CURRENT PROJECTS ON BIOLOGICAL CONTROL OF INSECTS

E. W. VALENTINE

Entomology Division, DSIR, Auckland

Summary

The Biological Control section of Entomology Division is responsible for research into the application of natural methods to control major pest insects and weed plants. Current areas of activity are in the attempted improvement of natural control of noctuid caterpillars (army caterpillar, cutworms etc.), aphids, pear slug and nodding thistle by the introduction and establishment of appropriate natural enemies. Recently a programme to explore the possibilities of applied biological control of black beetle (*Heteronychus arator*) has been initiated. Other activities of the research group include cooperation in the Integrated Control project on apple pests and the survey of distribution, plant association and natural enemies of Tortricid (Leafroller) caterpillars, establishment of insect pollinators of legumes and biosystematic studies on parasitic Hymenoptera in relation to biological control programmes.

INTRODUCTION

The common pest noctuids in New Zealand, cosmopolitan army caterpillar (*Pseudaletia separata*), silver Y moth (*Crysothrips chalcites*), greasy cutworm (*Agrotis ypsilon*) and tomato fruitworm (*Heliothis armigera*) are all known to be attacked, at some stage in their development, by parasitic wasps or flies and although the activities of these parasites are significant, their efficiency is limited and often they do not maintain their host populations at a level acceptable in commercial cultivation. The aim of our programme is to supplement the existing natural control by the introduction of specific or otherwise more effective parasites which should help to stabilize pest populations at a lower level. An encouraging beginning has been made with the establishment of strains of the Braconid wasp *Apanteles ruficrus*, from Pakistan, as a parasite of *Pseudaletia separata*. This parasite readily accepted army caterpillar as a host and with importations received in April 1971 a mass rearing programme was set up by Dr R. A. Cumber, resulting in the production of large numbers of adult parasites for wide distribution. From August 1971 to March 1972 a total of over 40,000 were released at 108 selected sites in the Waikato, Auckland and North Auckland regions and smaller numbers at Nelson. Rapid establishment was achieved and the new *Apanteles* soon became the dominant parasite in the complex. Sampling and reports since that time indicate consistently low populations of army caterpillar in maize and pasture and obviously high levels of parasitism by *Apanteles* and this augurs well for the future with better stabilized populations and absence of devastating outbreaks.

Another successful introduction is a *Litomastix* sp. (family Encyrtidae) a parasite of the larvae of the silver Y moth. Although known to be attacked by the larval parasites *Apanteles ruficrus* and *Microplitis* sp. (Braconidae) and by the pupal parasite *Echthromorpha intricatoria* (Ichneumonidae) it was not effectively checked by natural enemies. As *Litomastix* develops by polyembryony (large numbers of offspring developing from a single egg) it was considered as being capable of ready establishment and a valuable addition to natural control. Parasite eggs, deposited in the egg

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of the host, continue to divide into a mass of embryonic cells while the caterpillar grows. Each cell eventually gives rise to a separate parasite larva. Upwards of 2,000 progeny may develop from the four or five parasite eggs laid and this high multiplication rate gives the potential for very rapid spread. Collected in Australia on the related host *C. argentifera* it was imported in March 1969. Establishment in the first release sites at Nelson was immediate and laboratory breeding during the following summer allowed for wider distribution in that region and transfer to other places including Auckland, Hamilton and Lincoln. With confirmed establishment at Auckland, in 1973, a large scale breeding programme was initiated and the species released in more than 100 sites throughout the Auckland and Wellington provinces and at Christchurch. Rapid establishment and spread is expected and the parasite should add considerably to the natural enemy pressure against this pest. The recently discovered egg parasite *Trichogrammatoidea* sp. is responsible for a high level of parasitism in the northern areas and may be in direct competition with *Litomastix* for hosts. This aspect is at present under investigation.

The noctuid *Spodoptera litura* which has come to be known in New Zealand as the tropical army caterpillar assumed a greater significance as a pest during the past summer and autumn particularly in northern areas. This voracious species, with a very wide food range has been an occasional pest in this country but its prominence this past season may have been due to favourable climatic conditions in the absence of effective natural enemies. It was considered to be only of seasonal occurrence, the larval population arising from moths being blown from Australia each season but it may be possible that an adapted population is capable of surviving the winter in sheltered situations. Preliminary examination has not shown evidence of parasitism except insignificant attack by *Euplectrus* sp. (Eulophidae) and predation of egg batches by the European wasp (*Paravespula germanica*). In order to be prepared for the possible need to apply biological controls the specific egg parasite *Tele-nomus remus* (family Scelionidae) is being cultured in the laboratory and can be released in the field at an appropriate time. In the event of epidemic outbreak or in the absence of effective natural control consideration will be given to the introduction of further specific parasites of this pest.

