

Functional Plant Biology

Contents

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Editorial: Food security, climate change and biofuels:
integrative plant biology is now in the spotlight

Rana Munns

Goldacre Paper: Auxin: at the root of nodule development?

Ulrike Mathesius

651–668

Legumes can form two types of root organs: lateral roots and nodules. The ability of legumes to nodulate in symbiosis with nitrogen-fixing bacteria has only evolved recently. This review examines whether auxin, a central regulator of lateral root development, has been targeted by symbiotic bacteria to coax plants into forming symbiotic root nodules.

Molecular and physiological adaptation to prolonged drought stress in the leaves of two Andean potato genotypes

Shrinivasrao P. Mane, Cecilia Vasquez Robinet, Alexander Ulanov, Roland Schafleitner, Luz Tincopa, Amelie Gaudin, Giannina Nomberto, Carlos Alvarado, Christian Solis, Luis Avila Bolivar, Raul Blas, Oscar Ortega, Julio Solis, Ana Panta, Cristina Rivera, Ilanit Samolski, Doris H. Carbajulca, Meredith Bonierbale, Amrita Pati, Lenwood S. Heath, Hans J. Bohnert and Ruth Grene

669–688

The responses of two Andean potato landraces, Sullu and Ccompis, to prolonged drought and recovery after drought were compared. Physiological, metabolomic, and gene expression data demonstrate the presence of distinct molecular and biochemical mechanisms that lead to yield maintenance but differential biomass accumulation in vegetative tissues.

Orchestration of transpiration, growth and carbohydrate dynamics in rice during a dry-down cycle

D. Luquet, A. Clément-Vidal, D. Fabre, D. This, N. Sonderegger and M. Dingkuhn

689–704

Dynamics of plant transpiration, growth and morphogenetic processes were investigated in relation to carbon metabolism under drought in rice seedlings. Transpiration, leaf expansion rate and tissue sugar concentrations responded linearly to soil water deficit when falling below critical values. Invertase genes were up-regulated in sink leaves. Starch accumulated in sink leaves and hexoses in source leaves. In conclusion, developing leaves enhance sink activity and storage under stress.

Cover illustration: The figure shows a cross section through an indeterminate nodule in the model legume *Medicago truncatula*. The blue staining is a result of GUS expression driven by the auxin responsive promoter, GH3. High auxin activity is visible in the apical meristem and peripheral vascular strands of the nodule, as well as in cortical and vascular tissues of the root (see Mathesius pp. 651–668).

Leaf longevity and drought: avoidance of the costs and risks of early leaf abscission as inferred from the leaf carbon isotopic composition

Alfonso Escudero, Sonia Mediavilla and Hermann Heilmeyer

705–713

Stomatal restrictions to C assimilation (as estimated by leaf carbon isotopic composition) increased with leaf longevity and the annual water deficit in Mediterranean woody species. We hypothesise that stronger stomatal control arose as a mechanism to reduce the risk of desiccation and to avoid the costs of anticipated leaf mortality in species with a long leaf life expectancy.

Enhanced sensitivity of *Arabidopsis* anthocyanin mutants to photooxidation: a study with fluorescence imaging

Ling Shao, Zhan Shu, Chang-Lian Peng,

Zhi-Fang Lin, Cheng-Wei Yang and Qun Gu

714–724

Chlorophyll fluorescence and antioxidative capability in detached leaves of *Arabidopsis* mutants deficient in anthocyanin biosynthesis (*tt3*, *tt4* and *tt3tt4*) and the wild type (*Ler*) were investigated under photooxidation stress induced by Methyl Viologen (5 μ M). Results suggested that anthocyanin, along with other antioxidants, protected the photosynthetic apparatus from photo-oxidative damage.

Relating leaf photosynthetic rate to whole-plant growth: drought and shade effects on seedlings of four *Quercus* species

José L. Quero, Rafael Villar, Teodoro Marañón, Regino Zamora, Dolores Vega and Lawren Sack

725–737

A new framework for understanding the impacts of natural combinations of irradiance and water on growth is proposed by studying seedlings of four oak species, which have contrasting leaf habit and high seed mass variation. In addition, it is demonstrated that relative growth rate can be predicted from short-term measurements of leaf physiology, for closely related species, across water and irradiance supplies.