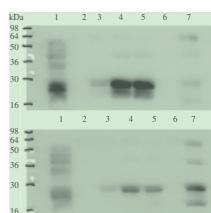


## Exhausted invader meets solid resistance

Parasitic plants, especially those that rely totally on their hosts for carbon and other key nutrients, are a serious problem in some agricultural systems where they can cause significant reductions in crop yield. Amongst these obligate parasites are the broomrapes (*Orobanche* spp.) and it is important to establish what enables some plants to resist attack while others cannot. A truly international team have been addressing this leading question (**Pérez-de-Luque *et al.*, pp. 935–942**) by examining *Orobanche crenata*, a species that parasitizes a range of legume species. Within these species, resistant varieties exist that make possible the direct comparison of successful and unsuccessful attack by the parasite. Because of the visual appearance of the host tissue around the infection site, it had been thought previously that resistance was based on a hypersensitive response. This is a well-known mechanism of resistance to pathogens in which host cells round the infection site die, preventing further spread of the pathogen. However, in this careful study it is shown that tissue darkening in resistant hosts is caused not by cell death but by a secretion from the invading parasite haustorium. Indeed, it is likely that this is an excess production of the parasite's normal secretion, which contains, amongst other substances, tissue-softening enzymes. This excessive secretion appears to be triggered by an early reaction of the host, namely the lignification of endodermis and pericycle, which impedes the parasite's progress. However, the parasite's response does not help further penetration because its secretion results in local blockage of the host's vessels and prevents nutrient transfer around the infection site. The result of all this is that, even if the parasite develops as far as forming tubercles, it cannot establish a functional relationship with the host and cannot take up any carbon or other nutrients. The invading tissues of parasite are thus contained and undergo necrotic death.

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## Dying for a drink

I have just returned from a spring visit to the Mediterranean coast of Spain. Many plants were in full bloom and much of the open ground was a profusion of colour against a green background. But by high summer much of this will be brown. The spring annuals will have completed their life cycles and many other herbaceous plants will be dormant. It is this phenomenon of summer dormancy that has been the subject of a thorough study by a joint French/Australian team (**Voltaire *et al.*, pp. 981–990**). They compared genotypes of cocksfoot grass, *Dactylis glomerata*, that differ in their summer dormancy. Interestingly, drought avoidance (dormancy) and increased tolerance of soil water deficit occur in the same variety: 'Kasbah' (summer dormant) was much better able to survive low soil water content than 'Oasis' (non-dormant). However, at the tissue level, there was no difference; leaf bases did not survive at water contents below 0.45 g H<sub>2</sub>O g<sup>-1</sup> d. wt (in well-watered plants water content was maintained at 5.0 g H<sub>2</sub>O g<sup>-1</sup> d. wt). In relation to dormancy behaviour, 'Kasbah' maintained a lower tissue water content than 'Oasis' in spring and summer, and exhibited a higher level of above-ground tissue senescence in the absence of addition of new biomass. This behaviour started as early as April in droughted plants but also occurred in well-watered plants (again showing that avoidance and tolerance are independent characters). There were also differences in carbohydrate metabolism: 'Oasis' accumulated less fructan but more sucrose than 'Kasbah'. In the latter variety there was also a very marked decline in monosaccharide content in the spring, and the resulting very low level was maintained through the summer period, even in well-watered plants. The patterns of accumulation of the putative desiccation-protection proteins, dehydrins, were not, however, correlated with drought tolerance or avoidance: in both varieties the presence of dehydrins was related to tissue water status.

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### Poor productivity points to pollination problems

In considering endangered species, one of the factors we need to know about is reproductive efficiency. An understanding of this will help in conservation management, informing us of the potential for an increasing or a decreasing or a static population. Thus, **Hirayama *et al.* (Kyoto and Nagaya, Japan, pp. 1009–1015)** have examined the role of pollen supply and quality in the endangered Japanese species *Magnolia stellata*. This insect-pollinated tree has abundant large and showy flowers; the flowers are hermaphrodites, but in an individual flower the stigma ceases to be receptive before the pollen is released. Selfing within an individual flower is thus not possible, but selfing between different flowers on the same tree certainly is. The authors ascertained, in hand-pollination experiments, that *M. stellata* is self-fertile but in self-pollinated flowers, seed set and ovule survival were much lower than in cross-pollinated flowers. This was not due to any self-incompatibility barriers, either early or late acting, and was therefore likely to be caused by inbreeding depression. They then investigated seed set in naturally pollinated trees; the extent of selfing being determined by investigating the inheritance of particular genetic markers. The most obvious feature of these data is that ovule survival in natural pollinations was very low, much lower even than that seen in self-pollinations performed by hand. The authors attribute this to a limited availability of pollen, which reduces the overall potential for pollination, combined with the level of inbreeding depression calculated for the rate of selfing deduced from study of the genetic markers. Breeding efficiency is thus affected both by the quantity and the quality of the pollen (self-pollen having a lower quality than non-self because of inbreeding depression). What is now needed is a study of the effects of pollinator populations and of tree density and population size on pollination efficiency in this species.



### Growing on trees – it's a matter of life or death

The vascular plant species that I most usually see growing on trees in the UK is the fern *Polypodium vulgare*. Indeed, there are some fine examples of this on trees near my house. However, in some ecosystems, such as the humid montane forests of Mexico, epiphytic vascular plants are much commoner and it was in this habitat that **Winkler *et al.* (Vienna, Austria, pp. 1039–1047)** investigated germination and seedling establishment of five epiphytic bromeliad species. Seeds ‘were tied to . . . woody twigs . . . with a thin thread’. The twigs were themselves tied to branches of forest trees at various positions in the canopy. Overall, less than 20 % of the seeds germinated. Canopy position did not affect germination percentage but it did affect the speed of germination: germination was faster in the inner crown than in the outer crown. This was attributed to the higher humidity in the inner crown. These epiphyte seeds are small, which aids both dispersal and the ability to lodge in bark crevices, but which mitigates against survival because of small nutrient reserves. Thus, seedling establishment is a very critical period. This is well illustrated by the data: after 1 year, only about 20 % of the seedlings had survived. Interestingly, it was those in the outer crown that were more likely to survive. Another factor affecting seedling survival was canopy structure, with open canopies being more favourable than closed canopies. In wild populations, survival of two species, *Catopsis sessiliflora* and *Tillandsia deppeana*, was favoured by bryophyte cover on the branches (presumably because this was associated with moister conditions) but this was a negative factor for *T. multicaulis*. Overall, in both experimental and wild populations it was clear that seedling establishment is a critical phase and that microclimate within the habitat has a major influence on this.

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