

A further note on the introduction of *Hypsipyla* parasites in Trinidad, West Indies¹ /.

Resumen. *Hypsipyla* spp. no ha podido hasta el momento establecerse en plantaciones comerciales de caoba y cedro gracias a los esfuerzos del Departamento Forestal de Trinidad. Con el fin de controlar esta plaga el Instituto de Control Biológico del Reino Unido, Estación de las Indias Orientales consiguió material de varios parásitos — *Apanteles* spp., *Phanerotoma* sp., *Tetrastichus spirabilis*, *Antrocephalus renalis*, *Flavopimpla laniannulata*, *Afrephialtes* sp. and *Trichogrammatoidea robustae* — de la India. Algunos de estos parásitos se liberaron directamente en el campo mientras que otros se mantuvieron en cautiverio y se liberaron periódicamente. Un número razonable de *A. renalis*, *T. spirabilis*, *Phanerotoma* sp. y *T. robustae* se ha establecido sin problemas pero los otros parásitos no se han adaptado a las condiciones de Trinidad. Recientemente se han aprobado algunas recomendaciones y una extensión del programa de control biológico y el Ministerio de Agricultura ha aprobado menos fondos para obtener material de otros géneros de *H. robusta* de la India para su evolución en el laboratorio y posterior liberación en el campo.

The phycitid shootborer *Hypsipyla grandella* (Zeller) is a serious pest of meliaceous timber trees in the neotropics. Rao and Bennett (3) reviewed the literature on its importance in the Caribbean and the American mainland. In Trinidad, Spanish cedar (*Cedrela mexicana*) and mahogany (*Swietenia macrophylla*) area of commercial importance. Attempts by the Ministry of Agriculture to use them for reforestation on a plantation scale were adversely affected by *H. grandella* and also to a lesser extent by *H. ferrealis* Hmps., which is a more serious pest in the seed capsules of *Carapa guianensis*. The moths oviposit on the axillary buds of young shoots and the hatching larvae bore into the rachis. Severe damage occurs when larvae make tunnels in the tender growing points of young trees and results in retarded growth. Repeated attacks produce a witches broom effect adversely affecting the commercial quality of the timber. Control by chemical pesticides is uneconomical and difficult to achieve under prevailing conditions so that biological control is particularly desirable. The Commonwealth Institute of Biological Control (CIBC) was approached to explore the possibilities. Funds were provided in 1966 to initiate field work at the West Indian Station, CIBC to obtain stocks of exotic parasites through the Indian Station, and to breed and release them in Trinidad.

Surveys in Trinidad

After initial surveys involving sampling of infested shoots and seeds in order to assess the status of *Hypsipyla* spp. and to determine quantitatively and

qualitatively the parasite complex and its seasonal fluctuations, Bennett (3) reported large seasonal population fluctuations apparently not caused solely by changes in the number of susceptible shoots and also found that the parasite complex varied considerably from season to season. Bennett (3) and Bennett and Yaseen (1) reported several native parasites including *Trichogramma* sp., *Trichogrammatoidea* sp. (Trichogrammatidae), *Metopiops mirabilis* Townsend, *Chrysodoria* sp. (Tachinidae), *Apanteles* sp., *Bracon chontalensis* Cameron and *Hormius* sp. (Braconidae). The *Trichogramma* sp. was described as *T. bennetti* (2). The *Trichogrammatoidea* sp. is to be described by H. Nagaraja as *T. hypsipylae*. A nematode *Hexameris* sp. was also obtained from a few larvae. Mortality due to the native parasites was usually very low and did not appear to exert any appreciable level of control.

Exotic parasites

At the same time, the natural enemies of a related Old World shootborer, *H. robusta*, were being investigated by the Indian Station, CIBC and exploration had already revealed a large complex of natural enemies including 1 bethylid, 17 braconids, 9 chalcids, 1 elasmid, 1 eulophid, 1 eurytomid, 13 ichneumonids, 2 trichogrammatids, 2 tachinids, a nematode *Hexameris* sp. as parasites and 1 malachiid and a clerid as predators (3).

Owing to delays in arranging shipments from India the investigations there had almost terminated so that smaller numbers and fewer species were obtained than had been anticipated. Nevertheless, *Apanteles*, sp. (*puera* group), *Apanteles* sp. (*vitripennis* group), *Apanteles leptoura* Cam. (Braconidae), *Flavopimpla laniannulata* Cam. (Ichneumonidae) were obtained. As there was a high mortality rate in some consignments and other shipments arrived when *Hypsipyla* was scarce so that there was insufficient host material to breed and maintain stocks in the laboratory, only relatively small numbers of parasites were released.

