

Functional Plant Biology

Contents

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Evans Review No. 4: Functional genomics in chickpea: an emerging frontier for molecular-assisted breeding

Tristan E. Coram, Nitin L. Mantri, Rebecca Ford and Edwin C. K. Pang 861–873

This timely review focuses on the emergence and progression of the use of functional genomics towards more efficient molecular-assisted breeding of chickpea. The authors focus on biotic and abiotic stresses with a critical analysis of the achievements made so far, including EST libraries, transcriptomics and innovative techniques such as the combination of SuperSAGE and microarrays to identify genes involved in stress resistance/tolerance. They suggest future directions using these valuable genetic tools in chickpea and the model legumes *Medicago* and *Lotus*.

Actin filaments modulate hypoosmotic-responsive K^+ efflux channels in specialised cells of developing bean seed coats

Wen-Hao Zhang, John W. Patrick and Stephen D. Tyerman 874–884

The symplasmic isolation of maternal seed coat and enclosed embryo makes a good system for studying nutrient transport between the two. As the embryo takes up nutrients, the apoplast becomes hypoosmotic, stimulating nutrient release from ground parenchyma cells. This paper presents strong evidence for the role of actin in the relationship between changes in cell size and efflux. The authors demonstrate that hypoosmotic treatment activates a K^+ -permeable channel in bean seed coat cells.

Endogenous auxin regulates the sensitivity of *Dendrobium* (cv. Miss Teen) flower pedicel abscission to ethylene

Karnchana Rungruchkanont, Saichol Ketsa, Orawan Chatchawankanphanich and Wouter G. van Doorn 885–894

These authors previously identified a *Dendrobium* cultivar in which floral abscission was ethylene-insensitive, in contrast to most other cultivars. Here they study the effect of auxin and auxin antagonists on ethylene sensitivity, measuring the activity of key enzymes associated with tissue abscission (polygalacturonase and β -1, 4-glucanase), reaching useful conclusions as to the role of auxin in the control of pedicel abscission.

N-protein mobilisation associated with the leaf senescence process in oilseed rape is concomitant with the disappearance of trypsin inhibitor activity

Philippe Etienne, Marie Desclos, Lucie Le Gou, Julie Gombert, Josette Bonnefoy, Karine Maurel, Frédéric Le Dily, Alain Ourry and Jean-Christophe Avice 895–906

N remobilisation during leaf senescence in oilseed rape is influenced by soil N supply. Protease inhibitors are potential regulators of senescence, so these authors investigated whether protease inhibitors were involved in the control of protein mobilisation associated with senescence. Results revealed that, under nitrate deprivation, the growth of young leaves was maintained by more efficient N recycling from mature leaves, which coincided with a rapid disappearance of protease inhibitors. Thus, a 19-kDa protein with trypsin inhibitor activity may have a protective role in delaying the onset of senescence.

Cover illustration: Chickpea (garbanzo beans) pods maturing in the (early August) late summer afternoon sun on the gentle slopes of the Palouse, eastern Washington (see Coram *et al.* pp. 861–873). Photo by Martin Chilvers.

The effects of UV-B radiation on photosynthesis in relation to Photosystem II photochemistry, thermal dissipation and antioxidant defenses in winter wheat (*Triticum aestivum* L.) seedlings at different growth temperatures

Shu-Hua Yang, Li-Jun Wang, Shao-Hua Li, Wei Duan, Wayne Loescher and Zhen-Chang Liang 907–917

The work described in this paper addresses an important area of crop ecophysiological research: the effects of UV-B on photosynthesis in wheat seedlings under two growth temperatures. The authors showed that UV-B radiation inhibited photosynthesis in winter wheat seedlings at both temperatures, mainly due to the impairment of PSII photochemical efficiency; lower temperatures further aggravated photoinhibition and damage by weakening the antioxidant system.

Incontinence in aging leaves: deteriorating water relations with leaf age in *Agastachys odorata* (Proteaceae), a shrub with very long-lived leaves
Gregory J. Jordan and Timothy J. Brodribb 918–924

Many aspects of leaf longevity, including metabolic control, signalling and whole-leaf issues, are poorly understood, although the topic has widespread ecological and evolutionary significance. The central idea in this paper is that increased water loss and reduced water use efficiency can be underlying causes of the need for leaves to be shed in an evergreen species, *Agastachys*, in a relatively well-watered region. The authors measured water loss and net CO₂ assimilation in leaves of various ages, and found significant increases in cuticular and stomatal residual conductance of long-lived leaves.

Physiological responses of the green alga *Dunaliella parva* (Volvocales, Chlorophyta) to controlled incremental changes in the N source
Mario Giordano, Alessandra Norici, Daniel J. Gilmour and John A. Raven 925–934

This work improves our understanding of the processes controlling the acclimation of algal cells to gradual changes in inorganic N sources. The authors demonstrate that a biphasic acclimation process takes place in algae subjected to a continuous and incremental change in the N source. This innovative piece of work contains important physiological and ecophysiological information on some fundamental processes controlling resource utilisation and allocation in microalgae.

Elastic properties of the forisome
Stephen A. Warmann, William F. Pickard and Amy Q. Shen 935–945

Prior to the discovery of the forisome, a proteinaceous inclusion in sieve element cells of legumes which undergoes Ca²⁺-driven shape changes and transiently halts sugar translocation in the phloem, plant biologists had no way of explaining phloem translocation sensitivity to abiotic stresses such as cold shock and mechanical vibration. Forisomes represent an exciting class of proteins since they are capable of reversible contraction that is independent of ATP but relies on external stimuli such as calcium ions. These authors compare forisomes from fava and sword beans, finding similar viscoelastic parameters. This is a significant step in understanding the anisotropic shape changes which can be chemically induced in the forisome, and will help to elucidate the mode of forisome action, their biophysical functioning *in situ*, and their technological potential as a natural smart material.

Identification and characterisation of acidic and novel basic forms of actinidin, the highly abundant cysteine protease from kiwifruit
Niels J. Nieuwenhuizen, Lesley L. Beuning, Paul W. Sutherland, Neelam N. Sharma, Janine M. Cooney, Lara R. F. Bialeski, Roswitha Schröder, Elspeth A. MacRae and Ross G. Atkinson 946–961

Cysteine proteases are of considerable scientific interest due to their roles in pathogen defence, as storage proteins and as allergens. Actinidin is a cysteine protease found in kiwifruit that affects nutraceutical properties, processing characteristics and allergenicity. This work profiles the protein and mRNA abundances of actinidin in a range of kiwifruit species. The authors identify and characterise multiple forms of actinidin, including a novel basic actinidin form.