Among the complex of natural enemies of noctuids an apparent gap is the absence of effective parasites of the egg stage. In other regions species of the genus *Trichogramma* are important in regulating the populations of noctuid and other pests but the otherwise "cosmopolitan" species are not known to occur in New Zealand. However, we do have some representatives of the genus which appear to be confined to their native hosts. In order to fill this gap the current programme includes importation and attempted establishment of a number of these cosmopolitan species. *Trichogramma australicum*, *T. dendrolimi*, *T. euproctidis* and *T. evanescens*, supplied by the Commonwealth Institute of Biological Control were mass reared in Auckland and some millions released in the northern areas over the past two summers. These species originated in temperate regions and it is hoped that they may fit into various habitats and accept a variety of hosts in our agricultural and horticultural environments. It is planned to survey for their establishment during the coming summer.

The representation of general predators of aphids in New Zealand is very small with only four species of aphid feeding coccinellid (Ladybird) beetles, *Coccinella undecimpunctata* (eleven-spotted ladybird), *C. leonina* (orange-spotted), *Adalia bipunctata* (two-spotted) and *Coelophora inaequalis* (Australian) established in this country. Other predators include Syrphid (Hover) flies, a Nabid bug and brown lacewings (Hemerobiidae) and some minor species. There is also a small complex of primary parasites of the family Aphididae with their associated secondary parasites. All of these were accidental introductions with the exception of the woolly aphid

parasite *Aphelinus mali* and possibly the eleven-spotted ladybird beetle. So that the range of natural enemies is narrow compared with other regions of the world. In an effort to increase the diversity of predators with the aim of limiting the fluctuations in host populations, further species of ladybird beetles are being introduced. The species *Oenopia sauzeti*, *Coccinella septempunctata* and *Leis demidata* imported from Pakistan are in culture at Lincoln and have been released in Canterbury, the first species also at Auckland. Green lacewings, of the family Chrysopidae, are missing from the New Zealand fauna and attempts have been made to establish *Chrysopa carnea*. Failure to establish may be related to the inability of the strain received from California to adapt to New Zealand conditions. It is hoped, in the future, to import a different strain, possibly from a region in Europe seasonally and climatically more similar to this country, which should have a better chance of establishment.

Calioa cerasi the pear slug (or sawfly) the widespread and well known pest of pear (*Pyrus* sp.) cherry, plum (*Prunus* spp.) and hawthorn (*Crataegus monogyna*) is little affected by natural enemies in New Zealand. A parasite introduced in the 1920's, *Lathrolestes luteolator* (Ichneumonidae), and established in Nelson is responsible for high levels of parasitism over the first half of the period of host larval feeding, during December and January, but its activity declines and later developing larvae escape parasitism. The overall effect of the parasite is minimal, sufficient pear slugs survive to produce a large population in the following summer. The establishment of a second parasite which operates during the late summer autumn period could help to fill this gap. Little progress has been made but small numbers of a *Synomelix* sp. (Ichneumonidae) imported from Europe, have been released at Auckland. A further attempt will be made next summer to establish this parasite after which the project will be terminated in favour of more economically important problems.

In recent years, in the absence of satisfactory insecticidal or other methods of control, black beetle (*Heteronychus arator*) has assumed greater importance as a pest of pasture and newly sown maize crops etc., particularly in North Auckland areas. This pest is known to be affected by a number of pathogens including the protozoan *Adelina* sp., the fungus *Beauveria* sp. a rickettsian, a nematode and a virus, but there is no evidence of arthropod parasitism or predation. Although the combined action of these pathogens does substantially reduce the numbers of larvae, populations are not reduced sufficiently to prevent the maintenance of continued high populations.

To restate; the aims in applied biological control are to establish natural enemies as parasites or predators where these do not occur; to supplement existing natural control by the establishment of specific or otherwise more efficient biological agents and to increase the diversity of natural enemies, in order to increase biological pressure against pest insects. The ideal result from the application of biological controls is stabilization of host populations at a level below economic significance and this is sometimes achieved. However biological controls on their own do not often meet commercial requirements and other methods of control are sought. Insecticidal treatments create other problems, in ecological disruption, contamination and added expense. In the long term the solution of pest problems lies in the integration of all methods of control; selective use of insecticides, resistant or tolerant plants, management and cultivation procedures into the overall background of natural control.