BIOLOGICAL CONTROL OF WEEDS

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Biological control of weeds is a question usually discussed among entomologists. This is, apparently, the first occasion on which the subject has been brought forward for discussion among people directly involved in weed control. Conceivably, the viewpoint of one engaged in weed control might differ from that of an entomologist. In my own case, I, an entomologist, by training, have become directly concerned with the practical aspects of weed control, and thus possess a two-sided view of the problem.

Mr. Wilson has stated that there have been comparatively few successes in biological control of weeds. I would put it rather differently by saying that there have been few, if any, failures where a serious attempt has been made to exploit biological control. All real efforts to introduce insect enemies appear to have met with some degree of success. And, of course, there have been at least two real triumphs.

The great advantage of biological control over other methods is that, once the insects are established, they breed and increase without assistance. Thus, the initial expense is the only cost.

The paramount difficulty in the introduction of weed insects lies in evaluating the danger of the importations becoming pests of some economic plant. The behaviour of most insects cannot be predicted with any certainty. Relatively few insects are so specialised that they can, of necessity, develop on one kind of plant only. Notwithstanding the adoption of the most rigid safety standards, the introduction of any plant feeding insect must entail some degree of risk.

Here, a very important point should be emphasised. In so far as I am aware, no insect that has been introduced into any country for the control of a weed has ever become a pest of any plant of economic value.

In considering the introduction of weed insects, two procedures have been adopted. Firstly, reliance or major reliance on a study of the insect's food plants in its native country. Hawaii took this course many years ago when it introduced several different kinds of Lantana insects, and did not carry out a comprehensive programme of feeding tests on other plants. The results, after more than 50 years, have shown that though there have been a few isolated examples of one or other of the Lantana insects feeding or even breeding on some other plant, such attacks have been of no importance whatever.

On the other hand, Australia in its prickly-pear campaign thoroughly tested the ability of each kind of insect to feed or develop on a lengthy list of economic plants. Many hundreds of each species of insect were used in these starvation tests, where the insect was given no choice of food plants; either it starved to death or it fed on the given plant. Every precaution was taken to ensure, in so far as possible, that no risk was involved with the insects selected for introduction. Some of the results in these tests were rather surprising, in that certain insects which definitely did not live naturally on any plant other than prickly-pear could be induced to feed and to develop on some very different food plant.

Even with starvation tests, the results may be open to different interpretations. For example, South Africa has introduced one prickly-pear insect after studying the results of the starvation tests carried out by the Commonwealth Prickly Pear Board, which had decided not to introduce the insect because it was not satisfied that its introduction would be perfectly safe. In other words, Australia refused to take the risk; South Africa said "We have studied your testing records and we are satisfied that the element of risk is very small". Of course, the two situations differed. By the time Australia had completed its investigation of this insect, Cactoblastis had been introduced and had shown promise of its eventual remarkable success. Cactoblastis was not an efficient destroying agent of the South African prickly pears, and a controlling insect was badly needed in that country.

Obviously, food testing of insects in confined spaces is, and must be, to some degree unnatural. It cannot possibly tell us what is likely to happen in the field, where the insect has its choice of host plants. Yet, probably with more experience than anyone else in the field, I believe in the value of starvation tests, with this proviso, that some elasticity is permitted in interpreting the results.

But I am firmly of the opinion that the whole question must be looked at from a broader angle than the actual ability of an insect to feed on some plant of some economic importance. My general concept of the points to be considered are roughly as follows :-

(a) the importance of the weed, and the difficulty of its control by any method other than the biological;

(b) the potential value of the insect for the control of the weed;

(c) the value of the economic plant which may be attacked by the insect, weighed against the damage and loss of production caused by the weed;

(d) the seriousness or otherwise of the damage that might be caused to the economic plant by the insect's attack;

(e) the simplicity or otherwise of the insect's control by cultural, chemical or other means, if and when it attacked some particular economic plant.

I believe, therefore, in taking a calculated risk. Mr. Wilson uses the term "gamble". There is a world of difference between these two definitions. If biological control of weed pests such as Noogoora burr, Lantana, and Groundsel bush, all of major importance to Queensland, is to be seriously attempted, it is certain that there will have to be some degree of relaxation of the existing rigid standards of safety with regard to insect introduction.

Take the case of Lantana. It has already been stated that certain Lantana insects introduced into Hawaii some fifty years ago have been found feeding or breeding on certain plants of some economic value, but that such attacks have been of no significance. Under present safety standards, these insects would not be considered for introduction to Australia. C.S.I.R.O. itself took a calculated risk when a good many years ago it introduced the Lantana bug, Teleonemia, without subjecting that insect to a wide range of food plant tests; in this instance, Mr. Wilson's term "gamble" might apply with greater force. Now, in Hawaii, the Lantana bug has been recorded on occasions feeding on some plant quite unrelated to Lantana. Had this insect been tested thoroughly it is unlikely that it would have been imported into Australia. Yet, the Lantana bug has been established for a number of years throughout Queensland, and has not shown any inclination to attack other plants.

Mr. Wilson has summarised the investigations that have been carried out recently into insect enemies of Lantana in tropical America, and has expressed the opinion that the results of the work may be anticipated with some optimism. Taking into account the life histories and habits of these insects, I would hazard a guess that when these insects are subjected to starvation tests on a sufficiently wide variety of plants it is possible that under test conditions most, if not all, will be found capable of feeding, if not breeding, on some plant other than Lantana.

