

Functional Plant Biology

Contents

Volume 41 Issue 1 2014

Root growth and N dynamics in response to multi-year experimental warming, summer drought and elevated CO₂ in a mixed heathland-grass ecosystem

M. F. Arndal, I. K. Schmidt, J. Kongstad, C. Beier and A. Michelsen

1–10

Ecosystems exposed to elevated CO₂ are often found to sequester more atmospheric carbon due to increased plant growth. We show that a heathland–grass ecosystem increases root growth when exposed to elevated CO₂. The nitrogen uptake did not increase similarly but the higher root production might lead to long-term increased N uptake on a whole-plant basis.

Making the best of the worst of times: traits underlying combined shade and drought tolerance of *Ruscus aculeatus* and *Ruscus microglossum* (Asparagaceae)

Alexandria Pivovarovff, Rasoul Sharifi, Christine Scoffoni, Lawren Sack and Phil Rundel

11–24

Shrubs in the genus *Ruscus* have flat, photosynthetic stems that are similar in appearance to leaves: these species are adapted to tolerate combined shade and drought. The aim of this work was to clarify the mechanisms that enable *Ruscus* to occupy extremely low resource understory sites. We studied 57 traits of two species, *Ruscus aculeatus* and *R. microglossum*, and considering their unique adaptations and trait values, *Ruscus* can serve as a model for how plants can avoid a general trade-off between shade and drought tolerance.

Partitioning hydraulic resistance in *Sorghum bicolor* leaves reveals unique correlations with stomatal conductance during drought

Troy W. Ocheltree, Jesse B. Nippert, Mary Beth Kirkham and P. Vara V. Prasad

25–36

Drought reduces the production and yield of plants worldwide, but the mechanisms that control the variable responses of plants to water limitation is still not fully understood. Among six genotypes of *Sorghum bicolor* we show that the hydraulic resistance of different leaf tissues correlates with stomatal conductance at different levels of drought severity. These results help explain the variability in plant responses to drought, and reveals fundamental relationships between leaf hydraulic conductance and plant water-use strategies.

The role of leaf hydraulic conductance dynamics on the timing of leaf senescence

Juan Pablo Giraldo, James K. Wheeler, Brett A. Huggett and N. Michele Holbrook

37–47

Despite their importance in plant nutrient redistribution, the mechanisms controlling the onset of leaf senescence are poorly understood. A reduction of leaf hydraulic conductance with age influences leaf senescence in tomato, but not in tropical and temperate trees. Although reductions of transpiration rates affected leaf longevity in tomato and one tropical tree species, hydraulic regulation of the xylem-transported compounds apparently acted as an age-dependent signal controlling leaf senescence in tomato.

Cover illustration: Ruscus microglossum Bertol. is an evergreen, woody monocot shrub that exhibits phylloclades, or flat, photosynthetic stems that resemble leaves (see Pivovarovff *et al.* pp. 11–24). Flowers originate on the surface of the phylloclade, as shown in this image.

<p>A phenotypic marker for quantifying heat stress impact during microsporogenesis in rice (<i>Oryza sativa</i> L.) Krishna S. V. Jagadish, Peter Craufurd, Wanju Shi and Rowena Oane</p>	48–55	<p>Heat stress at gametogenesis in rice causes significant reduction in spikelet fertility. Currently, there is no marker available for precise phenotyping of this trait. The inter collar distance of –8 to –9 cm between the immediate fully opened leaf and the flag leaf is an effective phenotypic marker to estimate heat stress induced damage at gametogenesis. This finding will drive breeding efforts to develop heat tolerance during gametogenesis in rice.</p>
<p>Understanding the molecular events underpinning cultivar differences in the physiological performance and heat tolerance of cotton (<i>Gossypium hirsutum</i>) Nicola S. Cottee, Iain W. Wilson, Daniel K. Y. Tan and Michael P. Bange</p>	56–67	<p>Daily exposure to temperatures above an optimum, as well as heat waves, reduces plant growth, development and ultimately yield. Development of heat resistant plants may improve crop yields in hot environments. By identifying genes and gene pathways involved in the heat stress response, this research shows key areas that can be targeted to breed cotton varieties with heat tolerance to improve yields in warm and hot environments.</p>
<p>Development and evaluation of a field-based high-throughput phenotyping platform Pedro Andrade-Sanchez, Michael A. Gore, John T. Heun, Kelly R. Thorp, A. Elizabete Carmo-Silva, Andrew N. French, Michael E. Salvucci and Jeffrey W. White</p>	68–79	<p>The limited availability of tools for rapidly and reliably measuring plant traits under relevant conditions has impeded progress in crop improvement. We developed and evaluated a tractor-based system that can measure traits related to the heat and drought stress tolerance of field-grown plants throughout the growing season. The system has the potential to increase the quantity and quality of field trait data, facilitating the development of high yielding stress-tolerant crops.</p>
<p>Molecular cloning and characterisation of an acyl carrier protein thioesterase gene (<i>CocoFatB1</i>) expressed in the endosperm of coconut (<i>Cocos nucifera</i>) and its heterologous expression in <i>Nicotiana tabacum</i> to engineer the accumulation of different fatty acids Yijun Yuan, Yinhua Chen, Shan Yan, Yuanxue Liang, Yusheng Zheng and Li Dongdong</p>	80–86	<p>The mechanisms by which coconut endosperm accumulates medium chain fatty acids ($\approx 60\%$) are still unknown. In this paper, an acyl- acyl carrier protein thioesterase (<i>CocoFatB1</i>) was isolated from coconut and heterologously expressed in transgenic tobacco. The results indicated that <i>CocoFatB1</i> acts specifically on 14 : 0-ACP, 16 : 0-ACP and 18 : 0-ACP, and can increase medium chain saturated fatty acid in transgenic plants.</p>
<p>Control of glycerol biosynthesis under high salt stress in <i>Arabidopsis</i> Ahmed Bahieldin, Jamal S. M. Sabir, Ahmed Ramadan, Ahmed M. Alzohairy, Rania A. Younis, Ahmed M. Shokry, Nour O. Gadalla, Sherif Edris, Sabah M. Hassan, Magdy A. Al-Kordy, Khalid B. H. Kamal, Samar Rabah, Osama A. Abuzinadah and Fotouh M. El-Domyati</p>	87–95	<p>Loss-of-function and gain-of-function approaches were utilised to detect the physiological influence of glycerol biosynthesis during salt stress and the role of glycerol in conferring salt tolerance in <i>Arabidopsis</i>. Results indicate the participation of glycerol overproduction in salt tolerance in <i>Arabidopsis</i>. Furthermore, we hypothesise that mechanism(s) of glycerol retention/efflux in the cell are affected at 200 mM NaCl in <i>Arabidopsis</i>.</p>
<p>Negative short-term salt effects on the soybean–<i>Bradyrhizobium japonicum</i> interaction and partial reversion by calcium addition Nacira Muñoz, Marianela Rodriguez, German Robert and Ramiro Lascano</p>	96–105	<p>The soybean–rhizobia symbiotic interaction is severely affected by salt stress. We analysed the short-term salt stress effects on soybean root hair ionic homeostasis, PR gene expression and its effect on nodulation. Short exposure to salt affected root hair ionic homeostasis and PR protein gene expression, and reduced the nodule number. The addition of calcium is a common agricultural practice to reverse salt effects. We report a positive effect of calcium addition on soybean nodulation under saline conditions.</p>