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

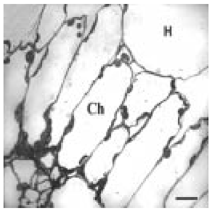
Not banking on getting into the zone

I live near the shore of a large estuary in southwest England. My concept of a salt marsh is moulded by my knowledge of the local salt marshes and in particular that the tide flows in and out twice per day. However, there are examples of inland salt marshes where the tide is not a complicating factor in ecological research. Such a situation is described by **Christy Carter and Irwin Ungar (Athens, Ohio, USA, pp. 119–125)**. The marsh is at the site of an abandoned salt mine. There is a gradient of salinity within the site but actually, the differences in salt concentration along the gradient are rather less than the variation over a year. Autumn and winter precipitation lead to flooding and hence dilution of the salt; the salt concentration starts to rise again in the spring. The vegetation in the marsh shows clear zonation with different species dominating different zones. The authors have selected *Spergularia marina* in order to investigate whether its zonation results from its germination behaviour. *S. marina* forms large seed banks with differing depths of dormancy. In general, seeds are dormant when shed from the plant and dormancy is broken by exposure to low winter temperatures. In the field, germination occurs in spring when both temperature and soil salinity are still relatively low. Germination does not occur in the heat of summer, even though the seeds are no longer dormant. This germination pattern clearly allows establishment of the plants in time to reach maturity and set seed in the summer. However, it does not explain zonation because firstly, this species banks seeds in all the zones and secondly because it can actually germinate in all zones (although germination may be inhibited by shading in the *Phragmites* zone). As the authors rightly conclude, they now need to examine later stages of growth and development.

Early or late: defending their differences

Heterophylly, the possession of different types of leaf in one plant, is widespread within the angiosperms, and is frequently seen in the differences between juvenile and adult phases of plant growth. Sometimes the differences in leaf morphology relate to changing needs in respect of defence against herbivory, for example in holly (*Ilex aquifolium*). It is in relation to defence that **Matsuki and colleagues (Sapporo, Japan, pp. 141–147)** have examined the differences between early season and late season leaves in three species of birch, *Betula ermanii*, *B. maximowicziana* and *B. platyphylla*. They were interested especially in the competing needs in young leaves for defence against herbivory and for growth – provision of defence mechanisms will use photosynthate that might otherwise contribute to tree growth. They therefore assayed both total phenolics and tannin (chemical defences) and counted trichomes and measured leaf toughness (mechanical defences) in early and late leaves of all three species. As indicated by phenolic and tannin content and by trichome numbers, early leaves of *B. ermanii* and *B. platyphylla* were more defended than later leaves. However, this did not seem to occur at the expense of growth since relative growth rates (RGR) were at their highest during the time of the early-season leaves. Indeed, in *B. platyphylla* removal of these early leaves restricted the overall growth that year. *B. maximowicziana* was different; its late leaves were more defended than its early leaves, both chemically and mechanically but especially the latter. Interestingly, RGR in this species remains more or less constant through the growing season leading the authors to suggest that there is no selective advantage in investing in defence of the early leaves. These differences in defence strategy may be related to differences in ecology because although all three species can act as pioneers, *B. maximowicziana* is also a species of mature mixed forest.

Continued overleaf



Sharing a single cell confounds conventional wisdom

It is one of those things that every botany student knows. Terrestrial plants that perform C_4 photosynthesis possess Krantz anatomy in which the C_4 and C_3 phases occur in different types of chloroplast located in different anatomical regions of the leaf. However, recent discoveries with two species of the family Chenopodiaceae show that our botany students will need to update their knowledge. In these species, the C_4 and C_3 phases of photosynthesis occur in different forms of chloroplast located at opposite ends of individual elongated leaf cells. The potential of this phenomenon for studying the intracellular spatial regulation of gene expression has been recognised by **Voznesenskaya *et al*. (St Petersburg, Russia and Pullman, Washington, USA, pp. 177–187)** who have focussed on one of these species, *Borszczowia aralocaspica*. In this paper they are interested especially in the transition undergone by cotyledons during germination, from a storage organ to a photosynthetic organ. Anatomical investigation of cotyledon development revealed that elongated cells, resembling those of leaves, are already present in mature seeds, but, as expected, they are not green. During germination, Rubisco content, as revealed by immunocytochemistry, starts to increase before emergence into the light (and indeed accumulates in seeds germinated in the dark). However, the presence of two key enzymes of the C_4 pathway, phospho*enol*pyruvate carboxylase (PEPC) and pyuruvate, Pi dikinase (PPDK) is completely light-dependent. Furthermore, as these chlorenchyma cells develop their full capacity, Rubisco is partitioned into fully developed chloroplasts at one end of the cell, while PPDK is at the other end, contained in less well-differentiated chloroplasts. PEPC, by contrast, is distributed throughout the cytoplasm, possibly reflecting the occurrence of different isoforms with different roles. What an amazing system this is, leading us to ask how the cell achieves this sub-cellular partitioning. Clearly the authors have some fascinating research ahead of them.

Sackcloth with a softer touch?

Lignin is of course essential for the life of vascular plants and is also very useful to humankind, for example in wood. However, there are situations in which our exploitation of plant material is hindered by lignin. One example of this is in the use of phloem fibres to make fabrics, including the fibres from flax (*Linum usitatissimum*) and jute (*Corchorus* sp). Comparing these two, the phloem fibres of flax contain much less lignin than those of jute and hence jute fibres cannot be used to make finer fabrics such as are made from flax fibres. There is thus great interest in identifying varieties of jute with reduced lignin content. Two such lines of *Corchorus capsularis* have been generated by X-ray-induced mutagenesis, as described by **Sengupta and Palit (Kolkata, India, pp. 211–220)**. They carried out a detailed comparison of one of these lines with wild type jute. Lignin content of the mutant phloem fibres was only about 50 % that of wild type but cellulose content was about 30 % greater. Intriguingly, the tensile strengths of the mutant and wild type fibres were very similar which means that decreased coarseness was not achieved at the expense of strength. However, there were some negative effects: the mutants plants were shorter as a result of lower growth rates and the fibre yield was very much less than in the wild type. In addition to these factors that affect the use of the fibres, the authors also noted that xylem lignification was unaffected in the mutants. The mutation affects specifically the lignification of the phloem fibres and this was attributed to a failure to up-regulate a key enzyme, phenylalanine-ammonia lyase. As the authors point out, these mutants therefore also have great academic interest in that they provide a system for studying positional information in relation to developmental changes in gene expression.

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