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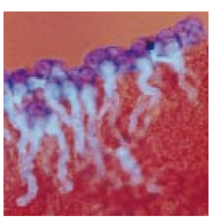
John Bryant takes a closer look at some of this month's Original Articles

Begonias bleached in bright light

The concept of 'shade leaves' and 'sun leaves' and their adaptations that maximize photosynthesis in specific light environments are well known to botanists. However, in nature, things are rarely this clear-cut. It is possible, for example, that a shade plant may become exposed suddenly to full daylight, and it is this type of situation that has been modelled by **Burritt and Mackenzie (University of Otago, New Zealand, pp. 783–794)**. They have worked with *Begonia* × *erythrophylla*, a hybrid begonia, popular as a houseplant. Many begonias show adaptation to growth in the shade, and indeed several wild *Begonia* species are described as 'shade-demanding'. In this study, the authors have grown the hybrid plants in full sunlight or in shade [at about 10–15 % of the photosynthetically active radiation (PAR) experienced by the 'sun plants']. Some of the shade-grown plants were then transferred to full sunlight. In a very comprehensive analysis, the authors have compared a range of characters from photosynthetic capacity to antioxidant metabolism in the leaves subjected to the experimental treatments. As might be expected, shade leaves show a saturation of photosynthetic electron transport at much lower PAR levels than do sun leaves, and when shade leaves are transferred to sunlight, the excess energy leads to the production of reactive oxygen species, photobleaching of photosynthetic pigments and oxidative damage to membranes and enzymes. In general, sun leaves have a greater capacity to dissipate reactive oxygen species with higher levels of the relevant enzymes. Furthermore, although the shade leaves transferred to full sun show some acclimation over a period of 25 d, this is far from complete and it is only the newly formed leaves that are fully adapted to the sunlight. I will think very carefully the next time I am tempted to move a house plant from a shady corner to a brightly lit window-sill!

Self-pollen in fruitless race for the ovule



In considering self-incompatibility (SI) mechanisms, most botanical text books focus on those that affect reception of pollen and/or growth of the pollen tube. However, angiosperms actually present us with a much wider range of SI mechanisms; we focus on two of these, in this commentary and the next. **Sage and Sampson (Toronto, Canada and Wellington, New Zealand, pp. 807–816)** draw attention to this range and suggest that the early evolutionary origin of several SI mechanisms contributed to 'the early success of angiosperms'. They have investigated pollination and fertilization in *Pseudowintera axillaris*, a member of the Winteraceae; this family is regarded as primitive, based on features of its anatomy and on its long history in the fossil record. In their study of fertilization by either self or non-self pollen they first showed that the pollen tubes from the two types of pollen have very similar growth rates indicating that there are no stylar rejection mechanisms. But what happens then? Surprisingly, there appear to be no differences in the abilities of the two pollen types to penetrate the ovule or to achieve a double fertilization: thus a zygote is formed and an endosperm is initiated in both types of pollination event. However, it is at this stage that the self-fertilization fails: there is no division of the zygote and thus no further development of the embryo sac. This happens with all zygotes that arise from self-fertilization and not with just a subset as happens with post-zygotic inbreeding depression (a phenomenon in which embryos that are homozygous for deleterious recessive alleles are aborted). This careful piece of work has thus revealed an SI mechanism that operates very late in the fertilization process, but has left open the question of the timing and nature of the recognition and signalling mechanisms. This interesting system is ripe for further investigation.

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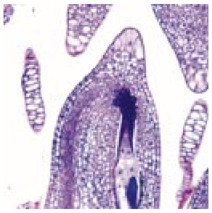
Falling flowers foil self-fertilization



As in the previous commentary, we focus here on late-acting self-incompatibility (SI) mechanisms. The species investigated by **Bittencourt *et al.* (Sao Paolo, Brazil and St Andrews, Scotland, pp. 827–834)** is *Spathodea campanulata*, a tree originating in tropical west Africa. The effectiveness of its SI mechanism is very clear. Self-pollinated flowers abscind within 4 d and no fruit is set. So, where does SI operate? There is little or no difference in pollen tube growth rates between self and non-self pollen but there is a clear difference in the speed of ovule penetration, which takes up to 24 h longer with self than with non-self pollen. Nevertheless, once ovule penetration has occurred, self pollen achieves a normal double fertilization giving rise to an endosperm cell and a zygote. At this stage further differences become apparent. Although an endosperm is effectively initiated in a self-fertilization, subsequent cell divisions occur only rarely, so that by 72 h the number of two-cell endosperms in selfed ovules is little more than half that in out-crossed ovules, and there is no evidence at all of subsequent cell divisions in the selfed ovules. This difference arises because of the lateness of ovule penetration by the self pollen; there are no indications of endosperm malformation. A similar situation exists with the embryo. Again, because of slow penetration of the ovule, formation of a zygote with self pollen occurs around 24 h later than with non-self pollen and there is no post-zygotic embryonic development following self-fertilization. There is no obvious embryo malfunction; embryogenesis is simply terminated by floral abscission. The latter is thus a major controlling factor in SI in *S. campanulata* and the authors make the interesting suggestion that it is the slow penetration of the ovule by self pollen (presumably dependent on a recognition event) that initiates the floral abscission pathway.

Moving bands amongst the beans

Over 25 years ago I suggested that the genus *Vicia* would be an ideal subject for study of plant genome evolution. The features that had caught my attention were the seven-fold range in genome size and the different chromosome numbers within the genus. These features have also been noted by **Alice Navrátilová and colleagues at České Budějovice, Czech Republic (pp. 921–926**). They have previously described two repetitive satellite DNAs, VicTR-A and VicTR-B in *Vicia* genomes. The copy number of the A-satellite varies between zero and approx. 10^6 in different species. There is some correlation between genome size and copy number suggesting that acquisition and further amplification of this repetitive DNA may be associated with genome expansion. B-satellite copy number varies between 100 and 10^6 but there is no correlation between copy number and genome size. Both satellites have proved useful in studying aspects of chromosome organization. The authors have used FISH (hybridization of fluorescently labelled DNA to metaphase chromosomes) and PRINS (amplification of DNA sequences *in situ*, using a PCR-based technique) to study the position of satellite bands in relation to established chromosome markers such as the rRNA genes. Three features of the results are very clear. First, these satellites provide unequivocal identification of each chromosome within each species, i.e. they can be used to establish the karyotype. Secondly, in species that possess the A-satellite it is always located at chromosome ends, whereas B-satellite bands occur throughout the karyotype. Thirdly, the banding patterns are not conserved between species so that they cannot be used to identify homologous chromosomes. This raises the possibility that the B-sequence may have been mobile in evolution and that there has been interspecific variation in the extent of amplification at different chromosomal locations. The genus *Vicia* thus continues to be highly suitable for study of genome evolution.

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