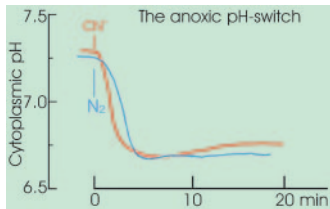


## Sensing and signalling in response to oxygen deprivation (Invited Review)

**Bailey-Serres and Chang (pp. 507–518)** consider the processes of low-oxygen sensing and response in diverse organisms, with special consideration of plant cells and the signal transduction cascades that regulate the diverse responses at the level of gene regulation, metabolism and development.



## pH regulation under anoxia (Invited Review)

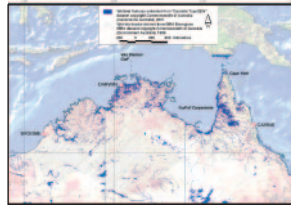
Anoxic plants experience an energy crisis. One consequence is a decrease in cytoplasmic pH, which represents a new set point required by the anoxic metabolism. **Felle (pp. 519–532)** argues that the degree of anoxia tolerance does not depend on the ability of the tissues to reverse the acidification but how they deal with the energy shortage.



## New perspectives in flooding research (Invited Review)

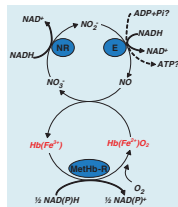
In several wetland species, submergence initiates an escape mechanism involving hyponastic movement of the leaves followed by rapid petiole elongation. **Pierik et al. (pp. 533–540)** illustrate how a molecular comparison with shade avoidance signal transduction and the use of *Arabidopsis thaliana* can help

identify signal transduction steps in submergence-induced growth responses.



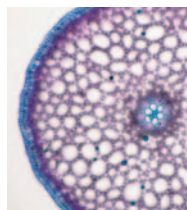
## Australia's tropical floodplain (Invited Review)

**Finlayson (pp. 541–555)** describes the spatial and temporal complexities of flood-prone tropical wetlands of northern Australia. A wide range of adaptations is shown to be required for year-round survival by the indigenous plants. Much remains to be learned about the species make-up of the area.



## Nitric oxide metabolism during root flooding (Review)

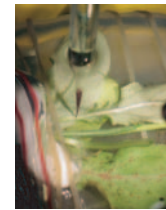
Nitrate has long been known to improve plant survival to flooding stress. **Igamberdiev et al. (pp. 557–564)** propose a cyclic pathway to account for this improvement involving conversion of nitrate to nitric oxide, which is then oxygenated to re-form nitrate. Nitrate reductase and haemoglobin are key elements in the pathway's operation. The net effect is improved redox and energy status of the anoxic root.



## Angiosperm root aerenchyma (Review)

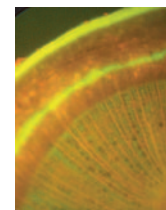
Patterns of aerenchyma development and structure in wetland angiosperm roots are

reviewed by **Seago et al. (pp. 565–579)**. They show that honeycomb aerenchyma, initiated by cell division and expansion in a process termed expansigeny, is characteristic of basal angiosperms and basal monocots. Different patterns of lysigeny and schizogeny are shown to be common in both monocots and eudicots.



## Underwater photosynthesis by terrestrial plants (Review)

Survival of flooding by terrestrial plants is substantially lengthened if completely submerged plants have access to light. **Mommer and Visser (pp. 581–589)** review how photosynthesis increases the availability of oxygen and carbohydrates during submergence, and how acclimatization in shoot morphology and physiology improves the exchange of oxygen and carbon dioxide between the plant and the floodwater.



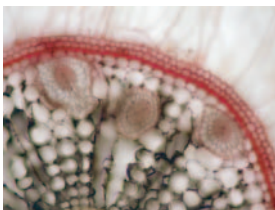
## Alder root aeration is enhanced by stem photosynthesis

After experimenting with physical models, stem cuttings and whole plants, **Armstrong and Armstrong (pp. 591–612)** contest claims that root aeration in wetland trees is improved by radiation-induced thermo-osmotic gas-pressurization in the stems. The effect is better explained by oxygen diffusing to roots from stem photosynthesis that utilizes internally sourced CO<sub>2</sub>. Pressurization in stem gas-space is shown to have little effect.



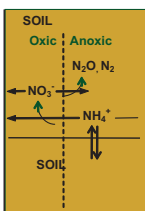
### Oxygen dynamics in *Lobelia dortmanna* and the seagrass *Zostera marina*

Sand-Jensen *et al.* (pp. 613–623) show that *L. dortmanna* builds up O<sub>2</sub> in sediment during the day because of efficient intra-plant transport of O<sub>2</sub> and its release from roots to sediments of low O<sub>2</sub> consumption. In the dark, O<sub>2</sub> in sediment, air lacunae and water is respired. *Zostera marina* inhabits anoxic sediments and relies entirely on O<sub>2</sub> in the water for night-time respiration.



