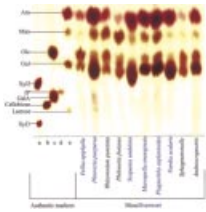


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John Bryant takes a closer look at some of this month's Original Articles



Just another Glc in the wall?

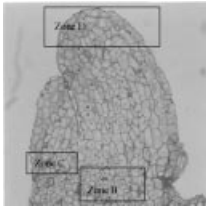
The emergence of photosynthetic land plants was a major step in the evolution of the biosphere, bringing major changes to the terrestrial environment and leading ultimately to extensive vegetation cover — ‘earth’s green mantle’. The move from water to land presented many challenges, including changes in the availability of nutrients and water, different parameters for gas exchange and, in vertical growth, problems of support. Modern phylogenetic research suggests that land plants evolved from green algae, very similar to present-day charophytes, and that early plants resembled ‘primitive’ bryophytes extant today. A key feature in the adaptation to life on land has been the cell wall; it is of great interest to understand the significant changes in cell wall biochemistry and architecture that have occurred during plant evolution. **Zoë Popper and Stephen Fry (University of Edinburgh, pp. 1–12)** have thus undertaken a thorough study of cell wall biochemistry in charophytes and in bryophytes ranging from ‘primitive’ to ‘advanced’. Amongst a wealth of interesting data, a number of important findings relate to the evolution of land plants. First, the walls of charophytes and of more primitive (and mostly moisture-loving) bryophytes contain much higher amounts of glucuronic acid (GlcA) and galacturonic acid (GalA) than do the walls of the more drought-tolerant advanced mosses. The authors suggest that GlcA-, GalA- and mannose-rich polymers form sponge-like walls, facilitating water uptake from the surroundings but not contributing to skeletal support. In contrast to the uronic acids, xyloglucans (a major component of the ‘hemi-cellulose’ fraction of higher plant cell walls) are absent from charophytes, but are present even in primitive bryophytes. Indeed, xyloglucans are completely correlated with terrestrial life. These data thus provide a link between cell wall structure and major steps in evolution: a great example of elucidating the past by thorough study of the present.



Maybe it's cold outside

Local intraspecific variation in the alpine plant *Potentilla matsumurae* is the theme of the paper by **Shimono and Kudo, Hokkaido University, Sapporo (pp. 21–29)**. They have focused on plants growing in the fellfield and on plants growing in places where there are long-lasting snowbeds. In the Taisetsu Mountains in northern Japan the fellfield is a hostile habitat: the wind prevents accumulation of snow, the soil is frozen in winter, severe wind-chill occurs well into the spring (although there can also be very warm days) and plants are subject to drought stress in summer. By contrast, in the snowbeds of the Taisetsu Mountains, plants are protected from frost damage and, because of the water from the melting snow, from summer drought. However, although the snowbed is a less hostile habitat, the persistence of the snow cover shortens the potential growing season. Shimono and Kudo performed germination experiments in the two habitats. Seed lots from the fellfield plants exhibited sporadic germination, indicating variation in depth of dormancy, and consistent with adaptation to a habitat in which conditions in spring are very variable: early germinators, emerging when the soil temperature reaches about 5 °C, may later be damaged or even killed by a cold snap. Late germinators avoid this risk but their growing season is restricted, lessening the chances of survival in the subsequent winter. This is a strategy that spreads risk. In contrast, seed lots from snowbed plants require a higher temperature for germination (12–15 °C) and tend to germinate synchronously; the whole population thus takes advantage of the favourable conditions in the short growing season. The differences in germination requirements, operating in the wild on a local scale, are maintained in reciprocal transfer experiments. This suggests a genetic basis for the germination behaviour, leading to speculation about the molecular basis of these heritable variations.

Continued overleaf



Genome stability in the frozen *Cosmos*

In discussing conservation of endangered plant species, the media usually concentrate on direct protection of the plant and its habitat, and ignore the detailed laboratory work that forms an essential part of a multi-disciplinary approach. One aspect of laboratory work with endangered species is establishing the best methods for conservation and storage of germplasm. For some species, cryopreservation of plant tissue is an appropriate method for germplasm conservation but it embodies a particular set of problems, including tissue damage during freezing, loss of viability during storage, failures in regeneration from the stored tissue and the occurrence of genetic changes (somaclonal variation) during the organ or tissue culture phases. However, with careful study of all the factors involved, these problems may be overcome, as exemplified by the work on a rare, endangered and interesting composite, *Cosmos atrosanguineus* (Wilkinson *et al.*, Reading University and Royal Botanic Gardens Kew, pp. 65–74). Optimal procedures for cryopreservation of cultured shoot tips have already been established, and in this paper the authors turn to investigation of the regeneration phase. Many of the cells of the main meristematic dome do not survive freezing and, thus, after return to culture conditions, regeneration of shoots is initiated from particular groups of cells, usually at the base of the primordia, rather than from the main meristem itself. However, success in storage and regeneration would be of much less value if these processes cause genome instability, which is totally undesirable when attempting to preserve endangered species. The authors have thus employed Amplified Fragment Length Polymorphisms (AFLP), a PCR-based procedure, rightly described as the ‘most sensitive multilocus fingerprinting technique . . . available’. So far their results obtained with seven pairs of PCR primers are very encouraging: comparison between original plant stocks and regenerated shoots revealed no sequence differences. For cryopreservation of *C. atrosanguineus*, genome instability is simply not a problem.



Underwater breathing apparatus

The remarkable variation between populations of *Ranunculus repens* leads us again to western Ireland. It is here that Lynn and Walden (Trinity College, Dublin, pp. 75–84) have been investigating the ability of a form of *R. repens* to survive several months’ submergence, often at depths of several metres, in temporary alkaline lakes (*turloughs* in Gaelic). They first compared the responses of a ruderal form and the turlough form to ‘normal’ flooding. Both exhibit some pre-adaptation to flooding in that they develop aerenchyma even in drained soil, and the amount of aerenchyma does not increase when plants are flooded to the soil surface. Thus, both forms survive this type of flooding. However, the difference between the turlough and ruderal populations becomes apparent when the plants are submerged. The ruderal form initially exhibits elongation growth of the petioles (the depth accommodation response), which, provided the water is not too deep, restores the leaves to contact with air. However, this is not enough to protect the plants from the effects of total submergence: there is extensive cell and tissue death. By contrast, the turlough population fails to show the depth accommodation response (which surely points to an interesting deviation from normal ethylene physiology), and yet this population survives submergence. The authors suggest that the difference between death and survival lies in a very subtle difference in photosynthetic biochemistry. In earlier work they had shown that neither form could use bicarbonate to any great extent, which means that photosynthesis in the alkaline waters of the turloughs is very limited. However, data in the current paper indicate that the turlough form of *R. repens* is able to utilize bicarbonate just about well enough to prevent depletion of carbohydrate stores and, more importantly, to generate oxygen within the submerged plants, thus preventing anoxia. So, research on wild plants gives us a breath of fresh air.