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# Functional Plant Biology

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## Contents

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*Review*: Salinity and the growth of non-halophytic grass leaves: the role of mineral nutrient distribution
***Yuncai Hu, Wieland Fricke and Urs Schmidhalter*** 973–985

This review focuses on the role of mineral nutrition in the leaf growth zone of (non-halophytic) grasses, and inhibition of growth, under salinity. The authors summarise current knowledge on the characteristics of spatial distribution patterns of mineral elements along the growing grass leaf, and on the impact of salinity on these patterns. The review continues the authors' excellent series of papers on this issue for wheat.

Hexose uptake by developing cotyledons of *Vicia faba*: physiological evidence for transporters of differing affinities and specificities
***Gregory N. Harrington, Katherine E. Dibley, Raymond J. Ritchie, Christina E. Offler and John W. Patrick*** 987–995

While it is well known that the developing broad bean embryo is apoplasmically isolated and primarily takes up sucrose during the storage phase, little is known about hexose uptake. Using radioisotope techniques, these authors found that at least two types of hexose transporters are present; a low and a high affinity hexose/$H^+$ symport mechanism. The high affinity mechanism exhibited strong specificity for glucose, whilst a broad range of hexoses was transported by the low affinity mechanism. These findings add another piece to the puzzle of transport and compartmentation of sugars in developing seeds.

Increased capacity for sucrose uptake leads to earlier onset of protein accumulation in developing pea seeds
***Elke G. Rosche, Daniel Blackmore, Christina E. Offler and John W. Patrick*** 997–1007

The hypothesis that sucrose stimulates the onset of storage protein biosynthesis is based on *in vitro* studies and on descriptive and correlative evidence. This paper demonstrates, using transgenic pea lines, that storage protein accumulation is stimulated by endogenous sucrose in developing cotyledons. Sucrose levels were elevated by selectively expressing a potato sucrose transporter; sucrose stimulates protein accumulation by acting both as a fuel and inductive signal regulating expression of storage protein genes.

How does temperature affect C and N allocation to the seeds during the seed-filling period in pea? Effect on seed nitrogen concentration
***Annabelle Larmure, Christophe Salon and Nathalie G. Munier-Jolain*** 1009–1017

Understanding C and N movement during reproduction is difficult, but of physiological importance, and the subject of many studies, particularly in cereals. These authors describe C and N levels within filling pea seeds grown at two temperatures, only once pod number had stabilised and all seeds had passed the physiological age when abortion was possible. The results demonstrate that mechanisms linked with assimilate availability during seed filling can be involved in the variation of seed N concentration with temperature (in a moderate temperature range).

*Cover illustration*: Distribution patterns of mineral nutrients in growing grass leaves. (See Hu *et al.* pp. 973–985.)

Phloem hydrostatic pressure relates to solute loading rate: a direct test of the Münch hypothesis
***Nick Gould, Michael R. Thorpe, Olga Koroleva and Peter E. H. Minchin*** 1019–1026

This paper continues an excellent series by Gould *et al.* on the regulation of phloem transport. Their study examines the effect of reduced sucrose loading rates on sieve sap hydrostatic pressure in two plant species, barley and sow thistle. The authors use transient measurements of sieve element hydrostatic pressure, and sieve element sap osmotic pressure and sucrose concentration, to directly test the role of solute uptake in creating the hydrostatic pressure associated with phloem flow. Phloem hydrostatic and osmotic pressures are shown to be dependant upon loading of solute into the phloem.

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Short-term storage of carbohydrate in stem tissue of apple (*Malus domestica*), a woody perennial: evidence for involvement of the apoplast
***Joanna C. McQueen, Peter E. H. Minchin, Michael R. Thorpe and Warwick B. Silvester*** 1027–1031

These authors provide important new information on sorbitol, the major photosynthetic and translocation product in apple. The authors test the role of sugar retrieval from the stem apoplasm as a mechanism to buffer axial phloem transport of sorbitol rather than sucrose. They found that exchange between the long-distance phloem pathway and surroundings involves active uptake from the apoplast, and is therefore regulated via trans-membrane transport. The data supports the hypothesis that sugar retrieval plays a role in buffering axial transport. The present paper demonstrates that the phenomenon also occurs in woody perennials and varies throughout the diurnal cycle.

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Osmotic stress changes carbohydrate partitioning and fructose-2,6-bisphosphate metabolism in barley leaves
***Dorthe Villadsen, Jesper Henrik Rung and Tom Hamborg Nielsen*** 1033–1043

This work adds to the growing body of information concerning the very important role of Fru-2,6-P2 as regulator in primary plant metabolism, and addresses an important question regarding the role in water limitation/osmotic stress. The results suggest that hexose accumulation associated with osmotic stress in barley leaves appears to be controlled by some as yet unknown means without an immediate direct effect of Fru-2,6-P2 regulation *via* sucrose metabolism, despite the fact that Fru-2,6-P2 levels rise significantly under these conditions.

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Glutathione S-transferase and aluminum toxicity in maize
***Geraldo M. A. Cançado, Vicente E. De Rosa Jr, Jorge H. Fernandez, Lyza G. Maron, Renato A. Jorge and Marcelo Menossi*** 1045–1055

This is the first report on an Al-induced GST gene from maize, and shows differences in mRNA levels of the gene between a tolerant and a sensitive line after Al treatment. The authors describe the characterisation of a glutathione S-transferase clone isolated by differential display and RT–PCR. Expression profiles of the gene were studied, and a phylogenetic tree constructed. The authors also analysed the possible three-dimensional structure of GST27.2–lactoylglutathione complex on the basis of the atomic coordinates of the 1AXD structure, solved by Neuefeind *et al*.

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The importance of nitrate in ameliorating the effects of ammonium and urea nutrition on plant development: the relationships with free polyamines and plant proline contents
***Fabrice Houdusse, Angel M. Zamarreño, Maria Garnica and Josemaria García-Mina*** 1057–1067

Although nitrate is the main available form of N for plants under normal conditions, when urease or nitrification inhibitors are used, other forms are also available, such as urea and ammonium. Therefore, the efficiency of these sources for plants is of great interest, and this study investigates the involvement of free polyamines and proline in the mechanism of action of nitrate in the correction of ammonium and urea toxicity. Few studies have identified the nature of the alleviation of ammonium toxicity by nitrate, so this work is of major importance for the understanding of the mechanism.

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