Later, *Antrocephalus renalis* Wtston (Chalcididae), *Tetrastichus spirabilis* Wtston (Eulophidae), *Phanerotoma* sp. (Braconidae), *Trichogrammatoidea robustae* Nagaraja (Trichogrammatidae) and *Afrephialtes* sp. (Ichneumonidae) were obtained, tested in the laboratory and breeding techniques developed (4).

Releases

The programme called for releases to be made in experimental plots of mahogany and cedar set up by the Forestry Division at Brigand Hill in the east,

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Cats Hill in the south and River Estate in the north. Most of the parasites received in the earlier phase were released at Brigand Hill but unfortunately the seedling trees failed to grow at this site and the plots were abandoned. The culture of *Afrephialtes* sp. was lost after three generations and before releases could be made. The other parasites were successfully mass-bred and released in the experimental plots and in stands of mahogany and cedar elsewhere. In all, 47 550 *T. spirabilis*, 6 160 *Phanerotoma* sp., 16 350

T. robustae and 2 952 *A. renalis* were released during 1969-71 (1). Details of subsequent releases are given in Tables 1-3.

Recovery surveys

Only *T. robustae* has been recovered. It was detected for the first time in 1971 and appears to be established but parasitism has remained at a low level, fluctuating between 5.3% and 8.9%.

Table 1. Releases of *Tetrastichus spirabilis* in Trinidad, 1972-76.

Locality	1972	1973	1974	1975-76
Brigand Hill	2 030	800	1 250	7 300
Marper	2 620	3 500	4 400	6 300
Toco	5 000	—	—	4 800
Curepe	—	—	—	400
Talparo	300	2 500	—	—
Biche	200	—	—	—
Cats Hill	—	1 000	—	—
St. Joseph	—	100	1 000	—
Total	10 150	7 900	6 650	18 800
Total for 1972-76	: 43 500			

Table 2. Releases of *Phanerotoma* sp. in Trinidad, 1972-76.

Locality	1972	1973	1974	1975-76
Brigand Hill	2 175	3 000	920	1 377
Marper	3 459	6 492	2 200	3 227
Toco	3 921	—	—	3 000
Talparo	1 000	800	—	—
Biche	700	—	—	—
Cats Hill	—	420	—	—
St. Joseph	—	900	100	—
Arena	—	—	200	400
Total	11 255	11 612	3 420	8 004
Total for 1972-76	: 34 291			

Table 3. Releases of *Trichogrammatoidea robustae* in Trinidad 1972-76.

Locality	1972	1973	1974	1975-76
Brigand Hill	800	1 400	1 050	950
Marper	1 650	1 000	2 100	2 700
Toco	4 520	—	—	4 200
Talparo	400	100	—	—
Biche	100	—	—	—
Cats Hill	—	200	—	—
St. Joseph	—	100	—	—
Arena	—	—	200	—
Carepe	—	—	100	—
Total	7 470	2 800	3 450	7 850
Total for 1972-76	: 21 570			

Discussion

Although *Antrocephalus renalis*, *Tetrastichus spirabilis* and *Phanerotoma* sp were released in sufficient numbers over several years to offer a reasonable chance of establishment they have apparently failed to adapt to Trinidad conditions despite the fact that they readily attack *H. grandella* and *H. ferrealis* in the laboratory. *T. robustae*, although established, does not seem to be capable of controlling the pest. These parasites were available mainly because they could be easily bred and multiplied in large numbers and because they are important parasites of *H. robusta* in India. The delayed start of the project, beyond the control of CIBC, did not permit it to be synchronized with investigations at the Indian Station which would have allowed adequate shipments of several other parasites, some of which, although not so readily bred in the laboratory, might have proved more successful.

As efforts to grow mahogany and cedar on a plantation scale in Trinidad are to continue, the Ministry of Agriculture has recently provided additional funds to allow the establishment of a temporary station in the forest areas of India so that stocks of other parasites can be obtained. It is hoped that some of these will be established and exert effective control.

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Summary

Hypsipyla spp. have so far foiled the attempts of the Forestry Department to establish mahogany and Spanish cedar as plantation crops in Trinidad. To attempt to control these pests the West Indian Station, Commonwealth Institute of Biological Control, procured stocks of several parasites – *Apanteles* spp., *Phanerotoma* sp., *Tetrastichus spirabilis*, *Antrocephalus renalis*, *Flavopimpla laniannulata*, *Afrephialtes* sp and *Trichogrammatoidea robustae* – from India. Some of them were released directly into the field and stocks of others have been maintained for periodic releases. Adequate number of *A. renalis*, *T. spirabilis*, *Phanerotoma* sp and *T. robustae*, to afford a reasonable chance of establishment, have been released over several years. *T. robustae*

is now established widely but other parasites have failed to adapt to Trinidad conditions. Recommendations for an extended biological control campaign have recently been approved and additional funds have been provided by the Ministry of Agriculture in order to obtain stocks of other parasites of *H. robusta* from India for laboratory evaluation and possible field releases.

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