although racial, genetic and environmental co-factors are necessary. On the other hand, enough has been learned about EB virus in relation to endemic Burkitt's lymphoma for a persuasive theory to have emerged[5].

Thus, it has been suggested that latently infected B cells undergo unusually abundant virus-driven replication, no doubt because of impaired T-cell control resulting from recurrent attacks of falciparum malaria, such that one or other of three specific chromosomal translocations occurs, each being a cause of c-*myc* oncogene activation. Serious doubts have been raised, however, as to whether cellular oncogenes are relevant at all to the induction of cancer[6], and certainly c-*myc* alone cannot render cells cancerous[7].

New information on a key EB virus gene promises to reconcile these conflicting views. The gene for the virus determined membrane protein of latently infected cells has been identified and cloned, and after transfection into quite alien cells expression of the product has been shown to confer tumorigenicity[2]. This transforming gene explains the ability of EB virus to cause malignant tumours rapidly and directly in susceptible animals[8], and clearly plays a major role in the chain of events leading to the development of endemic Burkitt's lymphoma, whether with or without interaction with an activated c-*myc* oncogene. Discovery of this gene also provides a first and important indication as to how EB virus might be involved in causing nasopharyngeal carcinoma and, indeed, the other epithelial tumours in which preliminary investigations have indentified the viral genome. □

1. Young, L. S., Sixbey, J. W., Clark, D. & Rickinson, A. B. *Lancet* **1**, 240 (1986).
2. Wang, D., Liebowitz, D. & Kieff, E. *Cell* **43**, 831 (1985).
3. Greenspan, J. S. *et al. New Eng. J. Med.* **313**, 1564 (1985).
4. Whittle, H. C. *et al. Nature* **312**, 449 (1984).
5. Klein, G. *Cell* **32**, 311 (1983).
6. Duesberg, P. H. *Science* **228**, 669 (1985).
7. Adams, J. M. *et al. Nature* **318**, 533 (1985).
8. Cleary, M. L. *et al. Science* **228**, 722 (1985).

M. A. Epstein is at the Nuffield Department of Clinical Medicine, University of Oxford, John Radcliffe Hospital, Oxford OX3 9DU, UK.

Plant ecology

Pesticides and pollination

from Peter D. Moore

INTERDEPENDENCE in nature is often regarded as a source of strength and stability, but it can also become a point of weakness when one member of a complex chain of interactions is affected by catastrophe. In the case of insects involved in flower pollination, for example, there are evident evolutionary advantages in specialization that involve interactions between individual plant species and specific vectors, but such relationships may lead to problems if the vector population becomes depleted as a result of catastrophe. And catastrophe in insect populations is a far from unlikely event in these days of broad-spectrum pesticides. This problem is the subject of a recent study on the consequences to the reproductive success of plants in a New Brunswick forest of pesticide spraying (Thomson, J.D., Plowright, R.C. & Thaler, G.R. *Can. J. Bot.* **63**, 2056; 1985).

In the coniferous forests of New Brunswick, the spruce budworm (*Choristoneura fumiferana*), a defoliation agent of balsam fir (*Abies balsamea*), is an economically significant pest. Various pesticides have been sprayed onto the forests in the past 25 years in efforts to control the budworm, but concern has been expressed about the possible effects of spraying on other, non-harmful insect species and even economically beneficial species, such as the bees involved in pollination, and therefore fruit production, in the blueberries (*Vaccinium* spp.) that grow in the same area. P.G. Kevan (*Biol. Conserv.* **7**, 301; 1975), studying the pesticide fenitrothion, provided evidence that such effects can indeed be harmful.

Thomson and his co-workers investigated the effects of spraying Matacil, an anti-budworm agent which, because it is less toxic to bees, has replaced fenitrothion. When they tested the effects of Matacil on the mortality of a range of wild insect species, Thomson *et al.* found that the most pronounced effects occurred among the smaller bees (Andrenidae, Halictidae and Anthophoridae) and one fly family, the Syrphidae. These families are important pollinators of some of the understorey plants such as the Canada mayflower (*Maianthemum canadense*) and the red-osier dogwood (*Cornus stolonifera*). But the question to be answered is whether the spraying influences the populations of these insects to a degree that affects the breeding success of these plants.

By studying fruit sets in *M. canadense, C. strolonifera* and the creeping dogwood (*C. canadensis*) both inside the sprayed area and in control plots outside the influence of the spray, Thomson *et al.* obtained an estimate of fecundity, expressed as a percentage of the total flowers on an individual achieving fruit set. In *M. canadense* and *C. stolonifera* they found a significant reduction in fecundity within the sprayed area (means of 4.6 and 8.8 per cent, respectively) compared with the control sites (9.7 and 24.6 per cent). But in *C. canadensis* there was no significant difference (spray mean of 13.1 per cent and control mean of 11.6 per cent). The discrepancy between the two *Cornus* species could be caused by the fact that *C. canadensis* is also pollinated by larger bumblebees (*Bombus* sp.) which are not affected by Matacil spraying. These results add weight to the argument that spraying where the pollinator is sensitive decreases fecundity.

The question of whether the decrease in plant fecundity actually influences its overall population stability still remains unanswered. Much depends on the degree to which the plant requires the seed as a survival and/or dispersal mechanism. If vegetative growth and dispersal are available as alternative strategies for a species, then the decrease may be of little consequence. Although there are exceptions, such as the pin cherry (*Prunus pensylvanica*) (Marks, P.L. *Ecol. Monogr.* **44**, 73; 1974), most woodland understorey species are long-lived perennials with little dependence on their seed set.

Where the effects I have described here are likely to have the most profound impact is in plants which have a limited geographical range, are out-breeding, perhaps dioecious, short-lived, have no capacity for vegetative propagation and are specific in their pollination vectors. A plant which answers to most of the elements in this description is the hop tree (*Ptelea trifoliata*), a rare plant that colonizes shorelines on the northern side of Lake Erie in Canada. J.D. Ambrose, P.G. Kevan and R.M. Gadawski (*Can. J. Bot.* **63**, 1978; 1985) have studied the reproductive biology of this species and conclude that it is dioecious, is entirely dependent on wind-dispersed seeds for its spread and exhibits a rapid population turnover. Its breeding would therefore seem particularly susceptible to any catastophic disruption such as that in the New Brunswick forests. But there is one factor in its favour — a considerable diversity of insect vectors in its pollination system. Ambrose *et al.* found that the flowers were visited by Hemiptera, Coleoptera, Diptera and Hymenoptera, totalling at least 102 species from 37 families. In this particular respect, what seems to be a vulnerable plant has a survival strategy and the ability to withstand the almost inevitable impact of pesticides on its pollination vectors. Perhaps we should give special attention to the conservation of those plant species which lack this key factor in their defences against human environmental disruption. □

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