

# ContentSelect

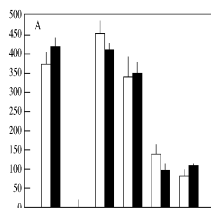
John Bryant takes a closer look at some of this month's Original Articles

---



## Post-pollination pulling power in *Platanthera*

As we have noted before in *ContentSelect*, the Orchidaceae provide an amazing range of plant-pollinator relationships. One of the variants is the provision of a reward to the pollinator, as studied by **Malgorzata Stpiczyńska at Lublin, Poland (pp. 191–197)** in *Platanthera chlorantha*. This white-flowered species is pollinated by moths, attracted initially by the floral scent. However, the flowers also secrete nectar into the long labellar spurs from which the moths are able to drink. This reinforces the reward once the pollinator has arrived, and thus nectar production is seen as a mechanism for prolonging the visit of the pollinator, thereby increasing the probability of successful pollination. But the story is more complex than this. Nectar production is energetically expensive in terms of synthesis, transport and secretion, and thus increased pollination success is a trade-off against the metabolic cost of holding the pollinators' attention. Furthermore, in *P. chlorantha*, nectar production is very copious: individual flowers often producing in excess of 8  $\mu$ l (means of 6.86 and 7.84 in successive years). Nectar secretion starts about a day and a half before anthesis but, contrary to expectation and despite the supposed metabolic cost, it does not stop once the flower is pollinated. Thus, for a period of about 5 days after pollination, flowers continue to provide a nectar reward to moths attracted to the inflorescence; indeed, nectar flow increases after pollination. Eventually, it is the post-pollination senescence and death of the flower that cuts off nectar flow (and concomitantly increases nectar production in neighbouring unpollinated flowers). What then is the trade-off against the cost of production? There is evidence from other species that multiple pollinations increase fertilization and seed set efficiency (even though only one pollen grain is directly involved in fertilization), and this clearly provides a selective rationale for the post-pollination nectar production reported in *P. chlorantha*.



## Mutualistic relationships in rocky patches

Flowering plants grow in a wide range of environments, some of which are very challenging for plants. One such environment is described by **Pimienta-Barrios *et al.* from Jalisco, Mexico and University of California, Los Angeles (pp. 239–245)**. This is the inselbergs, which are rocky 'islands' that protrude from the surrounding land, at the edge of the Chihuahuan desert in a semi-arid region of Mexico. In general, inselbergs may be colonized by plants that gain a root-hold in crevices in which some organic matter has accumulated and which have the potential to collect moisture. It is a precarious habitat and in the study area is made more difficult by the intermittent pattern of rainfall. Although the mean annual rainfall is approx. 500 mm, it nearly all occurs between May and September, the other months being dry. However, in the 6 years prior to the work described here, there had been a major drought, eventually broken in the 'wet' season of 2000. Needless to say, one common adaptation to life in the Mexican inselbergs is Crassulacean Acid Metabolism (CAM), in which CO<sub>2</sub> is initially fixed at night. Another adaptation to nutrient-poor environments is the establishment of mutualistic relationships with fungi to form mycorrhizae. The plant studied by the authors, *Opuntia robusta*, is a CAM plant that forms an arbuscular mycorrhizal symbiosis. They worked with plants in the field and treated some with fungicide to prevent the formation of mycorrhizae. They then measured photosynthesis, water uptake and phosphorus uptake in mycorrhizal and non-mycorrhizal plants. Surprisingly, apart from a slight reduction in photosynthesis in non-mycorrhizal plants at the end of the wet season, there were no differences between mycorrhizal and non-mycorrhizal plants. These results thus challenge the accepted view that mycorrhizal symbiosis increases water and nutrient uptake leading to increased photosynthesis. There is clearly much to discover about life in a Mexican inselberg.

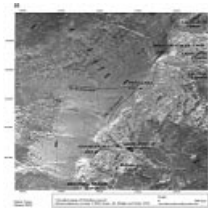
---

*Continued overleaf*



### Compare with care: caffeine may affect your judgement

Measurement of nuclear DNA content (C-value) is one of many tools used in study of plant evolution, in evaluating sexual and somatic hybrids and in assessing tissue cultures. Flow cytometry of propidium iodide-stained nuclei has become the method of choice and, as with many colorimetric or fluorimetric methods, it is subject to inter-experiment variation; careful use of standards is therefore absolutely necessary. However, even the use of standards may not eliminate significant error, as shown by **Noirot *et al.*, from Montpellier and Lusignon, France and Man, Ivory Coast, (pp. 259–264)**. They are working on inter-specific and inter-variety hybrids of coffee (*Coffea*). The different lines they use vary in their content of caffeine and of chlorogenic acids, and it is clear that both can affect measurements of DNA C-value. The authors first examined the effect of adding either caffeine or chlorogenic acid to the *Petunia hybrida* nuclei used as a standard. Caffeine increased the fluorescence of *Petunia* DNA, suggesting that it allowed a greater access of the propidium iodide dye, while chlorogenic acid decreased the fluorescence. They then showed that when *P. hybrida* was used as an *internal* standard (tissue processed together with the *Coffea* tissue), the estimated genome size was always different from the estimate obtained when the *Petunia* was used as an *external* standard. This difference they refer to as  $\Delta$ DNA. The  $\Delta$ DNA value was affected mainly by the caffeine content. This varied both within hybrids (affected by developmental and environmental factors) and between hybrids. However, chlorogenic acid also affected the  $\Delta$ DNA; furthermore, the relationship between estimated DNA C-value, caffeine content and chlorogenic acid content was complicated by the interactions between caffeine and chlorogenic acid. As the authors point out, stoichiometric errors in estimating DNA are very likely to occur in any plant where the phenolic content is variable: interpret the data with care.



### Montane warning of global warming

It is easy enough to obtain anecdotal evidence for the effects of global warming but we actually need hard data, based on careful floristic and meteorological analysis. Thus, **Sanz-Elorza *et al.* from Madrid and Almería (pp. 273–280)** have studied vegetational changes up to 2430 m in the Peñalara Massif of the Spanish Central Range. At these high altitudes, the main vegetation had been grassland communities, dominated by *Festuca supina*, while at slightly lower altitudes, the vegetation was more ‘shrubby’, typified by *Cytisus oromediterraneus* and *Juniperus communis alpina*. Both these shrubs are easily identified in aerial photographs and the authors have used this in high-resolution analyses of photographs taken in 1957 and in 1991. The results are startlingly clear. Much of the grassland at high altitude has been invaded extensively by the shrub species from the lower climatic zone. ‘On the ground’ vegetational analysis confirms that the shrubs are now indeed abundant at the higher altitudes and are likely to replace the grassland communities completely. The authors have also analysed weather recordings for the region going back to 1941. Of particular note are the steady temperature rise, especially marked for the coldest month of the year, January (leading to fewer frosts), and a redistribution of precipitation, with more in summer and less in winter now than previously. Can we then ascribe the vegetational changes to climate change? The authors point out that the distributions of grass-dominated and shrub-dominated communities may also be affected by land use, especially grazing. However, there has been no change in grazing practices in the study area since the 19th century. The authors therefore conclude that the main factors that have permitted the upward invasion of the shrub species are related to global warming, while more generally they note the vulnerability of isolated and specialized plant communities to the effects of climate change.