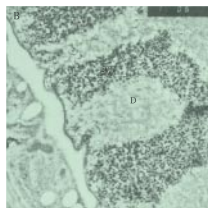


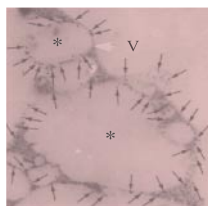
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John Bryant takes a closer look at some of this month's Original Articles



Demolish the wall—but recycle the bricks

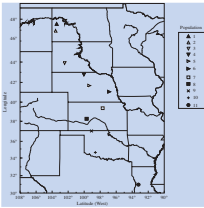
Seed storage reserves are, across the plant kingdom, laid down in a number of different tissues or organs, with the cotyledons and the triploid endosperm being the most common. Although their role is to supply carbon and/or nitrogen to the growing seedling, a wide range of compounds are used as storage materials and very little goes to waste. This is well illustrated by the work of **Buckeridge *et al.*, Sao Paulo, Brazil and Stirling, Scotland (pp. 435–444)** on the cotyledons of *Lupinus angustifolius*. The authors had previously observed that, during germination, the extensively thickened cotyledonary cell walls were reduced very markedly in thickness. Much of the thickening of these walls is due to deposition of β -galactan polymers (which also contain some arabinose) and it had already been shown that the β -galactan is the material mobilized from the walls during germination. The authors had also observed the *de novo* synthesis of a hydrolytic enzyme, an *exo*-(1 \rightarrow 4)- β -galactanase (which breaks down galactans by ‘chewing in’ from the end of the polymer). The authors have now extended these observations with some elegant experiments using purified enzyme and cell walls (‘ghosts’) of storage mesophyll cells isolated from imbibed but ungerminated seeds. Exposure of these ghosts to the enzyme resulted in dramatic loss of thickening from the cell walls so that they came to resemble the cotyledon cell walls of germinated seeds. Further, the interaction between the enzyme and the β -galactan substrate was very specific. By conjugating the purified enzyme to colloidal gold, it was shown in thin sections of these cells that the enzyme bound only to the β -galactan thickenings and not to the original pectin components of the primary wall. Here, as the authors state, is a clear change of function during evolution in which the cell wall has taken on the role of a storage organelle.



Water pores—water pours?

The discovery of aquaporins, specific protein channels that facilitate water flux through plant cell membranes, was relatively recent and we are far from understanding their role within plant water relations. A truly international team from France, Japan and Austria (**Fleurat-Lessard *et al.*, pp. 457–460**) briefly reviews the evidence that the distribution of aquaporins in the tonoplast and plasma membrane may be related to the ability to manipulate rapidly cell turgor and/or cell volume. The paper focuses on the cells of soybean (*Glycine max*) root nodules. Nodules are the sites of symbiotic N_2 fixation, a process that requires very low oxygen tension. Control of O_2 diffusion in the nodule is thus very important and it has been suggested that this control involves rapid changes in the shape and volume of the cells in the nodule inner cortex. This, in turn, implicates aquaporins and thus the authors have examined the distribution of plasma membrane and tonoplast aquaporins. Antibodies raised against two different aquaporins from the plasma membrane (PIP1 and PIP2) were conjugated to gold and were then used to detect their target proteins in ultra-thin sections of root nodules. The micrographs clearly show that the highest concentrations of both PIP1 and PIP2 were in the inner cortex and endodermis while the lowest were in the infected cells; pericycle cells showed intermediate levels. The authors also repeated earlier experiments in carrying out immunolocalization of a tonoplast aquaporin, γ -TIP, showing firstly that the protein was very abundant and secondly that its distribution pattern was very similar to that of PIP1 and PIP2. The authors comment that the density of aquaporins is similar to that of other plant cells in which rapid water fluxes occur, suggesting that rapid fluxes also occur in the nodule cortex. However, neither this nor a role in regulating O_2 diffusion has been directly demonstrated.

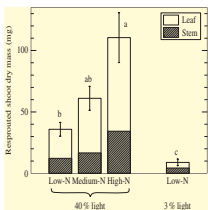
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Genes on the line

I have long been fascinated by biological examples of clines. These are linear distributions of species in which almost imperceptible variation between neighbouring populations can lead to marked differences between those at the two ends of the range. I first became aware of genetic clines in certain bird species, but in any organism with a long-range distribution there is the possibility of gradually changing genetic make-up, especially if the distribution lies along an environmental gradient. Just such a situation has been investigated by **Still *et al.*, Pomona, California, USA**

(pp. 467–477). In North America, *Echinacea angustifolia* occurs from the plains of Canada in the north to Texas in the south. From within that range, the authors sampled ten populations from North Dakota to Oklahoma, a 1500 km north–south range embodying a very marked temperature gradient. Genetic variation within and between populations was assessed by amplified fragment length polymorphism (AFLP) in which different pairs of primers were used in polymerase chain reactions to amplify a range of DNA fragments within the total genome. A total of 1290 fragments were scored for presence or absence in a number of individuals from each population. The data clearly showed that the smallest genetic distance between any pair of populations was nearly twice the average genetic distance between individuals within a population. When the data were used to construct a phenogram (effectively an intra-specific phylogenetic tree) there was clear evidence of four major groupings of populations that fell along the north–south gradient, correlating with temperature. One key feature of AFLP analysis is that it does not focus on DNA sequences under selective pressure in respect of, in this instance, temperature. It thus gives a good overall picture of microevolution. Accordingly, this paper provides good evidence for restricted gene flow between separated populations along a climatic gradient—a beautiful example of a cline.



Tapping into carbon supply

The developmental plasticity and capacity for regeneration after damage in plants are things that botanists tend to take for granted. These features are of course adaptations to a lifestyle in which running away is impossible, but nonetheless they are remarkable. One interesting example that we have discussed previously in these pages is the resprouting ability of *Quercus crispula* seedlings following decapitation. The tap-root acts as a storage organ and supplies the nutrients to support the outgrowth of previously dormant buds until the new shoots become photosynthetic. In the present study, **Kabeja and Sakai, Sendai, Japan (pp. 479–488)** have evaluated the roles of the carbon and nitrogen components of the stored material in the resprouting process.

Prior to clipping the seedlings, the carbon content of the tap-roots was manipulated by maintaining seedlings at different light levels (thus influencing photosynthetic carbon fixation) and N-content was manipulated via nutrient-feeding regimes. These treatments gave a range of combinations of carbohydrate and N-contents. Interestingly, the level of light, as well as positively influencing the carbohydrate content of the tap-roots, also negatively affected the N-content (high light levels led to lower N-contents). After clipping, it was clear that resprouting ability was directly correlated with the stored carbohydrate content of the roots and not with their N-content. Indeed, it was the carbohydrate content and not the N-content of the tap-root that was depleted during resprouting. However, there was some influence of N: the mass of the resprouted shoots was directly correlated with the N-content of the tap-root. In this situation, then, release from apical dormancy is not on its own enough to ensure outgrowth of the dormant buds: the available carbohydrate must also be adequate, presumably to supply energy and carbon skeletons. Only if these needs are met does N have any influence on the process.

Professor J. A. Bryant
 University of Exeter, UK
 E-mail j.a.bryant@exeter.ac.uk