### Sulphide-induced barrier in rice roots

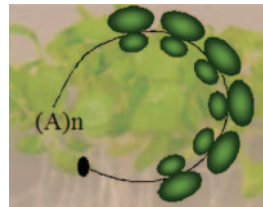
Akagare and Akiuchi diseases of rice have long been associated with sulphide toxicity in soils. Armstrong and Armstrong (pp. 625–638) show that sulphide induces barriers to radial oxygen loss to the rhizosphere, to Fe<sup>2+</sup> and water uptake and to lateral root emergence. The barrier occurs as suberized/lignified thickening in hypodermal cell walls.



### Modelling the potential for nitrification and nitrate uptake in the rhizosphere of wetland plants

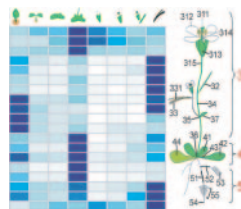
Plants generally grow better under mixed NH<sub>4</sub><sup>+</sup>-NO<sub>3</sub><sup>-</sup> nutrition, but NO<sub>3</sub><sup>-</sup> added

to wetland soils tends to be rapidly lost by denitrification. Kirk and Kronzucker (pp. 639–646) use data on the kinetics of NO<sub>3</sub><sup>-</sup> absorption by rice roots to show that rice and probably other wetland plants can capture a large proportion of the NO<sub>3</sub><sup>-</sup> formed in the rhizosphere.



### Selective translation contributes to regulation of gene expression under hypoxia

Survival to hypoxia requires extreme changes in gene expression. Genomic analysis of total RNA and polysomal RNA from *Arabidopsis* seedlings by Branco-Price *et al.* (pp. 647–660) allowed the identification of a small number of transcripts with maintained translation initiation instead of impaired, the prediction of roles for UTR features that may promote ribosome association in control and stressful environments, and the prediction of the contribution of translation for the regulation of gene expression.



### Anaerobic gene expression in oxygen-starved *Arabidopsis thaliana* seedlings

Transcript profiling coupled with an appropriate range of software tools has enabled Gonzali *et al.* (pp. 661–668) to initiate a comprehensive exploration of the expression of anoxia-inducible genes using microarrays. These findings hold promise for identifying appropriate mutations for targeted screening studies.



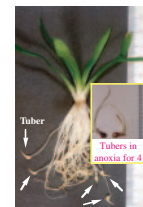
### Detection of new motifs in anaerobic genes

The transcriptional regulation of anaerobic genes is not yet fully understood. Mohanty *et al.* (pp. 669–681) show that the five new motifs, not yet known as plant transcription factor binding sites, could, either individually or in combination with other motifs, play an important role in regulating anaerobic metabolism.



### Sucrose synthase (SuSy) genes expressed during anoxic elongation of pondweed (*Potamogeton distinctus*) turions

Turions of pondweed are highly tolerant to anoxia and their elongation is enhanced by an absence of oxygen. Harada *et al.* (pp. 683–692) isolate cDNAs of two distinct SuSy genes from pondweed turions and investigate transcriptional changes in response to anoxia and other stimuli.



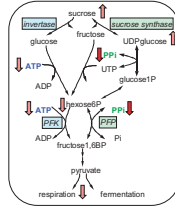
### Stimulation of shoot elongation and gene expression by anoxia, ethylene and carbon dioxide

Shoot elongation by aquatic *Sagittaria pygmaea* is stimulated strongly by anoxia, ethylene or carbon dioxide. Ookawara *et al.* (pp. 693–702) compare effects of these treatments on transcript levels of genes related to cell wall modification.



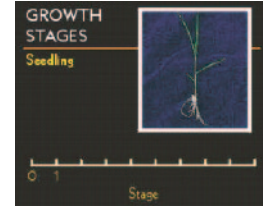
### Anoxic proteins in rice coleoptiles

Anoxia-tolerant plant tissues synthesize a number of proteins in addition to the ‘classical anaerobic proteins’ involved in fermentation. **Huang *et al.* (pp. 703–715)** use rice coleoptile tips to reveal patterns of protein synthesis under prolonged anoxia and identify several low-molecular-mass proteins. These may represent novel agents in anoxia tolerance that influence glycolysis and energy utilization.



### The role of pyrophosphate during hypoxia

Pyrophosphate (PPi) is discussed as an alternative energy source in plants during hypoxia. **Mustroph *et al.* (pp. 717–726)** demonstrate that potato plants with genetically reduced PPi content have inhibited sucrose cleavage using the sucrose synthase pathway during hypoxia, but unchanged PPi-dependent phosphofruktokinase activity compared to wild type. Consequently, removal of PPi impairs the vitality of potato plants during hypoxia.



### Acetaldehyde production may protect rice from severe hypoxia

Using sensitive photoacoustic laser gas detectors, **Boamfa *et al.* (pp. 727–736)** find that seedlings of a submergence tolerant line (FR13A) emit abnormally large amounts of acetaldehyde during and after exposure to severe hypoxia (0.05–0.15 %). This synthesis appears to involve catalase-mediated conversion of ethanol that utilizes hydrogen peroxide. Consequently, acetaldehyde formation may divert potentially damaging reactive oxygen species away from lipid membranes.