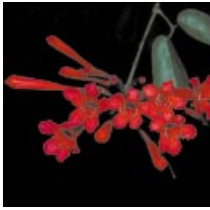


ContentSelect

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



Substitute provides the sweet taste of success

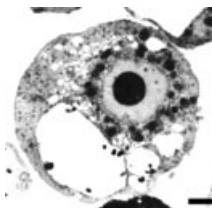
Appearances can be deceptive. Classic examples are those organs which, on a cursory glance, appear to be petals but are in fact sepals or even bracts. These substitutes are, nevertheless, fulfilling the biological role of petals and thus have, over the course of evolution, acquired the relevant petal-like features. Another example of substitution is provided by the work of the Brazilian team, based at Recife, working in collaboration with the University of Vienna (**Lopes *et al.*, pp. 169–174**). They study pollination mechanisms in the Bignoniaceae, a large family confined to new world tropics, all members of which are pollinated by animals, ranging, in different species, from bees to lemurs. Many possess, at the base of the ovary, a disc-like nectary from which nectar is secreted via modified stomata. However, several genera lack a nectariferous disc, or if they possess a disc it is non-secretory; some of these simply mimic nectar-providing flowers and thus deceive the pollinator. However, in the genus *Lundia*, all members of which are pollinated by humming birds, the function of the disk is fulfilled by a substitute, a 'carpet' of multi-cellular trichomes located on the inner surface of the corolla. These secrete their nectar into the base of the corolla tube thus providing a 'typical' feeding site for humming birds. Nectariferous trichomes have in fact been described elsewhere, including, somewhat surprisingly, the stipules of *Vicia sepium*. However, this paper gives us an interesting and unusual example of a substitute nectary providing nectar within the corolla. The authors surmise, with some justification, that the development of these substitutes occurred in evolution after the prior loss (or at least loss of function) of the nectary disc. Thus the evolutionary ancestors of these *Lundia* species may have been deceptive mimics. The substitute nectaries have re-instated the pollinators' reward.



If you can't stand the heat . . .

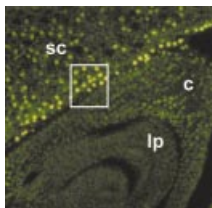
Although many thermo-tolerant micro-organisms have been described, habitats such as hot springs are a very hostile environment for more complex life-forms; it is thus not surprising that only a few vascular plants grow in geothermal areas. Previous studies suggest that soil temperature is the major limiting factor for plants in these habitats. In a fascinating study carried out in the Yellowstone National Park, USA, **Stout and Al-Niemi (Montana State University, pp. 259–267)** have found only nine angiosperm species, four of which are grasses, that can grow in soils with a mean temperature of above 40 °C at 10 cm depth. Both perennial and annual lifestyles are represented and several of the species are actually confined to hot soils; the dominant grass is *Dicanthelium lanuginosum* (formerly *Panicum thermale*). The mean temperature of 40 °C hides the extremes that these plants survive: rhizosphere temperatures as high as 65 °C have been recorded and it is not uncommon for temperatures to remain above 50 °C for extended periods. How do these plants survive? The authors have started to tackle this question by surveying the distribution of small heat-shock proteins (sHSPs) and of one larger HSP (HSP101). Taking *D. lanuginosum* as an example, sHSPs are expressed in roots at soil temperatures above 35 °C but are not present in leaves until the soil temperature reaches 45–50 °C. (Leaf temperatures are generally 15–25 °C lower than rhizosphere temperatures.) The expression of sHSPs is also induced by transferring laboratory-grown plants to 40 °C for 2 h. HSP101 is present under all conditions in both roots and leaves but the amount of protein increases with increasing temperature. This is an exciting start to understanding the extreme thermo-tolerance of this fascinating group of plants: it is a particularly encouraging to see molecular biology being applied to wild plants in the field.

Continued overleaf



Protoplast to plant: problems and pointers

As noted before in these pages, plant breeders often turn to wild relatives of crop species for ‘new’ genetic traits and then seek methods of introgressing the relevant genes into the crop. One such method is protoplast fusion which bypasses barriers to sexual hybridization and generates a somatic hybrid that possesses the genomes of both parental species. It is hoped that the somatic hybrid behaves as a stable tetraploid and thus inherits the desirable traits from both parents. There have indeed been some successes with somatic hybridization but there have also been many failures. One stage at which the process may break down is the regeneration of plants from the fused protoplasts. This is the problem faced by a Polish group (**Tylicki and colleagues (pp. 269–278)**) working with *Solanum lycopersicoides*. This is a potential source of several useful traits but somatic hybridization with other *Solanum* species has proved very difficult because of frequent failures at the regeneration stage. Indeed, *S. lycopersicoides* itself does not regenerate well and so the authors have undertaken a very detailed analysis of the structure and behaviour of protoplasts. There are many interesting features in this paper but perhaps the most significant is the finding that an apparently homogeneous source of cells (a culture of root primordia) can give rise to a heterogeneous population of protoplasts. Four types were distinguished: mononuclear, polynuclear (arising by protoplast fusion during isolation), anuclear and ‘homogeneous’ (which, from their ultrastructural appearance were probably undergoing cell death). Of these, only the mononuclear were able to establish cultures from which plants could be regenerated. This careful study has thus suggested that the heterogeneity of the original protoplast population is a possible bottleneck in regeneration. It is to be hoped that the authors can go on to obtain regeneration of somatic hybrids containing the *S. lycopersicoides* genome.



TUNEL of death

It is very well known that in cereal seed development, the cells of the endosperm undergo programmed cell death (PCD). Indeed, the roles of the embryo and aleurone in mobilizing the stored reserves of the dead endosperm during germination have been the subject of extensive research in relation to the action of gibberellins. But what of other parts of the seed, including the embryo itself? **Giuliani et al. (pp. 287–292)** from the University of Milan have used the TUNEL assay to study DNA fragmentation in the suspensor and embryo of maize. This assay detects strand breaks in DNA which are taken as symptomatic of an ordered degradation of chromatin. As expected, TUNEL-positive nuclei were readily detected in the suspensor — it has only a limited lifetime during embryogenesis — and their presence preceded the breakdown and collapse of the suspensor cells. More surprising, however, was the transient presence at particular times during embryogenesis of TUNEL-positive nuclei in specific parts of the embryo, particularly the scutellum (the single cotyledon of the cereal seed) and the coleoptile. However, we need to be cautious in interpreting a positive TUNEL assay as being diagnostic for PCD. For example, TUNEL-positive nuclei are detectable in ungerminated seeds. The nicks in DNA in mature seeds are due to DNA damage sustained during desiccation which are repaired during germination. However, the TUNEL-positive nuclei that occur at specific phases of embryogenesis are unlikely to result from DNA damage that is subsequently repaired. First, the authors find some evidence for breakdown and loss of nuclei, and secondly they detect much more extensive endonucleolytic hydrolysis of DNA as evidenced by the presence of a ‘ladder’ when extracted DNA is fractionated in agarose gels. At present, we do not know the significance of this localized PCD in cereal embryogenesis, but the data provide an excellent impetus for further research.