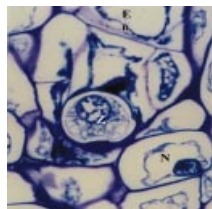


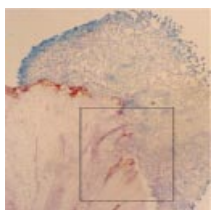
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John Bryant takes a closer look at some of this month's Original Articles



Puzzles of pollen performance

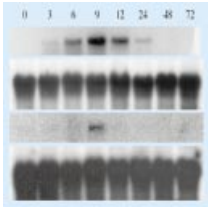
In the infamous words of Donald Rumsfeld, the current US Defence Secretary, 'there are things we know that we do not know'. Being aware of gaps in our knowledge is a major driver for our research. Thus the multinational team led by Tammy Sage (**Koehl et al. Toronto, New Orleans, USA and Glen Osmond, Australia, pp. 43–50**) states that 'to date, the site and timing of self-incompatibility within the carpel of *Illicium floridanum* remain unidentified'. Why is this important? *Illicium floridanum* is a relictual species, belonging to an ancient family that can be traced back to the basal branches of angiosperm phylogeny. Study of its self-incompatibility (SI) mechanisms may therefore yield information on the evolution of breeding systems in the earliest flowering plants. The flowers of *I. floridanum* are bisexual and the anthers mature before the stigmatic surface is receptive. This phenomenon (protogyny) prevents selfing in an individual flower. However, flowers on a single plant are at different stages and pollinators can (and do) transfer self-pollen to other flowers. How then is SI mediated? In a very careful study, this group has examined all possible stages of pollen growth and fertilization. The results show clearly that there are no differences between self- and non-self pollen in terms of germination, pollen tube growth, entry into the ovule or participation in the double fertilization. The situation becomes even more puzzling after fertilization: there are no differences in the appearance of the zygote, nor in the formation of the endosperm, following self- or non-self fertilizations (although, interestingly, endosperm formation is very variable in both selfed and non-selfed ovules: at 30 days after pollination, cellular endosperm varies between four and 300 cells). Overall then, SI relies on a very late mechanism, most likely to be, according to the authors, post-zygotic inbreeding depression. Whether this is the most primitive form of SI however remains unclear.



Transformed cells are reluctant regenerators

Although the first successful laboratory use of *Agrobacterium tumefaciens* to bring about plant genetic transformation occurred over 20 years ago, many economically important crops remain recalcitrant. There are several key factors in successful genetic manipulation. One of these is susceptibility of the host to the *A. tumefaciens*-mediated gene transfer system: extensive research has extended the list of susceptible species way beyond the natural range, including several *Citrus* species, as described by **Peña et al. (Valencia, Spain, pp. 67–74)** Further, even if a particular species cannot be transformed via *A. tumefaciens*, then direct DNA delivery systems, developed over the past 15 years, may be used. The other key step is the regeneration of plants from the transformed cells and, as the Valencia group point out, transformation-competent cells may not be the same as regeneration-competent cells. This group has used epicotyl explants from a hybrid citrus to study the location of the transformed cells (detected by assay of the β -glucuronidase reporter gene), under different culture conditions. The data clearly show that a medium containing auxin was by far the most efficient for transformation. This was associated with the induction of DNA replication and cell division in the cambium of the explants, as demonstrated by flow cytometry; this cell division activity led to the establishment of a cambium-derived callus. Such data are consistent with observations made by several authors (including Alicja Ziemienowicz in my lab): efficient integration of foreign DNA requires the host's DNA replication 'machinery'. However, de-differentiation and cell division are not good attributes for morphogenesis and, in fact, relatively few shoots were formed from the auxin-incubated callus. Nevertheless, the transformation frequency was so much higher than in other media, that it still gave the most transformed shoots. This illustrates nicely that well-worn English expression: 'What you lose on the swings you gain on the roundabouts'.

