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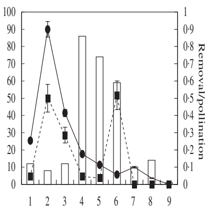
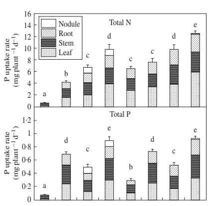


Fooling some of the bees some of the time

In flowers that are pollinated by animals, whether invertebrate or vertebrate, it is usually the case that the pollinator is offered a reward, for example, nectar. However, as reviewed by two Mexican botanists **(Parra-Tabla and Vargas, pp. 243–250)** some plants attract pollinators without offering a reward. This is known as deceit pollination and is particularly common in the family Orchidaceae: up to one-third of orchid species, perhaps numbering around 10 000, deceive their pollinators. In plants offering a reward, synchrony of flowering encourages multiple visits and hence maximizes pollen transfer. However, in plants utilizing deceit, naïve pollinators that are initially deceived may quickly learn that no reward is offered and give up visiting the flowers. It may therefore be advantageous to maintain a low frequency of plants in flower, an example of negative frequency-dependent selection. This further implies that individuals which flower early or late in the flowering season are more likely to be pollinated than individuals that flower at the height of the season. The authors have been able to test this by studying reproductive efficiency in *Myrmecophila christinae*, a deceit-pollinated epiphytic orchid of the Yucatán peninsula. Their data show that, indeed, both donation of pollen to pollinators and receipt of pollen are more frequent in plants that flower earlier or later than the main flowering period. However, the authors also report that the effect is variable from year to year, suggesting that there are other factors that contribute to breeding success. One such factor is the abundance of the bee species that act as pollinators. Further, we note that, despite the greater reproductive success attained by flowering at the beginning and end of the season, *M. christinae* nevertheless exhibits very marked peaks of higher flower abundance. The selective advantage of this is not at all obvious but it clearly illustrates the complexity of floral evolution.



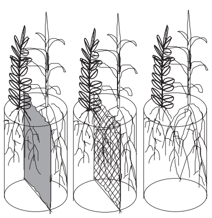
Getting to the root of the (dry) matter

The association between nitrogen-fixing *Rhizobium* and leguminous plants is a very well-known symbiotic relationship. However, in the 'real world' of the soil, other symbiotic relationships also occur, such as those between plant roots and mycorrhizal fungi. This raises a whole series of questions. Can two rather different micro-organisms form mutualistic relationships with the same leguminous plant? Do they interact with each other as well as with the plant? What is the overall effect on plant nutrition and growth? These questions have been addressed in a very thorough study by **Yinsou Jia and colleagues (Witwatersrand, South Africa, pp. 251–258)**. They have looked at a range of interactions (of which we focus here on a selection) between *Vicia faba* (broad bean), an arbuscular mycorrhizal fungus (AMF) and *Rhizobium leguminosarum*. Plants infected with the AMF showed a greater uptake of P (as has been shown for other AMF–plant symbioses) which in turn led to enhanced N uptake, increased photosynthesis and greater dry matter accumulation. One of the most obvious effects of the establishment of the *Rhizobium*–plant symbiosis was an increase in plant N; this was correlated with increased P-uptake, which seemed in this instance to be a result of, rather than a cause of, the increase in plant N. As with the AMF infection, photosynthetic efficiency and plant biomass were also increased. In relation to the interaction between the *Rhizobium* and the AMF, prior infection with *Rhizobium* reduced the infectivity of the AMF but, interestingly, the reverse was not true. The lower AMF infection rate in the presence of *Rhizobium* may have been related to the higher N-status of the plant since, in general, AMF colonization was greater in low-N conditions. Finally, productivity was greatest in plants infected with both AMF and *Rhizobium* and it is possible that the two symbionts act synergistically rather than just additively.

Continued overleaf

One-way traffic

Although some closely related species are inter-fertile, there are also many instances where specific incompatibility mechanisms have evolved to prevent inter-specific hybridizations. These are often a source of great frustration to plant breeders who may wish to introduce into a crop species a trait from a closely related wild species. However, those plant breeders will also know of situations in which attempted hybridizations work in one direction (pollen A to stigma B) but not in the other (pollen B to stigma A). Such unilateral incompatibility is particularly common in the Solanaceae, as described by **Naci Onus and Barbara Pickersgill (University of Reading, UK, pp. 289–295)**. They have studied the phenomenon in *Capsicum,* a genus that is evolutionarily distant from other solanaceous genera that have been studied. The authors used all the readily available wild and cultivated *Capsicum* species and carried out all possible crosses in both directions. The results are very clear-cut and very interesting. All crosses were compatible (as indicated by pollen tube growth) except when species in the *C. pubescens* complex were pollinated by species outside the complex. The *C. pubescens* complex contains the only species in the genus that are self-incompatible (SI) and the authors thus state that unilateral incompatibility in *Capsicum* conforms to the 'classic' pattern in which pistils of SI species, or of self-compatible (SC) species closely related to SI species, inhibit the growth of pollen from more distantly related SC species, but not the other way round. The authors point out that the data raise further very interesting questions. In evolutionary terms, is this just a 'snapshot' in the divergence of the *C. pubescens* complex from the rest of the genus? And what exactly are the recognition mechanisms that permit this traffic of genes in one direction only? Clearly there is a lot of interesting research still to come.



Chickpea, organic P and maize productivity

Although monoculture is by far the most widespread system for crop growth, inter-cropping, that is the growth of alternate rows of different crops, is finding increasing application. In the most frequently used arrangements, a legume is intercropped with a cereal. The available evidence suggests that this leads to increased productivity of the cereal while it has been claimed that the leguminous crop may also benefit. Intuitively, we may suppose that the cereal may be advantaged by an increased N-supply and there are certainly data to support this idea. However, there is also evidence that intercropping may make P more available, particularly from organic sources. This possibility has been studied by a joint Australian–Chinese group (**Li *et al*., pp. 297–303**). They investigated the effects on maize (*Zea mays*) of intercropping with chickpea (*Cicer arietinum*), in laboratory-scale growth experiments both in soil and in hydroponics. In the soil experiments some of the plants were grown with a solid, impermeable barrier between the maize and chickpea root systems. Ca-phytate was used as an organic P source. The results were very clear: the presence of chickpea plants led to significant increases in P uptake in the maize plants, except where the root systems were separated by solid barriers. Chickpea plants were much more able than maize to mobilize P from Ca-phytate. Further, the acid phosphatase activity of chickpea roots was two- to three-fold greater than that in maize roots. This difference was paralleled by differences in acid phosphatase activities exuded to the rhizosphere. However, the authors are careful, in the absence of direct evidence, to avoid the conclusion that the increased mobilization of P was a direct result of the greater acid phosphatase activity. As they rightly point out, this can only be properly demonstrated by comparing the efficacy of chickpea cultivars differing markedly in acid phosphatase activity.

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