

Functional Plant Biology

Contents

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Evans Review: Canopy conundrums: building on the Biosphere 2 experience to scale measurements of inner and outer canopy photoprotection from the leaf to the landscape

Caroline J. Nichol, Roland Pieruschka, Kotaro Takayama, Britta Förster, Zbigniew Kolber, Uwe Rascher, John Grace, Sharon A. Robinson, Barry Pogson and Barry Osmond

1–24

Leaf to ecosystem scale experiments in the controlled environments of Biosphere 2 stimulated new methods for measurement of canopy photosynthesis. These highlighted different processes responsible for reversible down regulation of inner and outer canopy photosynthetic efficiency in evergreen woody plants that retain dense canopies of old leaves in the shade. Further developments of laser induced fluorescence transient (LIFT) methods for remote sensing of these canopy processes are described.

Photosynthetic sensitivity to drought varies among populations of *Quercus ilex* along a rainfall gradient

Nicolas K. Martin StPaul, Jean-Marc Limousin, Jesús Rodríguez-Calcerrada, Julien Ruffault, Serge Rambal, Matthew G. Letts and Laurent Misson

25–37

Understanding how forest will respond to increasing drought in the long term is crucial in the context of climate change. Comparing leaf photosynthetic limitation to drought in three populations of a wide spread Mediterranean oak differing in water availability for decades; we found that populations from drier sites were less limited by drought. This result highlights the need for further research on forest acclimation to long term drought and its formulation in forest productivity models.

Flowering in snow tussock (*Chionochloa* spp.) is influenced by temperature and hormonal cues

Matthew H. Turnbull, Richard P. Pharis, Leonid V. Kurepin, Michal Sarfati, Lewis N. Mander and Dave Kelly

38–50

Snow tussocks exhibit extreme episodic seeding that appears to be triggered by environmental cues. In order to investigate this, we subjected plants to a range of treatments (combinations of warming, root pruning and applications of a plant hormone) and found flowering was causally related to high temperature-induced increases in hormone levels. This could have important implications for regulating the evolutionary interaction between these plants and their seed predators.

Response of *Aegilops* species to drought stress during reproductive stages of development

Gautam P. Pradhan, P. V. Vara Prasad, Allan K. Fritz, Mary B. Kirkham and Bikram S. Gill

51–59

Drought stress is an important environmental factor limiting productivity of wheat. Genotypes of wild (*Aegilops* species) and spring wheat were screened under controlled environments and genotypes tolerant to drought stress during flowering were identified. Tolerant genotypes had lesser decline in grain number and grain weight under drought stress and can potentially be utilised to improve drought tolerance in wheat.

Cover illustration: Automated remote sensing of chlorophyll fluorescence at 12 m using LIFT (Mk2) (see Nichol *et al.* pp. 1–24). The coordinates for 12 target areas (~10 cm diameter) on the South-facing (Northern Hemisphere) canopy of *Philadelphus coronarius* were set in the telescope driver of LIFT, and have been simulated by the red discs applied to the photograph taken at 18:00 hours. Inserts: close-up of laser excitation in one target space show little wind effect during successive 2 s excitation-measurement protocols at 06:00 hours (R. Pieruschka and B. Osmond; phenology garden, Forschungszentrum Jülich, May 2011).

Development of an assay to evaluate differences in germination rate among chickpea genotypes under limited water content

Saeedreza Vessal, Jairo A. Palta, Craig A. Atkins and Kadambot H. M. Siddique

60–70

The paper describes the development and use of an assay to evaluate genotypic differences in germination under low soil water content in chickpea. It consists of small plastic containers (50 mm × 50 mm × 60 mm) filled with river sand and tightly closed (but not sealed) to minimise water loss and maintain constant soil water content during germination. The assay is a suitable experimental tool to examine gene expression in contrasting genotypes during germination and early stages of seedling growth.

Generation and scavenging of reactive oxygen species in wheat flag leaves under combined shading and waterlogging stress

Huawei Li, Jian Cai, Fulai Liu, Dong Jiang, Tingbo Dai and Weixing Cao

71–81

Concurrent waterlogging and shading stress (WS) under persistent rainfalls during grain filling stage causes great yield losses in wheat. WS resulted in severe oxidative stress in chloroplasts and leaves which impaired photosynthesis, these effects were regulated at transcription level by modifying the expression of related genes. The results advanced our understanding of the climate change effects on wheat production.

Plant growth-promoting bacteria as a tool to improve salinity tolerance in sweet pepper

Francisco M. del Amor and Paula Cuadra-Crespo

82–90

Plant growth-promoting bacteria alleviate salt-produced stress in pepper plants. A study in which peppers were irrigated with a nutrient solution containing NaCl showed that a rhizosphere bacterium (*Azospirillum*) – commonly used as a biofertiliser – enhanced plant growth, reduced the harmful Cl[–] concentration in the leaves and improved N nutrition. The results open new possibilities for the use of low quality waters in agriculture in arid or semi-arid regions, as the use of good quality water faces strong competition from the demand for household and industrial consumption.