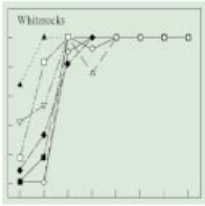


# ContentSelect

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

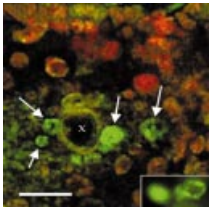
---



## Chilling out in cool locations

The presence of a single species over a wide area gives opportunities to study adaptation to different conditions within that area. Thus, **Meyer *et al.* (Provo, Utah, USA, pp. 653–663)** work with a grass, *Bromus tectorum*, an invasive species now dominant on tens of millions of hectares of former cold desert shrubland and of sagebrush steppe vegetation. The extent of this range means that different populations are exposed to different climatic conditions and one of the authors' interests is to understand the adaptability of this species. In this paper, the focus is on vernalization, the need for exposure to a period of chilling in order to flower. Plants were collected from warm desert, cold desert, sub-montane and montane habitats and their vernalization requirements were determined. Vernalization at 2 °C was carried out on either imbibed seeds or established plants for up to 10 weeks. The authors obtained a large data set, of which we concentrate on the following. First, there was some correlation between the winter temperature of the plants' provenance and the vernalization requirement. Thus, the warm desert population flowered without any vernalization. In the other populations, some unvernalized plants flowered but the proportion that flowered was very markedly increased as the period of cold treatment was extended. Secondly, in the populations that exhibited a vernalization requirement, cold treatment of established plants was more effective than cold treatment of imbibed seeds. Indeed, with the montane population, even 10 weeks vernalization of seeds did not result in 100 % flowering. Thirdly, in all populations, even that from the warm desert, vernalization decreased the time to flower initiation. Finally, the authors note an earlier report showing that the warm desert population is represented by a single genotype (as indicated by micro-satellite profile) whilst the other populations consist of several genotypes, providing evidence for genetic divergence resulting from habitat-specific selection.

---



## Via the normal channels

Because of the very sensitive nature of the signalling mechanisms in which calcium is involved, its concentration must be very tightly regulated in space and in time. Indeed, there are several situations known in which calcium signalling involves fluxes in concentration over very short time periods. Much of this control is exerted by the operation of voltage-gated Ca<sup>2+</sup> channels that are able to allow or to impede passage of calcium ions within the cell. However, the necessity to control, at concentrations lower than 1 μM, the calcium concentration in particular cell compartments is challenged by the abundance of calcium in the environment and hence the strong tendency for calcium to enter the cells. If Ca<sup>2+</sup> signalling is not to be disrupted, there must be means of sequestering the calcium in locations where it is physiologically inert. Many plant species form calcium oxalate crystals and, as indicated by **Volk *et al.* (Pullman, Washington State University, USA, pp. 741–753)** it is thought that one function of these is to sequester calcium in order to prevent tissue damage. A leading question is how the calcium is transported to the site of storage. The authors have studied this problem in *Pistia stratiotes*, which stores calcium oxalate in specialized cells called idioblasts, the abundance of which is directly related to the concentration of supplied calcium. Study of calcium transport in protoplasts and in whole plants showed first that idioblasts have a greater capacity than other cells to accumulate calcium. Secondly, Ca<sup>2+</sup> channel blockers almost completely inhibit calcium oxalate formation and thirdly, a fluorescently tagged Ca<sup>2+</sup> channel-binding protein revealed intense labelling in the idioblasts but not in normal mesophyll. Finally, a protein was present in microsomal preparations from idioblasts, but not from mesophyll, which was recognized by antibodies raised against a mammalian Ca<sup>2+</sup> channel subunit. All these data therefore point to the essential role of Ca<sup>2+</sup> channels in Ca oxalate formation.

---

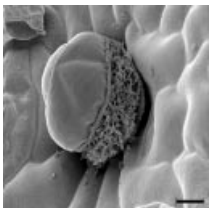
Continued overleaf



### The honey trap

Those familiar with ‘Old World’ orchids know that many species attract pollinators by means of sexual mimicry. Indeed, in some species, having been lured by the false promise of sex, the pollinator receives no reward at all because the flowers do not even provide any nutrition. However, rather fewer instances of sexual mimicry are known amongst ‘New World’ orchids and it is thus interesting that such mimicry has now been described in the Central American epiphytic orchid, *Mormolyca ringens*.

**Singer *et al.* (Campinas, Brazil, pp. 755–762)** describe the flower (particularly the labellum) as being similar to those of *Ophrys*, an Old World genus in which sexual mimicry is widespread. Further, the flowers produce a complex of volatile compounds that add to the sexual mimicry, by acting as a pheromone. Indeed, drones (males) of a particular bee species, *Nannotrigona testaceicornis*, exhibit a strong positive response to these volatile compounds and these drones are, not surprisingly, the most common pollinators. The drones become sexually excited and attempt copulation with the flowers. This, of course, is unsuccessful but there is a nutritional reward in the form of starch and lipids. Then, as the drone backs away from the flower, he picks up the pollinarium. At this point, the drone may visit another flower on the same plant, resulting in a self-pollination or may visit flowers on another plant. However, preliminary studies with manually pollinated plants suggest that *Mormolyca ringens* is not self-fertile. Thus, his visit is fruitful only if he moves on to another plant. The final point for comment is the compatibility of the floral ecology with bee biology. Flowers are produced throughout the year and are thus always available for the drones, which occur in large batches several times per year. The flowers, cleverly, are able to attract drones before the real females appear.



### Heightened awareness of spatial dimensions

Uppers, downers, painkillers, hallucinogens – and the list could go on. Every time we drink a cup of coffee (unless it is ‘decaf’) we experience at first hand the drug synthesizing abilities of plants. However, several of the drugs elaborated by plants have effects that are considerably more dramatic than those of caffeine. Thus, as reported by **Daniel Siebert (Malibu, California, USA, pp. 763–771)** a Mexican labiate, *Salvia divinorum* (‘diviners’ sage’) produces a powerful psychoactive diterpene, salvinorin A, which induces altered states of awareness that may include dream-like visions.

Salvinorin A is a powerful agonist of kappa-opioid receptors. In addition to traditional cultural and religious uses in Mexico there is interest in developing salvinorin A as an anti-depressant. It is thus important to understand better the processes of synthesis and accumulation of this compound. Anatomical examination of the plant reveals the presence of three types of glandular trichomes, and based on general knowledge of such structures they are thought likely to be involved in the elaboration of salvinorin A. Further, one class of glandular trichome, the peltate glandular trichomes, have a curious sub-cuticular space which is generated by the separation of the outer cell walls of the glands’ head cells from the substantial impervious cuticle that protects them. Any compounds that are secreted by these cells are likely to be trapped in this sub-cuticular space. The author surmised therefore that the peltate glandular trichomes are the sites of accumulation of salvinorin A in *S. divinorum*. Collection of glandular secretions from various parts of the plant, including peltate glandular trichomes stripped from leaves, followed by thin-layer chromatography, revealed that salvinorins, especially salvinorin A, are indeed secreted, as components of a complex resin, into the sub-cuticular space of these structures. Further, although not specifically demonstrated, it is likely that these compounds are actually synthesized within the trichomes.

---

**Professor J. A. Bryant**  
**University of Exeter, UK**  
**E-mail [j.a.bryant@exeter.ac.uk](mailto:j.a.bryant@exeter.ac.uk)**