Measures

Any measures should therefore be realistic, and compromise is unavoidable. While not setting our expectations too high, we must do our utmost to prevent, or at least delay, the spread of plant pests as a first line of defence, and we must increase alertness with a view to new hazards that are bound to develop. Infrastructures (expertise and facilities) must therefore be improved and maintained to deal adequately with crop pests, as they emerge with continuing agricultural and social change. A Programme for Monitoring Emerging Infectious Diseases would indeed serve such a purpose. Such measures have everything to do with environmental conservation and are highly relevant for sustainable crop health and human health.

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GUEST COMMENT

Trouble in the Cabbage-patch

For more than forty years I have been rearing broods of caterpillars, mainly to try to understand the genetics of colour and pattern-variation in butterflies and moths. From time to time my work has been frustrated by the sudden death of an entire brood, or sometimes of a whole series of broods, and once by the total loss of my laboratory stock; such losses I always attributed to outbreaks of virus infections. When infected, a caterpillar collapses into a liquified mass which hangs from the food-plant — a most unpleasant sight for a caterpillar enthusiast. Curiously, I have never encountered evidence of virus-induced mass mortality in wild caterpillars, although I have occasionally found a solitary caterpillar that showed symptoms of having succumbed to such infection.

For more than fifty years there has been a rapidly-growing interest in the use of viruses as substitutes for, or additions to, chemical insecticides to control insect pests — chiefly on the grounds that such control is biological and therefore potentially less harmful to the environment than Man-made insecticides. Attention has been focused on one group of viruses, the Baculoviruses (BVs) which affect caterpillars, and especially on a group of BVs called nuclear polyhedrosis viruses (NPVs). Trials and applications indicate that laboratory-produced NPVs are an effective method of destroying caterpillar pests of forest trees and crop plants. NPVs and other microbial insecticides now comprise up to 2% of the insecticide market (Cory, 1994). This figure is likely to increase as research produces new and better strains of viruses.

Dangers of Genetic Manipulation

Recent research has concentrated on genetically 'engineered' NPVs. For example, a scorpion-venom gene has been transferred to the *Autographa californica** NPV (AcNPV) which, it is claimed, makes the virus more effective; the virus is 'turbo-charged', some reports claim. In March 1994, the Institute of Virology, Oxford, announced in a local newspaper (*Oxford Mail*, 5 March 1994) a proposal to go ahead with a trial of this genetically engineered AcNPV on caterpillars feeding on cabbages grown in an experimental plot. The site chosen is a field within view of Oxford University's Wytham Estate, where much fundamental ecological research has been (and still is being) conducted — including research on caterpillars and caterpillar-feeding birds. Permission to perform such an experiment needs to be given by the appropriate office of the British Government, which seeks advice from the Advisory Committee on Releases to the Environment (ACRE), an independent body that evaluates the pros and cons of experiments of this nature.

A local resident, Dr G.D.W. Smith, became concerned about the possible dangers to wildlife which might be posed by the proposed experiment if something should go wrong and the virus escape to the wild, and wrote to the Biotechnology Unit (the Government department concerned) to express his fears. A letter of protest was also sent to ACRE. However, permission for the experiment to proceed was given on 12 April 1994. Soon afterwards, national newspapers were alerted and took up the story. There was plenty of scope for the headline writers: for example, 'Scorpion's venom fuels genetics dispute' and 'Scientists warn of scorpion venom test' (*The Independent*, 17 May 1994). As a result, the experiment was postponed for fourteen days, offering more scope for the newspapers: 'Testing of caterpillar death virus halted' (*The Times*, 26 May 1994) and 'Objectors win delay of scorpion virus trial' (*The Independent*, 26 May 1994). Nevertheless, ACRE reconsidered the proposal, and on 8 June 1994 the Government gave permission for the Institute of Virology to proceed with the experiment.

* A North American moth of which the caterpillars were an early source of the virus. Insect viruses are often named from their hosts, hence this 'AcNPV'.

