

Functional Plant Biology

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Do stomata operate at the same relative opening range along a canopy profile of *Betula pendula*?

Eve Eensalu, Priit Kupper, Arne Sellin, Märt Rahi, Anu Sõber and Olevi Kull 103–110

Stomatal density and size were measured along the light gradient of a *Betula pendula* Roth. canopy in relation to microclimatic conditions. The theoretical stomatal conductance was calculated using stomatal density and dimensions to predict to what degree stomatal conductance is related to anatomical properties and relative stomatal opening. Maximum measured stomatal conductance and modelled stomatal conductance were higher at the top of the crown. It was concluded that stomata operate closer to their maximum openness, and stomatal morphology is a more important determinant of stomatal conductance, in the top leaves than in leaves of lower canopy.

Genetic variation in tolerance to the osmotic stress component of salinity stress in durum wheat

Richard A. James, Susanne von Caemmerer, A. G. (Tony) Condon, Alexander B. Zwart and Rana Munns 111–123

This study searched for the existence of variation in tolerance to the osmotic component of salinity stress, as distinct from the ionic component. This was done by measuring the response of stomatal conductance to an increase in salinity, as a surrogate for growth rate, in leaves shortly after the salt was applied and before Na^+ and Cl^- could build up to potentially toxic levels. Marked differences in tolerance to osmotic stress were found in durum wheat, indicating that genetic variation may also exist in other species.

Naturally occurring arbuscular mycorrhizal fungi can replace direct P uptake by wheat when roots cannot access added P fertiliser

Huiying Li, Sally E. Smith, Kathy Ophel-Keller, Robert E. Holloway and Andrew Smith 124–130

The authors used novel compartmented pots to compare the function of roots and associated hyphae of naturally occurring arbuscular mycorrhizal fungi in uptake of phosphate (P) by wheat grown to maturity in a highly calcareous soil without addition of P fertiliser, or with localised addition of granular or fluid P fertiliser. Irrespective of fungal colonisation, granular P was an ineffective P source. Mycorrhizal plants were smaller than non-mycorrhizal plants but had higher P contents. The fungal hyphae took over the role of roots in P uptake when the roots could not access the localised fluid P.

Functional analysis of lactate dehydrogenase during hypoxic stress in *Arabidopsis*

Rudy Dolferus, Mark Wolansky, Rebecka Carroll, Yo Miyashita, Kathleen Ismond and Allen Good 131–140

The regulation of *LDHI* in *Arabidopsis* was studied by analysing changes in mRNA abundance, enzyme activity and the tissue-specific expression determined using *LDHI/GUS* transgenic plants. Functional analysis of *LDHI* included using transgenic *Arabidopsis* over-expressing the *ldh1* gene with a CaMV35S promoter and a T-DNA knock-out line. Over-expression resulted in improved survival of low oxygen conditions in roots, whereas knock-out mutants of *LDHI* showed reduced survival under low oxygen. We also demonstrated that *Arabidopsis* plants can exude lactate efficiently into the medium, preventing its accumulation to toxic levels.

Cover illustration: LDHI tissue localisation. GUS localisation studies of an LDHI promoter-driven GUS construct expressed in response to developmental and stress signals. Left to right. Three-week-old plants: C24 control, transgenic; and mechanical wounding of transgenic elicited an LDHI response in root tissues but not in leaf tissue (see Dolferus et al. pp. 131–140). Photograph by Allen Good.

Plant-growth-promoting rhizobacteria and arbuscular mycorrhizal fungi modify biochemical mechanisms in water-stressed plants

**Josef Kohler, José Antonio Hernández,
Fuensanta Caravaca and Antonio Roldán** 141–151

We examined the effect of *Pseudomonas mendocina*, *Glomus intraradices* or *Glomus mosseae* on biochemical mechanisms related to drought tolerance in lettuce plants. At severe drought, the fertilisation and *P. mendocina*, alone or in combination with either of the selected AM fungi, increased phosphatase activity and proline accumulation. Inorganic fertilisation and combinations of PGPR and AM fungus showed the highest values of peroxidase activity under severe drought. The highest catalase activity was recorded in the fertilised plants followed by the *P. mendocina*-inoculated plants grown under severe drought. These results support the potential use of a PGPR as inoculant to alleviate the oxidative damage produced under water stress.

Lack of visible post-pollination effects in pollen grains of two *Dendrobium* cultivars: relationship with pollinia ACC, pollen germination, and pollen tube growth

**Kanjana Luangsuwalai, Saichol Ketsa,
Apinya Wisutiamonkul and
Wouter G. van Doorn** 152–158

In orchids such as *Dendrobium*, pollination results in various visible changes, such as epinasty of the flower stalk, early petal senescence, and ovary growth. This occurs within days, long before fertilisation, which takes place only months after pollination. We discovered some *Dendrobium* cultivars whose pollinia did not produce any of the normal post-pollination changes. The absence of these changes was not correlated with the amount of ACC, the direct precursor of ethylene, in the pollinia. It was also not due to absence of pollen germination. The lack of effects was correlated with a much lower increase in ethylene production, and with slower pollen tube growth.

Research note: Extraction of high-quality tissue-specific RNA from London plane trees (*Platanus acerifolia*), permitting the construction of a female inflorescence cDNA library

**Zhineng Li, Guofeng Liu, Jiaqi Zhang,
Junwei Zhang and Manzhu Bao** 159–165

The London plane tree has global importance as an urban landscaping tree and is the subject of genetic improvement programs for reproductive sterility, disease and/or insect resistance. In this paper, a detailed RNA isolation and purification protocol, based on established CTAB extraction techniques combined with additional purification steps using butanol and the ionic detergent CTAB, followed by LiCl-mediated precipitation was developed. The RNA isolates were of sufficient quality for successful use in RT-PCR analysis and construction of a cDNA library containing full-length MADS-box genes, consistent with the library being representative of inflorescence expression profiles.

Research note: The N-terminal presequence from F1-ATPase b-subunit of *Nicotiana glauca* efficiently targets green fluorescent fusion protein to the mitochondria in diverse commercial crops

**Annathurai Gnanasambandam, David J. Anderson,
Matthew P. Purnell, Lars K. Nielsen and
Stevens M. Brumbley** 166–170

The authors show that the ATPase- β mitochondrial presequence efficiently targets green fluorescent fusion protein to the mitochondria in 12 commercial crop species, including five monocots (sugarcane, wheat, corn, sorghum and onion) and seven dicots (cucumber, cauliflower, tomato, capsicum, pumpkin, coriander and sunflower). This is the first report of successful mitochondrial targeting of a heterologous protein in many of the crops tested. The results indicate that the ATPase- β signal can be used to target recombinant proteins to mitochondria for biotechnological applications in both monocot and dicot crops.

Corrigendum to:

Protection mechanisms in the resurrection plant *Xerophyta viscosa*: cloning, expression, characterisation and role of *XvINO1*, a gene coding for a myo-inositol 1-phosphate synthase

*Arnaud Lehner, Denis R. Chopera, Shaun W. Peters, Felix Keller, Sagadevan G. Mundree, Jennifer A. Thomson and
Jill M. Farrant* [Vol. 35, No. 1 (2008) pp. 26–39] 171