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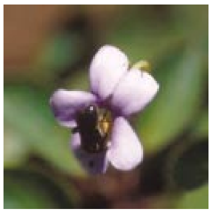
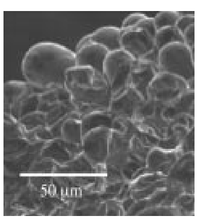
John Bryant takes a closer look at some of this month's Original Articles



Dancing with *Viola*—what's in it for the bees?

Relationships between insect-pollinated plants and their pollinators are very varied and sometimes complex. For the plant, there is the trade-off between the cost of attracting and/or rewarding pollinators and the need for successful pollen transfer. When pollen is the reward the problem of trade-off becomes more acute because, in addition to rewarding the pollinator, there must be enough pollen to effect gamete transfer. For the pollinator, there is a trade-off between the effort expended and the 'value' of the reward. All these features are apparent in the floral biology of *Viola*, as discussed by **Freitas and Sazima (University of Camponas, Brazil, pp. 311–317)**. They have worked on two (*V. cerasifolia* and *V. subdimidiata*) of the four *Viola* species that occur in Brazil. All four belong to a single relict lineage and are regarded as primitive members of a genus that contains approx. 550 species in total. The floral morphology of *Viola* suggests that they are bee-pollinated, with nectar as the main reward. However, some apparently advanced *Viola* species provide pollen as a reward, suggesting an evolutionary trend from nectar providers to pollen providers. The two species in this study are pollinated by bees, mostly females, in the genus *Anthrenoides*. During visits, female bees vibrate the flowers and also move backwards and forwards inside them, behaviours that optimize pollen collection from dehiscing anthers. These features, taken with, amongst other things, a relatively low nectar output and small nectary size, suggest that these two *Viola* species are primarily pollen providers. However, the situation is complicated by the male bees which, during their visits to these flowers, exhibit no behaviour associated with optimizing pollen production but do take nectar. The authors' suggestion that these species represent a stage on the evolutionary pathway from nectar provision to pollen provision is clearly very appropriate.



Spray and pray?

The topic of pesticide and fungicide residues on our food crops receives frequent attention in the media, and whatever our attitude to 'organic' agriculture, a reduction in the level of possibly harmful compounds in food must be regarded as worthwhile. However, one aspect that usually escapes attention is the effect of pesticides and fungicides on the crop plants themselves. The work of **Yi and colleagues (University of Georgia, USA, pp. 335–341)** is directed at this very problem. They have worked on almond (*Prunus dulcis*), a tree that typically exhibits a fruit set of only around 30 % of flower number. Any further reduction would be economically undesirable. Almond is susceptible to blossom blight and trees in commercial orchards are sprayed with fungicides during the flowering season. Do these fungicides damage the flowers and thus reduce fruit set? The authors have studied the effects of controlled applications of four commercially used fungicides (at appropriate concentrations) to flowering shoots of almond. Control shoots were sprayed with similar volumes of water. Stigmas were then examined (without fixing) by SEM. The results of spraying varied slightly between the fungicides, but in general it was clear that spraying led to significant damage to the stigmatic surface. This damage included the production of a sticky exudate and the collapse of cells. The production of a stigmatic exudate in almond is normally associated with the phase of flower senescence. The authors suggest that the fungicides had caused a senescence-like process in the stigmas, a suggestion supported in those instances where cell collapse followed. These changes induced by the fungicides are very likely to reduce receptivity to pollen. Thus, the authors now wish to follow up these laboratory experiments with observations on plants sprayed in the field, focusing both on stigmatic receptivity and on fruit set.

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Sources, sinks and cells

According to Barbara McClintock, the problem with studying bits of nature is that we come to understand nature only in bits: we can too easily miss interactions and connections between different events. However, this is not a trap that **Chen and Setter of Cornell University (pp. 373–381)** fall into. They have studied the relationship between rate of photosynthesis and tuber growth in potato. Tubers are initiated on underground stems at localized foci of dividing cells originating from the cambium. The cells expand and many of them undergo several extra rounds of DNA replication in the absence of cell division. This DNA endoreduplication occurs in many storage organs and may be associated with the formation of large cells. When photosynthetic rates were enhanced by elevating the CO_2 concentration, the rate of accumulation of cells during initiation increased markedly. This led to an increased cell number at the tuber bulking stage. However, there was no increase in the proportion of cells undergoing DNA endoreduplication nor in average cell volume. Decreasing the rate of photosynthesis by shading led to a decrease in the rate of cell accumulation at initiation and decreased cell numbers during tuber bulking. However, there was an increase in cell volume during bulking but with little effect on endoreduplication. Thus, the control of cell proliferation via complete cell cycles is much more sensitive to changes in source activity than is endoreduplication. This provides clues about the points at which photosynthate may interact with cell cycle regulatory mechanisms. Concerning the signalling mechanism, the authors have evidence that glucose may be involved. They suggest that glucose concentration may be regulated by acid invertase located in the tuber-initiating cambium: invertase activity goes up when the rate of photosynthesis increases, and goes down when photosynthetic rate drops. There is clearly further exciting research to come from the Cornell lab.

Sleeping in the sun

The remarkable intraspecific variation exhibited by many species in respect of response to environmental factors has been noted previously in this column. A questions that arises is the origin of that variation: is it inherited or does it represent developmental and/or physiological plasticity within one relatively homogeneous genotype? **Ofir and Kigel (Hebrew University of Jerusalem, pp. 391–400)** have investigated this in a perennial grass, *Poa bulbosa*, and have worked with plants in habitats where the annual rainfall varies from 110 to 810 mm. All these populations are dormant in summer; dormancy is induced in spring (before the end of the wet season) by increasing day length and increasing temperature. However, in the wild there is a clear correlation between rainfall and dormancy: the higher the annual rainfall, the later is the onset of dormancy. The authors transplanted *P. bulbosa* from several sites along this rainfall gradient to a single outdoor site. After 2 years' growth (to eliminate carryover effects), basal tiller bulbs were removed and planted under one controlled growth regime in the phytotron. The age at which these 'daughter' plants became dormant was strongly correlated with the amount of rainfall at the original collection site (the lower the rainfall, the earlier the onset of dormancy), as was the timing of dormancy onset in the parental plants grown at the outdoor site. This clear association between rainfall at the original site and dormancy onset was mirrored in other aspects of plant growth. For example, plants with the earliest dormancy onset, and hence the shortest growing season, produced the most flowers, while those with the longest growing season were more likely to reproduce solely by vegetative means. These results suggest that the specific traits exhibited by different populations growing in habitats with differing rainfall do indeed represent genetic differences between those populations.

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