DIFFRACTIVE OPTICS

Floral seduction

Certain species of flowers use iridescent petals featuring submicrometre-scale diffraction gratings to act as a pollination cue and attract insects. That's the finding of UK researchers who have just published a study of the *Hibiscus trionum* (below, left) and *Tulipa* species and the behaviour of bumblebees (*Science* **323,** 130; 2009).

It is well known that in animals, iridescence (change of colour with varying observation angle) is used for recognizing species as well as attracting and choosing promising candidates for mating. However, there has been much less study of how plants signal to animals, which is particularly important for the pollination cycle among other things. Conventional non-iridescent cues such as pigment colour, ultraviolet and polarization effects are assumed to provide signals, but many flowers also show iridescence (particularly in the blue and ultraviolet spectra) that is presumed to have a biological signalling function. Researchers have now shown that these iridescent features, causing continuously changing colour as seen by a moving observer such as an insect, are used by bumblebees to identify flowers.

Initially the team investigated the surface structure of hibiscus and tulip petals, revealing a rich and detailed texture that allowed the flower surfaces to function as diffractive optics in the ultraviolet and visible region. For example, petals of *T. kolpakowskiana* flowers were shown to be bi-periodic with one period of about 1 μm (below, bottom right) and larger undulations with a period of 29 μm (below, top right). With the knowledge of the petal surfaces, artificial flowers were then fabricated from disassembled compact disks.

To test the hypothesis of iridescent signalling, iridescent disks and non-iridescent disks both containing yellow, blue and violet pigments were offered to the bees. The iridescent disks yielded sucrose rewards, whereas the non-iridescent disks provided a less than appetizing quinine hemisulphate salt solution. After 80 feedings the bees dined on the iridescent disks more frequently than when they were first introduced. The conclusion drawn was that the bees were not only able to recognize the iridescent disks from the others, but also to associate that with a particular type of flower. Preference for iridescence was not affected by pigment colour. The researchers also did similar experiments with casts of actual flower surfaces to ensure that the behaviour was also observable with less regular and imperfect gratings. So far the researchers have identified ten angiosperm families containing species that show petal iridescence, but it is assumed that this is a very common feature of flowers.

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