

Functional Plant Biology

Contents

Volume 36 Issue 2 2009

Invited review: Cryo-scanning electron microscopy (CSEM) in the advancement of functional plant biology. Morphological and anatomical applications

**Margaret E. McCully, Martin J. Canny
and Cheng X. Huang**

97–124

Cryo-fixation and cryo-SEM have greatly advanced understanding of plant function in ways unattainable by conventional methods of observation, because the major part of intact plant tissues, water and extractable components are retained *in situ*. This review covers fields as diverse as plant pathology, physiology, and symbiosis, including tissue freezing, stomatal behaviour, lichen desiccation, xylem function, and root/soil interactions.

Impact of salinity on early reproductive physiology of tomato (*Solanum lycopersicum*) in relation to a heterogeneous distribution of toxic ions in flower organs

**Michel Edmond Ghanem, Johannes van Elteren, Alfonso Albacete, Muriel Quinet, Cristina Martínez-Andújar, Jean-Marie Kinet, Francisco Pérez-Alfocea
and Stanley Lutts**

125–136

The vegetative and reproductive development was investigated in tomato plants under short-term saline treatments. Salt stress induced flower abortion, reduction of pollen number and viability. LA-ICP-MS analysis revealed that Na⁺ accumulated in female gametophyte and anther intermediate layers but not in the tapetum nor in the pollen grains. We explain failure in inflorescence development in terms of altered source–sink relationships rather than accumulation of toxic ions.

Ultraviolet radiation stimulated activity of extracellular carbonic anhydrase in the marine diatom *Skeletonema costatum*

Hongyan Wu and Kunshan Gao

137–143

UV radiation (280–400 nm), especially UV-A (320–400 nm), stimulated the activity of extracellular carbonic anhydrase (CAe) in the chained diatom *Skeletonema costatum* when exposed to moderate levels in addition to visible light, which enhanced the utilization of bicarbonate and supply of CO₂, resulting increased photosynthetic carbon fixation. Higher UV doses resulted in inhibitory effects.

Shoot $\delta^{15}\text{N}$ gives a better indication than ion concentration or $\Delta^{13}\text{C}$ of genotypic differences in the response of durum wheat to salinity

**Salima Yousfi, Maria Dolores Serret
and José Luis Araus**

144–155

This study shows in durum wheat that stable nitrogen isotope composition ($\delta^{15}\text{N}$) of leaves provides a better indication of genotype response to long-term exposition to salinity than other well established physiological traits related with salinity tolerance such as ion ‘exclusion’ (e.g. Na⁺ concentration and the K⁺/Na⁺ ratio) or stomatal opening (e.g. carbon isotope discrimination, $\Delta^{13}\text{C}$). Possible mechanisms relating $\delta^{15}\text{N}$ to biomass and the implications for breeding are discussed.

Cover illustration: A cryo-fixed maize root in which inherent water and solutes have been retained *in situ*. The image includes a portion of two large metaxylem vessels, two early metaxylem vessels and three phloem poles. The eutectic pattern in the large sieve tubes is consistent with high sugar content, while absence of pattern in the xylem sap indicates low solute. The *in vivo* thickness of cell walls is preserved, including that of the thick, gel-like walls of the endodermis. Transverse cryo-planed face viewed by cryo-SEM (see McCully *et al.* pp. 97–124).

Using a mathematical model to evaluate the trophic and non-trophic determinants of axis development in grapevine
**Benoît Pallas, Angélique Christophe,
Paul-Henry Cournède and Jérémie Lecoœur** 156–170

A joint approach coupling an ecophysiological analysis of organogenesis and a mathematical modelling of biomass partitioning improved our understanding of the trophic determinism of axis organogenesis in grapevine. When considering the duration of axis development according to the level of trophic competition, independent structural and functional determinisms were identified. A hierarchy was revealed inside branch populations according to the type of axes and their level of development.

Microclimate determines community composition but not richness of epiphytic understory bryophytes of rainforest and cacao agroforests in Indonesia
**S. Goda Sporn, Merijn M. Bos,
Monika Hoffstätter-Müncheberg,
Michael Kessler and S. Robbert Gradstein** 171–179

Management intensification in cultivated, tropical forests drives changes in the microclimate that can threaten native forest flora and fauna. We show that epiphytic bryophyte communities on understory trees in natural forests and cacao trees in agroforests are particularly sensitive to changes in maximum temperatures and minimum humidities ('microclimatic bottlenecks').

Frost tolerance and ice formation in *Pinus radiata* needles: ice management by the endodermis and transfusion tissues
**John S. Roden, Martin J. Canny, Chen X. Huang
and Marilyn C. Ball** 180–189

Cell structure and ice formation in needles of *Pinus radiata* were visualised with cryo-SEM when both winter acclimated and unacclimated seedlings were unfrozen, frozen or thawed. Transfusion tracheids of the vascular cylinder and other anatomical features of pine needles may play important roles in ice management and frost tolerance.

Arabidopsis phospholipase D δ as an initiator of cytoskeleton-mediated signalling to fundamental cellular processes
**Angela Y. Y. Ho, David A. Day, Melissa H. Brown
and Jan Marc** 190–198

Phospholipase D (PLD) δ , a member of a multigene signalling family, has been implicated in binding microtubules. Here, mass spectrometry of a protein complex isolated by pull-down assays from an *Arabidopsis* cell line expressing GFP-AtPLD δ identified a set of proteins including β -tubulin, actin 7, HSP70, and clathrin heavy chain. By interacting with these partner proteins, AtPLD δ may initiate signalling networks that modulate cytoskeletal rearrangements, vesicular traffic, and cell division.
