	598–608	<p>Measurement of the phloem translocation of herbicides is a challenge, especially at the initial development of compounds. <i>B. distachyon</i> was evaluated for potential use in phloem bioassay showing a clear evidence of xylem discontinuity. This novel bioassay provides an opportunity to determine quantitatively phloem mobility of molecules <i>in vivo</i> without the use of radiolabel and with a high throughput during the early stages of pesticides research.</p>

Cover illustration: Brachypodium distachyon treated with Lucifer Yellow CH (LYCH) and HPTSA for 16 h (see Zhivotovsky Castello *et al.* pp. 598–608). (*Top left*) A three channel confocal micrograph showing cell wall autofluorescence (white, excited by a 405 laser line), LYCH fluorescence (yellow), and chlorophyll autofluorescence (red). (*Top right*) Same field of view as (*Top left*), but without the autofluorescence channel so that any signal in the LYCH channel can be seen. (*Bottom left*) *B. distachyon* crease region after uptake of HPTSA, demonstrating the movement of phloem-mobile compound into the caryopsis. Similar to what was observed in *Triticum aestivum*, the dark region in the centre of the image is likely xylem cells. (*Bottom right*) A cross-section of the palea surrounding the caryopsis shown in (*Top left*) and (*Top right*), demonstrating LYCH has reached the height of the caryopsis after the 16 h treatment. Crease region (arrowheads), crease vascular bundle (vb). Scale bars = 50 µm. Images by Andrew J. Bowling.

Is the differential response of riparian plant performance to extreme drought and inundation events related to differences in intraspecific trait variation?

Yasmijn A. M. van der Knaap, Rien Aerts and Peter M. van Bodegom

609–619

Climate change scenarios predict an increase in extreme climatic events. In our study we tested the effects of multiple extreme events on plant performance and trait intraspecific variation, and discovered that trait intraspecific variation was not induced by extreme events. However, multiple extreme events have quantitatively and qualitatively different impacts on plant performance than single events and it is difficult to predict those impacts beforehand, which hampers predicting plant responses to a future climate.

Does the hydrocooling of *Vitis vinifera* cv. Semillon vines protect the vegetative and reproductive growth processes and vine performance against high summer temperatures?

Dennis H. Greer and Mark M. Weedon

620–633

Heat events are a natural summer occurrence in Australian vineyards but costly in lost production, thus, protecting vines during these events is an economically important issue. We have assessed spraying water onto vines for brief periods as a means of reducing canopy temperatures. The canopies were nearly 10°C cooler during the heat events and both yields and berry composition were improved, suggesting spraying water onto vines is an effective means of reducing impacts of high temperatures.

Morpho-structural and physiological response of container-grown Sangiovese and Montepulciano cvv. (*Vitis vinifera*) to re-watering after a pre-veraison limiting water deficit

Alberto Palliotti, Sergio Tombesi, Tommaso Frioni, Franco Famiani, Oriana Silvestroni B, Maurizio Zamboni and Stefano Poni

634–647

The intraspecific diversity of Sangiovese and Montepulciano grapevine varieties is accentuated under early water deficit. Higher physiological and productive efficiency under non-limiting water supply noted by the near-isohydric Montepulciano compared with the near-anisohydric Sangiovese was reversed when both cultivars were subjected to a pre-veraison water deficit. Sangiovese had excellent net CO₂ exchange (NCER) recovery upon re-watering and is confirmed to be better adapted to dry/hot conditions.

Stomatal pore size and density in mangrove leaves and artificial leaves: effects on leaf water isotopic enrichment during transpiration

Leonel da Silveira Lobo Sternberg and Lynn M. Manganiello

648–658

In order to further the use of plant biomass stable isotope ratios as a proxy for environmental stressors such as drought and salinity, we must understand the long-term impact of such stressors on the isotopic composition of leaf water. Here we show with stomatal count and artificial leaves, that the lower leaf water isotopic enrichment observed in mangroves compared to freshwater plants is due their larger and lower density of stomatal pores. Our results have important implications in interpreting paleoclimate with tree ring oxygen isotope ratios, since stomatal frequency and size has varied over the ages.

Over-expression of *SlCycA3* gene in *Arabidopsis* accelerated the cell cycle transition

Jia Guo, Jiawen Wu, Tiantian Zhang and Haijun Gong

659–670

Since the connection between cyclins and plant development involving plant hormones is poorly understood, we characterise the *SlCycA3* gene to determine the effect of A3-type cyclin gene on cell-cycle-related plant growth and its regulation mechanisms under auxin treatment. Our results showed that overexpression of the *SlCycA3* gene accelerated root growth and development. Cyclin abundance may function as a regulator to control root growth in response to plant hormone treatment.