

Some Hawaiian Experiments in the Biological Control of Insect Pests.

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BIOLOGICAL control is the term generally employed to denote the part played by natural enemies introduced for the specific purpose of checking the increase of an insect pest of an economic plant. It is a term that is also applicable to such undertakings as the present campaign for the control of various species of prickly-pear by the introduction from America of certain of their insect enemies.

A survey of agricultural conditions reveals the fact that among the worst pests with which the producer has to contend are many accidentally introduced insects. In the early days of the modern world-wide migration of the white race, economic plants were transported from one country to another on quite an extensive scale, and not unnaturally some of the destructive insects associated with these economic plants were unintentionally transported with them. In many of these cases the accidentally introduced insect pests were unaccompanied by the insect and other enemies that kept them more or less under control in their original homes. Under such circumstances many introduced insects, that were only relatively unimportant pests in their native lands, became responsible for extremely serious losses in the countries to which they unfortunately gained access.

Objective in Biological Control.

The objective in the biological control method of fighting introduced insect pests is to readjust the balance by bringing in and establishing the natural enemies that were left behind when the destructive insects migrated. If success is achieved in the introduction of these enemies then the normal balance of nature will be more or less restored, and the numbers of the destructive insects will be so greatly reduced that the pests dealt with in this manner will cease to be of outstanding importance.

Natural Enemies of Destructive Insects.

The chief enemies of destructive insects are other insects which, instead of attacking plant life, habitually feed on insect life, either as internal or external parasites, or as predators that simply seize and destroy their prey. Mention may also be made of the valuable control factors represented by introduced insectivorous birds. Other small animals, such as the mongoose, have also been used as introduced natural control factors,

but the case in their favour has not been clearly demonstrated. The utilisation of fungus and bacterial diseases of insects has also been discussed, but, speaking generally, comparatively little progress has so far been made along this line of attack.

Hawaiian Experiments in Biological Control.

The biological control method of fighting destructive insects has been given particular prominence in connection with sugar-cane pests, and it seems well worth while to direct attention to some of the results achieved in the application of biological control to that branch of economic entomology. Sugar-cane entomology affords excellent examples of the success of the method, where conditions are favourable, and hence the three instances of biological control quoted in the following paragraphs are all associated with sugar-cane, and, further, all were carried out in the same country—namely, the Hawaiian Islands.

The Sugar-Cane Leafhopper.

The first illustration of biological control is one that should be of a particular interest to Queenslanders, because the insect fought in this case is one that has intimate associations with Australia—in fact, Queensland is its native home. Here reference is made to the sugar-cane leafhopper which was accidentally introduced from Australia to Hawaii shortly before 1900. The insect in question is regarded as a minor pest in Australia, but on its introduction to Hawaii it spread and multiplied with astonishing rapidity, and by 1902 the position had become so serious that the insect was estimated to be responsible for a loss of £500,000 annually. The Hawaiian Sugar Planters' Association accordingly organised an Entomological Branch, and the investigation of the problem was commenced.

It was evident that the insect was a recent importation, and it was equally clear that it was not subject to the attacks of many enemies, although a few relatively unimportant native Hawaiian insects have turned their attention to this newcomer from Queensland. Eventually it was demonstrated that its native home was Australia, and an investigation of the sugar-cane districts of this State revealed the presence of a number of enemies that were keeping it in check.

It was found that three extremely small wasps were breeding in the eggs of the leafhopper, and as a consequence the attacked eggs were destroyed. These wasps were introduced into Hawaii, and certain other enemies were obtained elsewhere. These importations produced a marked improvement in the situation, and a visit to Hawaii in 1914 afforded convincing proof of the fact that on the majority of the sugar-cane plantations appreciable losses had been practically eliminated.

The entomologists, however, were not fully satisfied with the position, because, on a few plantations where climatic or other conditions were abnormal, serious losses were still being experienced, and on one plantation on the Island of Hawaii the position was far from satisfactory.

