Pollination mechanisms

Exploitation of animal mobility

from Peter D. Moore

CO-EVOLUTION of plants and insects, particularly in terms of pollination, is full of subtle and striking relationships. In the palms, for example, the mechanism of pollination varies between species and for some palms uncertainty still exists about the relative importance of wind and various insects in effecting pollen transfer[1]. The blueberries (*Vaccinium* spp., Ericaceae) are clearly insect pollinated, but a recent report suggests that a pathogenic fungus also uses the insects for transport from one plant to another[2]. Great selective advantages are evidently associated with the development of mechanisms that exploit the mobility of animals to disperse pollen grains and spores.

In his work on palms, J.H. Beach has examined the reproductive biology of two species of *Bactris* in the lowlands of Costa Rica[1]. Palms generally produce very large quantities of pollen, a feature often associated with wind pollination; but recently many palm species have been found to rely on insects, which may explain why palms are so poorly represented in the current pollen rain of the Mediterranean

Scarab beetles feeding on an inflorescence of the peach palm (*Bactris gasipaes*).

area[3]. Few detailed observations have been made, but Beach has documented the course of events in *Bactris gasipaes*, a cultivated species and the wild *B.porcshiana*. The *Bactris* inflorescence, or flower cluster, is a mass of spikes (see figure) that pushes its way out of an enveloping bract late in the afternoon. No nectar is produced, but the musky odour that is emitted is accompanied by the heating up of the inflorescence, which probably serves to volatilize the scented compounds[4]. The female flowers on the spike are receptive and the whole inflorescence is soon invaded by weevils 2 millimetres long and then by scarab beetles 2 centimetres long. The weevils gather in very large numbers, up to 100,000 per inflorescence, and feed on the outer parts of the petals of the male flowers, which are conveniently free of the tannins found in other floral parts.

The scarabs also gather in thousands and indulge in two main activities: copulation and extensive feeding on knobbed hair structures found on the inflorescence stalk. The shelter and relative safety of the palm inflorescence for copulation may be one of its main attractions, as Beach has previously observed in other flowers, such as *Cyclanthus*[5]. The feeding activity on the hairs, however, is surprising because they pass through the gut structurally unaltered. Evidently the hairs are not a major energy resource, but they could supply some other dietary requirement.

It is not yet clear which of these two potential pollen vectors is the more efficient. But because the inflorescence contains dietary resources that are attractive to both insects, each vector possibly provides advantages for specific conditions, such as different inter-tree distances[5].

The studies of Batra and Batra[2] on blueberries, on the other hand, provide the first observation of a pathogenic microbe that has evolved a sophisticated form of mimicry to take advantage of pollination vectors moving between plants as a means of spore dispersal. The fungus *Monilinia* spp. infects *Vaccinium* species and *Gaylussacia baccata* (huckleberry) in North America, causing the development of withered 'mummified' berries in which the fungus overwinters. Young shoots are infected in the spring and become discoloured and wilted. These shoots are coated with a layer of conidia rich in sugars, which attracts the attention of insects engaged in floral foraging. But what the insects find most attractive is the ultraviolet reflection from the wilted leaves, which corresponds to that of the *Vaccinium* flower calyx. Evidently this acts as a honey guide under normal conditions, a form of flower mimicry by a fungus that has never been recorded previously.

The efficiency of the mechanism for spore dispersal was tested by excluding insects from 400 flowers and pollinating them by hand. The bags used for insect exclusion allowed air currents to pass through, along with any suspended fungal spores. Of the resulting fruit produced, only 10 per cent were infected compared to 63 per cent under control conditions. There seems to be no limits to the subtleties evolved by the plant and microbial kingdoms to harness mobile animals for their own ends. □

1. Beach, J.H. *Principes* **28**, 107 (1984).
2. Batra, L.R. & Batra, S.W.T. *Science* **228**, 1011 (1985).
3. Stevenson, A.C. *J. Biogeogr.* **12**, 243 (1985).
4. Schroeder, C.A. *Principes* **22**, (1978).
5. Beach, J.H. *Am. J. Bot.* **69**, 1074 (1982).

Peter D. Moore is Reader in Ecology, Department of Biology (KQC), King's College, 68 Half Moon Lane, London SE24 9JF, UK.

Human reproduction

Prospects for developing vaccines to control fertility

from G. L. Ada, A. Basten and W. R. Jones

SINCE its establishment in the early 1970s, the World Health Organization's (WHO) special programme of research, development and research training in human reproduction has been engaged in the development of new and improved methods of fertility regulation*. The need for these studies, being carried out at the request of the governments of several developing countries, is as great now as it was at the outset of the programme. There are thought to be six hundred million couples of reproductive age in the developing countries; some eighty per cent of these, for various reasons, do not use adequate methods of birth control.

*WHO *Special Programme of Research, Development and Research Training in Human Reproduction 13th Annual Rep.* (1984).

One new approach that could yield an efficient, safe and cheap method is a fertility-regulating vaccine. In April 1985, an expert panel at WHO reviewed progress in defining reproduction-specific antigens which could be used in the development of such vaccines; the criteria that these antigen(s) should meet; and the application of new technologies in the detection and study of appropriate antigens.

The following factors are relevant in selecting target antigens for acceptable fertility control vaccines. The antigen should be: (1) present transiently and in low amounts relative to the predicted antibody response (sequestered antigen not excluded); (2) specific, that is, restricted to the target; (3) chemically well characterized to facilitate manufacture by modern