

# Functional Plant Biology

Continuing *Australian Journal of Plant Physiology*

## Contents

Volume 31      Number 10      2004

The contribution of lateral rooting to phosphorus acquisition efficiency in maize (*Zea mays*) seedlings

**Jinming Zhu and Jonathan P. Lynch** 949–958

Lateral root initiation and elongation may play an important role in the uptake of immobile nutrients, such as phosphorus, by increasing soil exploration and phosphorus solubilisation. This study assesses the value of lateral rooting for phosphorus acquisition by considering the 'benefit' of lateral rooting for phosphorus uptake and the 'cost' of lateral roots in terms of root respiration and phosphorus investment. Two separate cost–benefit analyses show that lateral rooting is advantageous under conditions of low phosphorus availability.

Genetic mapping of basal root gravitropism and phosphorus acquisition efficiency in common bean

**Hong Liao, Xiaolong Yan, Gerardo Rubio, Steve E. Beebe, Matthew W. Blair and Jonathan P. Lynch** 959–970

Root gravitropism determines the distribution of plant roots in soil and may influence the acquisition of soil resources such as phosphorus (P). Root gravitropism of common bean in response to P deficiency was highly variable in 86 recombinant inbred lines, and analysis of quantitative trait loci (QTL) indicated that several QTL for root architecture were associated with QTL for phosphorus acquisition. These markers will facilitate efforts to breed crops with improved P-acquisition efficiency.

Biomass allocation in tomato (*Lycopersicon esculentum*) plants grown under partial rootzone drying: enhancement of root growth

**Darren M. Mingo, Julian C. Theobald, Mark A. Bacon, William J. Davies and Ian C. Dodd** 971–978

Tomato plants were grown with roots divided between two pots to assess the effects of partial rootzone drying (PRD) on biomass allocation. PRD plants had more root biomass, but a similar total biomass to controls. Promotion of root biomass by PRD may allow the root system to access resources (water and nutrients) that would otherwise be unavailable, contributing to the ability of PRD plants to maintain similar leaf water potentials to conventionally irrigated plants even when smaller irrigation volumes are supplied.

The history of *Solidago canadensis* invasion and the development of its mycorrhizal associations in newly-reclaimed land

**Liang Jin, Yongjian Gu, Ming Xiao, Jiakuan Chen and Bo Li** 979–986

This study examined the associations between an invasive alien plants (*Solidago canadensis*) and arbuscular mycorrhizal fungi (AMF). The results suggest that certain AMF species might have helped *S. canadensis* colonise newly-reclaimed habitats, and that succession of belowground AMF communities may occur concomitantly with the development of the aboveground plant communities.

*Cover illustration:* Geometric simulation of a maize root system after 336 h growth, showing zones of phosphorus depletion as cloudy white regions around each root. Image prepared in *SimRoot* by Tom Walk (Pennsylvania State University). (See Zhu and Lynch pp. 949–958.)

Direct measurements of sieve element hydrostatic pressure reveal strong regulation after pathway blockage  
**Nick Gould, Peter E. H. Minchin and Michael R. Thorpe** 987–993

In this work, direct transient measurements of sieve element (SE) hydrostatic pressure and SE sap osmotic pressure and sucrose concentration were used to investigate the level of pressure regulation within the sieve tubes. Phloem flow was perturbed by localised cold chilling of sow thistle stems, while sieve element hydrostatic pressure was measured with a modified cell pressure probe attached to an exuding aphid stylet. Radial solution fluxes are used to explain the observed changes in hydrostatic pressure.

Nitrogen source and water regime effects on barley photosynthesis and isotope signature  
**Marta S. Lopes, Salvador Nogués and José L. Araus** 995–1003

Water stress and nitrogen availability constrain barley (*Hordeum vulgare*) yield in Mediterranean conditions. These authors have studied the combined effects of N source and water regime (WR) on plant growth, photosynthesis and carbon isotope discrimination ( $\Delta^{13}\text{C}$ ). Leaf  $\Delta^{13}\text{C}$  proved useful for assessing differences in growth, photosynthetic activity and water-use efficiency caused by various N sources but the use of natural abundance of  $^{15}\text{N}$  in plant tissue as a marker for N source was restricted by the effect of WR and internal plant fractionation.

Photosynthetic and antioxidant enzyme responses of sugar maple and red maple seedlings to excess manganese in contrasting light environments  
**Samuel B. St.Clair and Jonathan P. Lynch** 1005–1014

These authors studied the responses of sugar maple (*Acer saccharum*) and red maple (*Acer rubrum*) to excess manganese, which can be a significant constraint to forest health. Photosynthetic responses to Mn and light depended on the developmental stage of the leaves but were not explained by photo-oxidative stress. In natural forest environments, sugar maple and red maple foliage exposed to high light intensity may be prone to Mn toxicity.

Kiwifruit L-galactose dehydrogenase: molecular, biochemical and physiological aspects of the enzyme  
**William A Laing, Nicky Frearson, Sean Bulley and Elspeth MacRae** 1015–1025

L-Galactose dehydrogenase (L-GalDH), an enzyme critical for ascorbate biosynthesis, was purified to homogeneity from leaves of kiwifruit (*Actinidia deliciosa*). This paper describes some novel properties of the purified enzyme, identifies the gene, reports the levels of activity in different tissues and shows gene expression data. Levels of L-GalDH activity and mRNA decreased during fruit and leaf development, while activity varied between flower parts, with ovaries and styles showing equivalent activity to young fruitlets and sink leaves.

Photosynthetic utilisation of inorganic carbon and its regulation in the marine diatom *Skeletonema costatum*  
**Xiongwen Chen and Kunshan Gao** 1027–1033

In marine environments, the predominant form of dissolved inorganic carbon (DIC) is  $\text{HCO}_3^-$  and  $\text{CO}_2$  usually accounts for less than 1% of the total DIC. Photosynthetic uptake of inorganic carbon and regulation of photosynthetic  $\text{CO}_2$  affinity in *Skeletonema costatum* are extensively characterised in this study, advancing our understanding of the carbon concentrating mechanism in these marine primary producers. This paper follows that by Chen and Gao in FPB 31(4) pp. 399–404.

Molecular analysis of a stress-induced cDNA encoding the translation initiation factor, *eIF1*, from the salt-tolerant wild relative of rice, *Porteresia coarctata*  
**Rangan Latha, G. Hosseini Salekdeh, John Bennett and Monkumbi Sambasivan Swaminathan** 1035–1042

*Porteresia coarctata* can withstand sudden changes in soil salinity. Protein synthesis is sensitive to salt stress and proteins involved in this process may be important determinants of salt tolerance. Translation-initiation factor 1 (*PceIF1*) mRNA levels in leaves of *P. coarctata* increase after a salt treatment, as well as after ABA and mannitol treatments, suggesting that its induction is related to the water-deficit effect of high salt. The authors suggest that expression of *eIF1* might provide an indicator for monitoring a stress-responsive mechanism in *P. coarctata*.