Mixed Public Perception and Scientific Finding

Public perception of the experiment is likely to have been influenced by emotive phrases in the press such as 'scorpion venom' and 'death virus'. People can easily become worried about exactly what is going on when they read such phrases as these. On the other hand, many people react unfavourably to words such as 'caterpillar' (they are destructive to cabbages) and 'moth' (they eat clothes), and welcome ideas for new methods of control; but as soon as 'butterfly' is mentioned, there is an image of something colourful and delightful which, moreover, is endangered by changes brought about by modern farming. This image was exploited by the British Butterfly Conservation Society, which also opposed the experiment.

NPVs are often claimed to be host-specific, affecting only the target species of caterpillar, but AcNPV is otherwise. Payne (1986) lists 43 species of Lepidoptera, belonging to eleven families, that are known as hosts. There are in fact many more species of such known hosts, but full details have not yet been published. This means that, if the experiment happened to go wrong and the virus became established in the wild, a wide spectrum of species of butterflies and moths could be affected — starting perhaps in Wytham, a woodland rich in species of butterflies and moths, including several that are nationally rare and endangered. This is a point that is being stressed by the British Butterfly Conservation Society, which is reported to have asked a London law-firm to apply to the High Court for an injunction to stop the experiment.

There is, too, the possibility that a genetically engineered AcNPV would behave differently in the wild from a natural virus. It can probably be assumed that there is a reciprocal coevolutionary relationship between natural viruses and their hosts, the outcome of which is that natural viruses rarely cause widespread and long-lasting effects; but what of a genetically engineered virus, and suppose it were able to combine with a natural virus? This is another worrying risk that has generated alarm among conservationists.

The Director of the Institute of Virology is reported as saying (The Times, 26 May 1994) that the virus cannot survive in the soil; yet a member of his own Institute has written that such viruses 'can survive for considerable periods of time (years) in protected reservoirs such as the soil' (Cory, 1994) — a property which seems to be seen as a commercial advantage rather than as something to worry about. There is wide agreement that these viruses do not affect vertebrates, and it is repeatedly stressed that birds are safe — which no doubt goes a long way towards placating a bird-loving public. However, birds can apparently transport infected caterpillars over long distances, which is again viewed as an asset (Cory, 1994) rather than a conservationist's nightmare.

Institute's Two-fold Problem

The problem faced by the Institute of Virology is two-fold. First, public perception of the release of a 'scorpion venom virus' is understandably unfavourable. More public-relations work is needed here. Secondly, there does not appear to have been enough risk assessment, and so there is a feeling that a genetically engineered virus would harm a broad spectrum of caterpillars, many of which belong to interesting, attractive, or rare, species of butterflies or moths. This second point can be elaborated by way of analogy. When the siting of a nuclear power-station is under consideration, all possible risks are carefully evaluated, but even so the power station is invariably (in Britain) sited in a remote area as far away from significant human settlement as possible. In contrast, the Wytham virus experiment is only about a hundred metres from the edge of a much-studied, internationally famous ecological site, and should something go wrong (however unlikely this may be) the fauna of Wytham might be the first to suffer.

Remarkably, much of the funding for research on the development of insect viruses as a means of pest control in Britain comes from the Natural Environment Research Council (NERC), an organization that has a history of dispensing public money for ecological and environmental conservation research. It could be questioned whether the use of NERC funds for such commercial projects is really justified; instead, should not such research be funded by the companies that are already in the pesticide business?

Meanwhile, laboratory research on BVs proceeds apace. It is undoubtedly high in technology (though not so high in science, some would say), but in assessing the ecological consequences — and, particularly, public perception — of what is going on, it leaves much to be desired. Needless to say, universities and research institutes favour high-tech 'useful' research because it brings in much sought-after funding, and these days everyone working in scientific research knows that success is judged more by the level of funding than by the scholarly results achieved.

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