

Functional Plant Biology

Continuing *Australian Journal of Plant Physiology*

Contents

Volume 31 Number 11 2004

Review: A critical overview of model estimates of net primary productivity for the Australian continent

**Stephen H. Roxburgh, Damian J. Barrett,
Sandra L. Berry, John O. Carter, Ian D. Davies,
Roger M. Gifford, Miko U. F. Kirschbaum,
Bevan P. McBeth, Ian R. Noble, William G. Parton,
Michael R. Raupach and Michael L. Roderick**

1043–1060

Net primary productivity (NPP) links the biosphere and the climate system through the global cycling of carbon, water and nutrients. Accurate quantification of NPP is critical for understanding the response of ecosystems to global climate change, and how changes in ecosystems might, in turn, feed back to the climate system. These authors reviewed twelve model estimates of long-term annual NPP for Australia. Model estimates ranged from 0.67 to 3.31 Gt C y⁻¹ and within-continent variation was similarly large. The authors conclude that current NPP modelling capability falls short of the accuracy required for effective application in understanding the terrestrial biospheric implications of global climate change.

Studies on spatial distribution of nickel in leaves and stems of the metal hyperaccumulator *Stackhousia tryonii* using nuclear microprobe (micro-PIXE) and EDXS techniques

**Naveen P. Bhatia, Kerry B. Walsh, Ivo Orlic,
Rainer Siegele, Nanjappa Ashwath and
Alan J. M. Baker**

1061–1074

Stackhousia tryonii is a rare, herbaceous plant that accumulates nickel in leaf and stem tissues. Localisation of Ni in *S. tryonii* was studied by two micro-analytical techniques — energy dispersive X-ray spectrometry and micro-proton-induced X-ray emission spectrometry. Leaf Ni was concentrated in epidermal cells and vascular tissue. Stem tissues showed a similar Ni distribution, with relatively low concentrations in the pith. Up to 92% of Ni was extracted from freeze-dried sections by water, suggesting that it exists in a highly-soluble form in *S. tryonii*.

Phosphorus deficiency enhances plasma membrane H⁺-ATPase activity and citrate exudation in greater purple lupin (*Lupinus pilosus*)

**Ayalew Ligaba, Mineo Yamaguchi, Hong Shen,
Takayuki Sasaki, Yoko Yamamoto and
Hideaki Matsumoto**

1075–1083

Mechanisms underlying the exudation of organic anions by greater purple lupin (*Lupinus pilosus*) in response to P deficiency and Al toxicity are examined in this paper. P deficiency reduced shoot growth, enhanced proteoid root formation, and induced citrate exudation by enhancing the activity of plasma membrane H⁺-ATPase and H⁺ export. Al toxicity caused only an exudation of malate in P-deficient plants, thus in *L. pilosus*, exudation of organic anions is more dependent on P deficiency than on Al toxicity.

Phosphate and arsenate interactions in the rhizosphere of canola (*Brassica napus*)

Mieke Quaghebeur and Zed Rengel

1085–1094

Arsenate [As(V)] and phosphate [P(V)] compete for the same uptake systems in plant roots and P(V) is often added to contaminated soils to alleviate As toxicity. In this paper the effects of arsenate [As(V)] and phosphate [P(V)] additions, as well as plant P status on As(V) uptake by canola (*Brassica napus*) were investigated. Plant P status together with P(V) and As(V) interactions at the surfaces of roots and soil particles should be considered when assessing P(V) and As(V) interactions in the plant–soil continuum.

Cover illustration: Spatial variation among twelve model estimates of Net Primary Productivity (NPP) for the Australian continent (see Roxburgh *et al.*, pp. 1043–1060).

Turgor, solute import and growth in maize roots treated with galactose

Jeremy Pritchard, A. Deri Tomos, John F. Farrar, Peter E. H. Minchin, Nick Gould, Matthew J. Paul, Elspeth A. MacRae, Richard A. Ferrieri, Dennis W. Gray and Michael R. Thorpe 1095–1103

Maize root growth is restricted by exposure to D-galactose, but the import of recent photoassimilate into roots is temporarily promoted. Galactose treatment rapidly decreased root extension along the growing zone while turgor pressure in the cortical cells of the growing zone increased. ^{14}C labelling of photoassimilate showed that galactose increased the import of recently fixed carbon into the whole root but decreased import into the apical 5 mm. The authors conclude that the inhibition of growth and the elevation of solute import induced by galactose are spatially separated within the root.

A locus for sodium exclusion (*Nax1*), a trait for salt tolerance, mapped in durum wheat

Megan P. Lindsay, Evans S. Lagudah, Ray A. Hare and Rana Munns 1105–1114

A novel source of salt tolerance in the form of a sodium-exclusion trait was mapped in salt-sensitive durum wheat (*Triticum turgidum* ssp. *durum*) by a QTL approach. A locus named *Nax1* (Na exclusion), which accounted for approximately 38% of the phenotypic variation in the mapping population, was identified on chromosome 2AL. A microsatellite marker closely linked to *Nax1* was validated in genetically diverse backgrounds, and has proven to be useful for marker-assisted selection in a durum wheat breeding program.

Control of salt transport from roots to shoots of wheat in saline soil

Shazia Husain, Susanne von Caemmerer and Rana Munns 1115–1126

Durum wheat is less salt-tolerant than bread wheat owing to the greater ability of bread wheat to restrict Na^+ accumulation in the shoot. Durum wheat genotypes with 5-fold difference in shoot Na^+ concentrations were studied over a salinity range of 1–150 mM NaCl and CaCl_2 of 0.5–10 mM to assess their performance in saline and sodic soils. The authors show that there are large genotypic differences in durum wheat in shoot Na^+ accumulation that could be exploited to increase the salt tolerance of this crop, and that Ca^{2+} may control Na^+ loading of the xylem.

Mobilisation and distribution of starch and total N in two grapevine cultivars differing in their susceptibility to shedding

Christophe Zapata, Eliane Deléens, Sylvain Chaillou and Christian Magné 1127–1136

Excessive shedding of flowers or young fruit constrains grapevine productivity. These authors compared two grapevine varieties, differing in their susceptibility to shedding, to investigate the roles of N assimilation and mobilisation of stored reserves of C and N at flowering in fruitlet abscission. Low levels of assimilation or mobilisation of C and N at flowering were associated with susceptibility to shedding, presumably by predisposing plants to sensitivity to unfavourable climatic conditions during berry development.