The Question of Noogoora Burr:

No doubt, in order to summarise the information as concisely as possible concerning Mecas and its relation to economic plants in the United States, Mr. Wilson has had to omit certain important information.

We know that this insect normally attacks wild sunflowers, ragweed (Ambrosia) and certain other composite weeds, in addition to Xanthium.

Sunflowers are grown for seed in several of the western States of U.S.A. to the extent of not less than 10,000 acres under cultivation annually. Such cultivation includes States where Mecas is found attacking wild sunflowers, Xanthium and ragweed. The insect enemies of cultivated sunflowers in U.S.A. have been studied freely, and are, in fact, well known. Various official publications have dealt with this subject; Mecas is not mentioned in any of these publications. The U.S. Bureau of Entomology has one lone record, made in 1929, of Mecas being obtained from Russian sunflower; it is not known whether the sunflowers were cultivated or wild plants, but it is assumed that the plants were in cultivation. Apart from this record, the U.S. Bureau has been unable to locate any references or records of Mecas attacking this crop.

Similarly, no records can be found of Mecas attacking garden annuals and ornamentals of the Compositae.

Concerning the statement that Mecas attacks Jerusalem artichoke, the U.S. authorities state :-

> "This plant is not cultivated commercially in the United States. It is doubtful if there are more than a few hundred acres under cultivation in small garden patches throughout the country; in many cases it is grown as a curiosity. As with sunflowers, the insects which attack this plant are fairly well known. The only record we have of Mecas saturnina attacking Jerusalem artichoke was made in July, 1925, at a locality in Louisiana. It is not known whether this attack was on a cultivated or a wild plant".

Parthenium hysterophorus is a common weed in the United States, where it is termed a Ragweed. It is fairly closely related to the Ambrosia ragweeds, which are known to be host plants of Mecas.

The statement given by Mr. Wilson as coming from the U.S. Bureau that "extent of the attack by Mecas on Noogoora burr is assumed to be very light" omits three words, the inclusion of which does make a difference. What the Bureau said was :-

> "the extent of its attack on Xanthium is not known, but is assumed to be very light". Actually the Bureau has not investigated the effect of Mecas on Xanthium. Such investigations have been carried out by Australian entomologists.

This brings me to the point, just what is known concerning Nupserha and Mecas.

Nupserha, a Longicorn Stem borer, was studied in India for one season by an Australian entomologist, who reported that it was very common in many areas and caused serious damage to Noogoora burr. Two extracts from his reports are quoted :-

"Extensive fields of Noogoora burr in one district bore the appearance of having been reaped, due to the breaking off of the growth from the injuries caused by the larvae".

"In another area some fields of Noogoora burr were so severely damaged that it was obvious that less than 20 per cent of the plants would survive long enough to reach the fruiting stage".

Nupserha was not studied as fully as was Mecas in North America. It was found on one occasion breeding in wild sunflowers. Cultivated sunflowers were not located. In tests it was capable of developing in sunflowers; eggs were laid in Jerusalem artichoke and in certain other Composites, but the larvae died in their young stages. However, it is possible that, like Mecas, the insect could develop in some of these plants under test conditions.

Mecas, also a Longicorn stem borer, in the United States attacks Xanthium, wild sunflowers and ragweeds. The adults cut off or prune the tops and branches of Xanthium, while the larvae can destroy the whole plant by tunnelling down the stem and then cutting it off at ground level. Mecas was tested on a great variety of economic plants, and showed no indication of being able to develop on any plant other than certain Composites. It did develop in sunflower, Jerusalem artichoke and dahlia. This insect is not a pest of sunflower crops or of garden Composites in the United States.

The next point is what would be risk to economic crops of introducing Mecas and Nupserha. Obviously, there would be some degree of risk to cultivated sunflowers, to Jerusalem artichoke and to certain garden Composites. In view of the experience in the United States that Mecas is not known to attack sunflower crops and garden Composites, and has been recorded once only on Jerusalem artichoke, this element of risk may not be great. It would be a calculated risk, based on the information available; it certainly would not be a gamble.

Queensland's attitude toward this question is expressed by a Royal Commission which was appointed to investigate certain matters relating to the pastoral industry in Queensland. One member of this Commission was the Under-Secretary, Department of Agriculture and Stock. In its report presented in 1951, the following recommendation was made :-

"The Commission recommends that a full investigation of the possibilities of biological control of Noogoora burr be made, with a view to the introduction of a suitable insect or insects from abroad. We are further of the opinion that the

matter is of sufficient importance to the sheep industry, and so to the national economy, as to far outweigh possible cost of treatment or losses in minor crops and a few ornamental plants".

In so far as sunflowers are concerned, Queensland, which is the major grower of this crop, is prepared to accept the risk entailed by the introduction of Mecas and Nupserha, particularly if further investigation confirms present information that in North America Mecas does not attack or seriously injure cultivated sunflowers. It considers, further, that if the insects did attack cultivated sunflowers, modern insecticide practice might readily effect control. It is of the opinion that Jerusalem artichoke is of very minor importance as a crop, and that the risk of attack on garden ornamentals should not be considered as important.

What Queensland wants is recognition that a renewal of investigations is warranted. Such investigation would embrace :-

(a) A field study in the United States of the relationship of Mecas to uncultivated plants and to cultivated crops, more particularly sunflower.

(b) A field study in India of the relationship of Nupserha to uncultivated plants and to cultivated crops, and a programme of feeding tests with this insect on plants of economic value.

Provided that the above investigations do not produce new evidence indicating that the risk entailed in introducing these insects is greater than the existing information discloses, it is felt that permission to introduce should be granted.