This led to a renewed search for further enemies, and Queensland again supplied requirements in the shape of a very small bug that lives by extracting the leafhopper egg contents through punctures made by its sharp beak. The relationship of this bug to the sugar-cane plant was not clearly understood in the earlier investigations, but, in 1919, it was fully demonstrated that it was not a sugar-cane pest, but was actually a very valuable enemy of the leafhopper.

It was accordingly introduced to Hawaii, and the remaining leafhopper infestations were brought under control. The financial result of the application of the biological control method in this particular case is that an annual loss of £500,000 has been virtually eliminated.

The Sugar-cane Beetle Borer.

A second serious pest in the Hawaiian Islands was the sugar-cane beetle borer, the original home of which is believed to have been New Guinea. The annual loss in this case was regarded as being in the vicinity of £250,000.

Being an introduced pest the biological control method was again employed, and a fly parasite was eventually discovered in the Dutch East Indies. After encountering many difficulties this parasite was successfully transported to Hawaii in 1910, and during a visit paid to that group in 1914 it was observed breeding freely on the great majority of the plantations, and it has obviously succeeded in very materially improving the situation.

The Anomala Grub.

The third Hawaiian success to which attention might be directed is the control of the Anomala grub. The white grubs of this beetle, which were probably introduced from the Far East, first caused noticeable injury in the year 1912. On a visit being paid to Hawaii in 1914, it was observed in enormous numbers in the magnificent rich, red soil on two of the largest plantations on the Island of Oahu, the infestation extending over several miles. Fortunately, its rate of spread was slow, and the entomological staff decided to endeavour to nip in the bud infestation which, although restricted to relatively small area, was nevertheless responsible for an annual loss of £20,000. Further, it was bound to spread throughout the whole of the group if left uncontrolled, and hence it constituted a very serious menace to the whole of the plantations of Hawaii.

Again a search for parasites was commenced, and in 1916 a wasp parasite was introduced from the Philippine Islands and was eventually permanently established. On a return visit to Hawaii, in 1917, the parasite was seen breeding in very large numbers, and here again a marked measure of success was obtained, and it is now possible to say that the Anomala grub menace to the uninfested plantations no longer exists.

The particularly interesting point about this case is the fact that biological control was established before the pest had become distributed throughout the length and breadth of the Hawaiian Islands. In the case of the leafhopper and beetle borer, the whole of the plantations were more or less infested, and enormous losses had been sustained before biological control was attempted.

Success Achieved in Hawaii.

Such is the record of three very fine instances of entomological work in the Hawaiian Islands. Although many of the parasites experimented with were failures, success was eventually achieved in each of the three major problems attacked by the staff. The balance sheet on the whole is a very favourable one, and the expenditure involved in the investigations has been returned a hundredfold.

One cannot but admire the splendid faith displayed by both the Hawaiian Sugar Planters' Association and its entomologists in carrying out

the work, for it must be remembered that frequently years of arduous, discouraging, and even dangerous work had to be undertaken before success was finally achieved.

It is but right to draw attention to the fact that the conditions in Hawaii are particularly favourable for this type of entomological control work. Success has, however, been achieved elsewhere in eliminating certain difficult problems, and there are doubtless many others that can be satisfactorily handled in this manner. Biological control is, however, generally applicable only to introduced insects, and it is usually, but not invariably, of little assistance in the campaign against native pests.

Queensland Experiments in Biological Control.

Mention may be made of the fact that the biological control method has also been extensively employed in the United States, Fiji, Mauritius, South Africa, New Zealand, and Australia, as well as in several other countries. In Queensland very considerable success has been achieved in controlling woolly aphis of apples by means of a small wasp parasite, while colonies of a predaceous beetle have been introduced from Java in an attempt to minimise the losses caused by the banana weevil borer. While it should be clearly understood that, as a rule, success is possible only in the case of its application to introduced insect pests, there is, nevertheless, a large and promising field for this type of work wherever immigrant entomological problems are a serious factor in determining the degree of success likely to be achieved in agricultural or pastoral pursuits.—*Queensland Agricultural Journal*, Vol. XXVIII., Part 2.