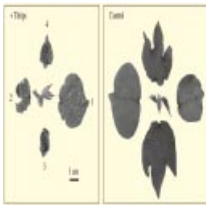
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Do phenolics foil fungal foes?

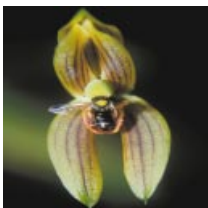
It is sad but true that so much more research effort has been expended on the crops of developed countries than those of less-developed countries. An example of the latter is cassava (*Manihot esculenta*), a starchy staple of the tropics and sub-tropics. It is, as reported by **Gómez-Vásquez et al. (Bath, UK, pp. 87–97)**, subject to attack by around 25 different pathogens. However, so little is known about its responses to pathogen attack that it is difficult to select for specific resistance mechanisms.

The group have therefore studied the synthesis of defence chemicals in cassava leaves and cell cultures, and it is on the cell cultures that we focus here. Pathogen attack was mimicked by challenging the cells with the yeast cell wall glucan which, in many plant species, is a powerful elicitor of defence mechanisms. This proved to be also true for cassava cells. The cells showed an oxidative burst, including rapid synthesis of hydrogen peroxide, which is typical of early responses to attack by non-compatible pathogens. This was followed, within a few hours, by up-regulation of the gene encoding phenylalanine-ammonia lyase, leading to increases in the activity of the enzyme itself. This is involved in the synthesis of phenolic compounds but, strangely, the amounts of relevant phenolics did not increase. Indeed, the concentrations of these phenolics in cultured cells were very low (although they were much higher in leaves). Nevertheless, the effectiveness of cassava phenolics was tested and four of them, esculetin, ferulic acid, quercetin and scopoletin, were shown to inhibit germ tube growth in *Fusarium oxysporum* and in *Trichoderma* species. A later event was an increase in peroxidase activity and although the role of this is not clear, it may be involved in oxidation of phenolics thereby increasing their pathogen-inhibiting activity. This work thus provides a good basis for understanding defence mechanisms in cassava.



Cotton-picking thrips turn over a new leaf

One of the hazards of being rooted to the spot is the inability to run away. Thus during the course of evolution, mechanisms have developed for defence against herbivores and for recovery from herbivory. It is the latter that interests **Lei and Wilson, Cotton Research Unit in Narrabri, New South Wales, Australia (pp. 179–186)**. Early in the year, cotton plants may be infested by thrips, which can reduce leaf area by up to 50 %. However, as the thrip population declines later in the year, the plants recover their leaf area and the authors have investigated how they are able to do this. One of the sites of thrip attack is the shoot meristem where they feed on emerging leaf primordia. However, the primordia are not destroyed totally but instead grow out into damaged and stunted leaves with much-reduced cell numbers, and consequently much reduced area. But how do the plants recover from this? Several hypotheses had been previously suggested including the idea that the damaged leaves have a much higher photosynthetic rate than undamaged leaves, thus producing enough photosynthate to drive the recovery of leaf area. However, the authors' comparison of thrip-damaged and control leaves showed that this, and other essentially physiological mechanisms were not the basis for leaf area recovery. Instead, they propose a mechanism that involves the acceleration of leaf emergence and enlargement from later nodes. In support of this, they report that in the later stages of recovery, leaf emergence in recovering plants was two nodes more advanced than in control plants. They suggest that this happens because thrip-damaged early leaves, with their reduced cell numbers, complete expansion earlier, thus releasing resources for development of later leaves. This of course raises another question: are the extra resources themselves the direct signal for accelerated leaf ontogeny or is there a more complex signalling pathway?



The honey trap: a correction

In the June issue (93: 6), the Select article concerning the work of **Singer et al. (pp. 755–762)** mistakenly stated that male bees which attempted to copulate with the orchid *Mormolyca ringens* received a nutritional reward in the form of starch and lipids. This is in fact not the case, and the authors consider the species to be a purely 'deceiving' one that offers no form of reward to the pollinator.

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