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INSECT PESTS - WHAT KIND OF CONTROL? By D. Bevan

Abstract
The feasibility or advisability of artificial control of insect pests is frequently questioned. Is biological control worth considering or is it better to use chemicals? A generalised answer cannot be given, but this note tries to formulate an overall philosophy on the subject.

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1. "Natural control" operates within a complex system of host plant, insect, and the natural enemies of that insect (parasites, predators, viruses and other diseases). Numbers of insect and enemies fluctuate in a jerky see-saw fashion, a process sometimes referred to as the "balance of nature". If the insect is a pest species causing damage such "natural control", which is usually slow-acting, may not therefore be very satisfactory to man.

2. "Biological control" may be defined as a form of man-assisted or artificial "natural control". It can take two main forms. Either a "new" enemy of the pest may be introduced to become permanently established within the system, or a known enemy may be released with the short-term aim of controlling the insect pest, usually for one season only. Initially the first approach is normally expensive and technically demanding, but if successful only needs to be done once. It is the only economically feasible approach for low value perennial crops such as forests, or amenity trees where values are difficult to compute but budgets are small. The second approach is only possible where there is a high degree of confinement and isolation (e.g. in a greenhouse) where there can be very rapid colonisation. and increase from a small inoculum, and/or where annual yields can withstand high annual costs for pest control (e.g. in a region of citrus groves).

3. Assuming money is available, what factors must be taken into account before deciding to attempt "biological control"? Technical information is necessary on whether or not the particular pest is a type known to be a good target for` this kind of control. Experience has shown that by far the greatest number of pests against which biological control has been successful have been exotics. This is not surprising since foreign insects must often arrive unaccompanied by the enemies which provided a "natural control" in their home territory. Certain insect groups, and in particular scale insects, have shown themselves easier to control by biological means than others. Caterpillars and sawfly larvae also seem to be good targets.

4. Before embarking on a biological control programme it is essential to know if the particular pest has natural enemies already present, and then to find out if there are known enemies elsewhere. It may be necessary to search in another country and probably approach an international biological control organisation to make overseas collections. Any new species for introduction would then have to be multiplied by intensive breeding and, in the case of parasites, would also need to be screened to eliminate hyperparasites, i.e. parasites upon parasites. Any detrimental effect on other desirable species within the British environment would also have to be considered. Field releases would then follow at the correct time to synchronise with the required stage of the pest development.

5. The world-wide record of successes over all damaging agents number tens rather than hundreds. One exception to this generalisation may be found in the field of pathology, where it is possible to prevent the spread of infection by *Fomes annosus* by treating the stumps of newly felled conifers with a proprietory suspension of the competing saprophytic fungus *Peniophora gigantea.*

6. The obvious alternative is pesticides, which are relatively cheap in the short-term, can be dramatically effective, particularly with defoliators, and seldom demand high skills to use. The arguments against pesticides reflect our increasing discomfort at the further contamination of the environment with strong chemicals. Most people would accept an occasional chemical control operation if the objectives seemed commensurate with the gain, as for example against an outbreak of caterpillars bearing rash-inducing hairs in an urban or holiday area, or to save trees from death. Few of us however would support a routine spray programme, particularly in an urban situation. As for the ecological objections, would the so-called "balance of nature" be upset? It seems very unlikely, at least with an occasional localised operation employing a non-persistent pesticide, that there would be permanent damage to the ecosystem. Nature has great powers of recovery and insects a great capacity to redistribute themselves and re-occupy suitable niches from which they have been ousted. A high kill of both pests and natural enemies may result in very rapid recovery by a residue of surviving pests. However, it is sometimes possible by adjusting the timing of application to obtain a kill by chemicals and at the same time preserve the lives of efficient enemies to Sweep up the residue of live pests - i.e. ‘integrated control’. Before work commences it is essential to know the likely effects of an artificial control programme.

7. One category of "pesticide", often referred to as microbial control, needs special mention. This includes insect-specific agents such as *Bacillus thuringiensis* and certain viruses. Both occur naturally, although some selection for a particularly virulent strain has taken place in the case of B. *thuringiensis. B. thuringiensis is* widely active among most caterpillars, while the viruses which are of interest, the baculoviruses, are harmful as a group only to insects and individually, commonly specific to single insect species. *B. thuringiensis* is often credited with some ecological respectability on the grounds of its being a natural product. The baculoviruses, although often teeming in nature, have had raised against them largely emotional objections unsupported by sound evidence. As yet no virus has official clearance for use against plant pests in UK. Only *B. thuringiensis* is available at present but has proved somewhat unreliable in use. However, it does offer a material against moth caterpillars which is 'kind' ecologically, having very little activity against other elements of the environment including man, fish, birds, parasites and predators. This bacterium's mode of action is complex but most authorities agree it brings about death of the target insect through its associated toxic crystal rather than through its own direct action, and it is difficult to know whether to regard it as a disease or a poison. *B. thuringiensis* does not appear to reproduce itself in the field, at least to any significant extent, and it is therefore not a persistent addition to the ecosystem and might be regarded as an atypically inexpensive example of our second form of biological control. Viruses, on the other hand, will establish themselves and multiply and are therefore without doubt biological control agents of the first kind.

Conclusions

8. There is no single answer to the problem of controlling the occasional epidemic of pests among or near dense populations of man. Except in special circumstances biological control, with its low success rate and considerable expense, seldom offers any solution. Particularly serious situations may demand an occasional application of chemicals, and if the pest is a moth *B. thuringiensis is* a possibility. Is there anything else?

8. It must be remembered that man grows his ‘crops’ in a way that nature never intended. Moreover, he manipulates most of them by breeding and management to suit his requirements. Consider the unnaturalness of a grafted cultivar, stuck in a pavement, periodically pruned or even lopped to suit the buses, growing in an atmosphere containing exhaust gases and regularly visited by dogs. Why does an 'Albertine' rose on the side of a house become covered in powdery mildew or aphids while another specimen climbing up a pergola is healthy. The reason is that all organisms, including insect pests and fungi, are dependent upon the physiological condition of the host plant. Stress in one guise or another, whether it is through water supply, nutrient supply or balance, or some other site factor, will often be the basis of many troubles of young trees (those of older age are rather different but at once understandable by human analogy). Little is known about the alleviation of stress in plants or about the techniques for ameliorating growing conditions. Until there is better understanding the policy must be - "if it won't 'do' properly then have it out and put in something else". Keep pesticides as a last resort and reserve tools such as biological control for the very few cases in which, in enlightened opinion, the possibility of success is a little higher than zero.

Produced by -

0. N. Blatchford
Principal Research Communications Officer
Forestry Commission Research Station
Alice Holt Lodge
Wrecclesham
Nr Farnham
Surrey

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