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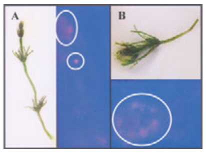
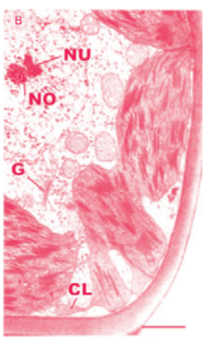
John Bryant takes a closer look at some of this month's Original Articles



XET marks the spot in plant evolution

One of the key processes in the elongation growth of plant cells is the slippage of cellulose microfibrils within the cellulose–xyloglucan network. Essential for this are xyloglucan hydrolases (XEHs) and xyloglucan endotransglycoslylases (XETs); the two types of enzyme are classified together as XTHs, as described by **Van Sandt *et al*. (Antwerp, Belgium, pp. 39–51)**. Previous work by this group had shown that XET activity is correlated with cell elongation in all orders of vascular plants, including the 'primitive' Selaginellales; they had also shown the presence of a conserved XTH-coding amino acid sequence in *Selaginella*. The authors have now turned their attention to non-vascular plants, carrying out an extensive search for both XET activity and for XTH-like gene sequences. XET activity is present in bryophytes and again is generally correlated with cell growth. In accord with this, two cDNAs with XTH-like sequences were identified in the moss *Physcomitrella patens*. Going further down the complexity scale, XET activity was also detected in association with zones of growth in *Chara* (representing the Charophyta) and in *Ulva* (representing the Chlorophyta). However, no activity was detected in brown or red algae. Further, by using degenerate primers based on angiosperm XTH sequences, the authors identified a putative XTH-coding sequence in *Chara*; this sequence also had features characteristic of endoglucanases. The presence of both XET enzyme activity and XTH-like coding sequences in these, the simplest of the multicellular green plants, is particularly interesting because they do not possess xyloglucans in their cell walls. The likelihood is that these relatively primitive members of the enzyme family are capable of working on xylans and/or glucans in relation to cell growth. Overall, therefore, these data suggest that the evolutionary sequence culminating in the XET-based mechanisms in the cell walls of angiosperms originated towards the very base of the green plant lineage.



Rapid responses rule out repair

Many mosses have a remarkable capacity to withstand extreme desiccation and to recover rapidly when re-watered. How they do this is, as discussed by **Proctor *et al*. (Exeter and London, UK and Napoli, Italy, pp. 75–93)**, a matter for debate. Do cellular components survive desiccation intact, thus remaining ready for reactivation when plants are re-watered (the 'constitutive' model) or do cell membranes and organelles suffer desiccation-related damage and thus need repairing when cells are re-hydrated (the repair model)? The authors set out to resolve this debate with their very thorough work on *Polytrichum formosum*; here, space permits discussion of only the main features. Chlorophyll fluorescence ratios were found to return to 80 % of control values within 10 min and to 95 % within 1 h. Full recovery took about 24 h. Initial recovery of overall quantum yield and CO_2 fixation was slightly slower. Nevertheless, CO_2 uptake re-started within10 min of re-wetting; net carbon gain was achieved within 20–60 min. However, as with chlorophyll fluorescence, CO_2 uptake did not fully recover for approx. 24 h. Nevertheless, the rapidity and extent of the first recovery phase suggests there is no need for repair. The authors' careful light microscope and EM study led to the same conclusion. Taking great care to avoid fixation artefacts, they showed that the internal structures of chloroplasts and mitochondria remained intact during desiccation and re-wetting, consistent with the rapid recovery of photosynthesis (and respiration). However, the numerous lobes and lamellar extensions of the chloroplasts were lost during drying and thus the organelles became much more rounded (although with little or no change in overall volume). Upon re-wetting, the chloroplasts regained their complex morphology over a period of about 24 h. These results also tend to rule out the repair hypothesis. Nevertheless, the correlation between the slower, later phase of photosynthetic recovery and the 're-modelling' of the chloroplasts suggests that reconstruction of certain aspects of chloroplast morphology is needed for a full restoration of photosynthetic capacity.

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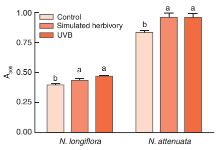

Caterpillars off their food – must be too much sun

There is a growing body of evidence that exposure of plants to UV-B radiation makes them less appetizing for at least some herbivores. One possible reason is that UV-B elicits synthesis of compounds that are also defences against herbivory. This idea has been tested in a series of experiments carried out on two annual species, *Nicotiana attenuata* and *N. longiflora*, by **Izaguirre *et al*. (Buenos Aires, Argentina and Jena, Germany, pp. 103–109)**. Experiments with *N. attenuata* were carried out in glasshouses; exposure to levels of UV-B typical of growth outdoors was achieved with a UV lamp and appropriate filters. *Nicotiana longiflora* was grown outdoors and here it was non-UV-B conditions that were obtained by using filters. To study the response to herbivores, a simulated herbivory treatment, already shown to elicit defence responses, was employed. The results were very clear. Although baseline levels of phenolic compounds were different, levels increased significantly in the two species in response to both UV-B exposure and herbivory. Analysis of the phenolic compounds by HPLC and by electrospray ionization MS showed that the variety and relative amounts of phenolic compounds elicited by the two experimental treatments were very similar. The most abundant of the phenolics were chlorogenic acid (three different isomers) and the flavanoid, rutin; polyamines (particularly isomers of dicaffeoylspermidine) were also present. In addition to being UV-absorbent, chlorogenic acid is also a powerful antioxidant, thus protecting plants from the oxidative damage that may follow UV-exposure. In addition, chlorogenic acid is an anti-feedant and there is strong negative correlation in *Nicotiana* between the concentration of chlorogenic acid and the feeding activity of *Manduca sexta* caterpillars. It looks very much then as if the responses of *Nicotiana* to UV-B exposure and to herbivory are indeed achieved at least partly via a common signalling pathway, most probably involving jasmonic acid.

Knotty problem of hybrid invaders

'Building work halted by knotweed' declared a headline in my local newspaper. During site clearance prior to construction work, a building company had discovered a stand of Japanese knotweed (*Fallopia japonica*). Rather than attempt to remove the plants themselves, the builders had called in experts to deal with the problem. So, what is the problem? Several members of the genus *Fallopia* are both invasive and persistent, as described by **Tiébré *et al.* (Gembloux, Belgium, pp. 193–203)**. These authors have focused on the breeding systems of these species and on the formation of interspecific hybrids. In general, plants may be either hermaphrodite or male-sterile, with variations in the proportion of the two forms in different parts of the range. For example, in the UK only male-sterile examples of *F. japonica* are known, which means that spread from the initial sites of colonization is by vegetative methods. However, the interfertility of different members of the complex means that male-sterile plants can set seed if pollinated by a male-fertile species. Thus the authors confirmed that male-sterile *F. japonica*, with *F. sachalinensis* as the male partner, forms the hybrid *F.* × *bohemica. Fallopia japonica* can also backcross with *F.* × *bohemica* and hybridize with an ornamental species, *F. aubertii*. Indeed, in this paper it was these latter crosses for which the greatest seed set was reported. However, variation in germinability between different species/hybrids and from year to year means that seed set is not necessarily an indicator of reproductive success. Nevertheless, the ready hybridization and the formation of polyploids (as shown by flow cytometry) clearly give potential for this group to exploit further niches and to become more of a nuisance. Of particular concern is the use of *F. aubertii* as an ornamental, giving ready access of the highly invasive but male-sterile *F. japonica* to a source of pollen. Will this cause further problems? Watch those open spaces!

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