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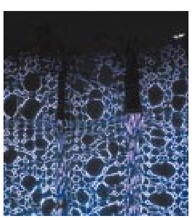
John Bryant takes a closer look at some of this month's Original Articles

After the flood – photosynthesis

Ranunculus repens is a terrestrial plant that thrives in damp habitats. It can survive total immersion for several days during which it develops aerenchyma and exhibits the petiole elongation response (coming up for air). However, in western Ireland there is a habitat that provides a more extreme challenge to the flexibility of this species. Turloughs are temporary limestone lakes (*lough* is the Gaelic word for lake) that exist for several months of the year, and in these lakes there is a distinct population of *R. repens*. Morphologically, the population is distinguished by having much more dissected leaves than the normal form. The morphological differences are genetically determined and it is thus possible that the turlough population is a distinct ecotype adapted to this unusual habitat. Certainly the coping mechanisms exhibited by normal populations during temporary submergence are not adequate for long-term survival in several metres of water. This has led **Lynn and Waldren (Dublin**; **pp. 707–714)** to compare the turlough population with a normal ruderal population in respect of several physiological characters, of which I focus on photosynthesis. Plants were grown in flooded or non-flooded soil for 8 weeks before photosynthetic rates were measured. In both populations, flooded plants showed slightly higher rates than non-flooded plants, but rates in the turlough population were two- to three-times greater in both flooded and non-flooded conditions than those of the ruderal population. When photosynthesis was measured in submerged plants, both populations exhibited rates of only about 5 % of those in non-submerged plants, maintaining the difference between the two populations. Intriguingly, given the alkalinity of the lakes, neither form could use bicarbonate as a carbon source. Taking these and their other data, the authors suggest that the leaf morphology of the turlough population may enhance gas exchange, permitting the accumulation of storage carbohydrates for times when photosynthetic rates are severely depressed by submergence.

Xylem as a source of cells for sealing wounds



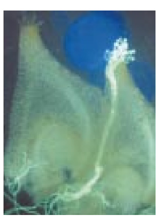
The ability of plants to renew growth in response to damage is well-known. Growth may be renewed very quickly to replace lost tissue (as anyone who mows a lawn will know) and developmental pathways may be diverted to replace organs that have been removed. At the local level, smaller wounds are sealed by proliferation of cells around the wound site, often in association with the production of phenolic compounds that act as disinfectants. However, despite the widespread occurrence and importance of these phenomena, our knowledge of the detail is in many cases rather hazy. We need to know more about the signalling pathways, the re-allocation of cell and organ identities and the switches of gene expression that are involved in these processes. In some instances we do not know which cells participate and it just such a situation that has been investigated by **Stobbe and colleagues at Hamburg (pp. 773–782)**. When a patch of bark is removed from a tree the wound is healed by the formation of a callus which differentiates into periderm. It is often assumed that the initial callus is derived from the cambium that underlies the bark. However, the authors' careful study of wound callus formation in lime (*Tilia*) shows that this is not so. Instead, the callus is derived from the outer layers of the xylem that have not yet undergone secondary thickening. After the callus has differentiated into the three-layered periderm a new cambium is formed between the periderm and the remaining xylem. This wound-healing process in *Tilia* thus starts with a dedifferentiation and re-programming of cells that were *en route* to becoming thickened vascular tissue. And what of the original cambium? If any remains at the wound surface after bark removal it does not contribute to callus formation; instead these the cells simply collapse and die.

Continued overleaf

Host favoured by fungal foraging

How do plants get the most out of the soil in which they are rooted? In many species, lateral roots proliferate in, and/or grow towards, zones of higher nutrient availability. However, growth is often too slow in the competitive soil environment for roots to benefit from transient and local increases in nutrient content. In such situations, **Tibbett (Bournemouth University) and Sanders (University of Leeds) (pp. 783–789)** suggest that plants in a mutualistic relationship with an ectomycorrhizal fungus are at a distinct advantage. They tested this suggestion with a hybrid *Salix* (willow) and an ectomycorrhizal symbiont, *Hebeloma syrjense*. In initial experiments under axenic conditions in Petri dishes, *H. syrjense* rapidly colonized and initiated breakdown of autoclaved bean cotyledons (model nutrient patches), but what would happen in soil? The authors used willow plants that had an established ectomycorrhizal symbiosis with *H. syrjense* and similar aged non-mycorrhizal plants. The willows were grown in nutrient-poor soil in which the autoclaved bean cotyledons had been buried. The results were very clear. The mycorrhizal willows were much greener and had higher leaf chlorophyll, nitrogen and phosphorus contents than non-mycorrhizal plants. Leaf biomass, however, showed no difference between mycorrhizal and non-mycorrhizal plants. The bean cotyledons were again extensively colonized by the fungus and the invading hyphae could be observed to connect to the mycorrhizal roots via the mycelial network. These data thus support the authors' suggestion that mycorrhizae are important in enabling plant roots to exploit nutrient patches that might otherwise be out of reach. However, we can also ask what the fungus gains from the relationship. It is generally held that while the fungal partner provides inorganic nutrients to the plant, the plant provides carbohydrate to the fungus. Certainly in these experiments, the fungal partner was able to outcompete other soil micro-organisms in colonizing and exploiting the nutrient patches. There is more to this relationship than meets the eye.

If at first you don't set seed, try, try, try again



In the remarkable double fertilization event that occurs in angiosperms, the pollen tube delivers two sperm nuclei to the embryo sac; one fuses with the egg cell to form the zygote and the other fuses with the diploid central cell to form the endosperm. It is not unusual for more than one pollen tube to reach an individual ovule but only one actually penetrates the ovule. In plants, as in many other sexual organisms, there are mechanisms to block polyspermy. Pollen tubes that are prevented from entering an ovule may continue to grow for a short time, but eventually atrophy and die. However, there are some exceptions to this. **Xiao-Fan Wang and colleagues at Wuhan University in China (pp. 791–796)** have carried out a detailed study of pollination and fertilization in *Sagittaria potamogetifolia.* This plant is pollinated by bees and can be both out- and in-breeding. It is very fertile, with individual plants achieving up to 100 % fruit set. The authors ascribe this at least partially to the behaviour of those pollen tubes that are prevented from entering the ovule in the block to polyspermy. Instead of curling up and dying, they continue to grow right through the base of the ovary into the receptacle and then grow upwards to seek ovules in adjacent carpels that have not been pollinated. These observations were verified experimentally by pollinating only one stigma with more than one grain. As predicted from the authors' descriptions of natural pollination, this led to fertilization of ovules in nearby carpels. These fascinating observations raise many more questions. Does the re-targeting of pollen give a clear selective advantage? Is this efficiency in pollen use associated with reduced pollen production? What are the mechanisms involved in the re-orientation of pollen tube growth? The authors clearly have several potentially fruitful avenues to explore.

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