EVALUATION OF THE BIOLOGICAL CONTROL PROGRAM AGAINST SUGAR CANE STALK BORER, DIATRAEA SACCHARALIS F., AFTER TWO DECADES OF FIELD ESTABLISHMENT OF COTESIA FLAVIPES (CAMERON) IN JAMAICA

By

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Abstract

Cotesia flavipes, the imported braconid parasitoid of the sugar cane stalk borer, Diatrea saccharalis, was laboratory-reared and released in Jamaican sugar cane fields from 1972 to 1974 and from 1980 to 1987. Field establishment was achieved by 1982, after which the parasitoid rapidly spread to colonise most cane areas. Once field establishment was satisfactorily achieved, further field releases were phased out. Collection of borers from November 1999 to March 2000 from three estates and rearing under observation showed that, in the area of initial colonisation, where C. flavipes parasitism once stood at 19.9%, populations had dwindled to almost nil. Meanwhile, throughout the industry, borer damage levels remained relatively high, at above 7% of internodes bored. More satisfactory levels of parasitism by C. flavipes were found on a neighbouring farm as well as on the North Coast. The virtual disappearance from some areas of the parasitoid, once left on its own, suggests that augmentative releases are necessary to sustain desired levels of parasitism.

Introduction

Among sugar cane insect pests in Jamaica, the stalk borer, Diatrea saccharalis F. (Lepidoptera: Pyralidae), has been the target of the most protracted and intense program of biological control. Mass rearing and release of various parasitoids, including Metagonistylum minense, Paratheresia claripalpis, Cotesia (formerly Apaneles) flavipes, Pediobius furvus and Allorhogas pyralophagus, were carried out over two periods, between 1972 and 1975 and resuming in 1980 (Falloon, 1980, 1985). Cotesia flavipes (Cameron), a larval parasitoid, has been the only field success, gaining permanent establishment by 1982 and spreading to cover much of the industry shortly thereafter (Falloon, 1989).

We adopted the classical biological control approach that, once the parasitoid’s establishment was deemed successful, further field releases were discontinued, while periodic checks were made to monitor its progress. This was, however, contrary to the approach taken by the majority of the cane world where augmentative and inudative releases of C. flavipes over indefinite time spans seems to be the accepted norm (Macedo and Botelho, 1986; Suasa-ard and Charernsom, 1999).

Earlier biological control efforts in Jamaica were centred on augmentative releases of the native egg parasitoid, Trichogramma fasciatum. Prior to the introduction of C. flavipes, the native larval parasitoids, Lixophaga diatraeae and Agathis stigmatanae, were commonly found. Predators also played an important role, with Euborellia annulipes and E. stali listed among the more prominent species (Falloon, 1980). In Sao Paolo, Brazil, predators were regarded as important in natural control, accounting for an estimated 63.6% of the egg population in one study (Teran, 1980).

Materials and Methods

Cotesia flavipes was obtained through the then Commonwealth Institute of Biological Control’s Trinidad laboratory, mass reared and released in a process described by Falloon (1980). The exercise was conducted in two phases, the first between 1972 and 1974, the second between 1980 and 1987. Field success was measured by collecting stalk borers, the target host, from the field and rearing under observation in the laboratory on a natural diet of corn cobs. Levels of native parasitoid species found alongside and in isolation from C. flavipes in field populations were used to determine impact on local parasitoids through competition. Similar studies, done following cessation of laboratory rearing/release of C. flavipes in 1987, were used to assess the value of augmentative releases. The annually conducted stalk borer damage survey, which focuses on the southern irrigated plains, the traditional zone of high borer infestation, was the means by which I measured the success of the program in reducing the level of damage.

Results and discussion

Parasitism with augmentation

Within three years of the start of the second phase of importation, rearing and release of C. flavipes, the parasitoid appeared permanently established and had
increased the level of borer parasitism by some 16% (i.e. from 21.6% to 37.4%) in areas colonised (Falloon, 1989). In most areas, it had become the dominant parasitic species. For instance, at Rowington, New Yarmouth, where field establishment was first recorded, *C. flavipes* accounted for 18% parasitism as against 5% for *L. diatraeae* and 7% for *A. stigmaterus*. Rowington then became a focal point of studies surrounding the program. Of 13 fields sampled at Rowington in this early period, 12 were colonised by *C. flavipes*, which was responsible for parasitism of 19.9% of all borers collected, attaining a high of 59% in one field. The native parasitoids together resulted in 12.3% parasitism.

**Parasitism without augmentation**

Rowington was again the site of spot checks when it was decided in 1999, 12 years after the last field release, to assess the status of the imported parasitoid. The surprising result was that *C. flavipes* appeared to have virtually disappeared from the farm. In three of four fields sampled, not one cocoon mass was recovered. Two cocoon masses were eventually found in the fourth field sampled (Table 1). One of these gave rise to an apparent hyperparasitoid, similar to the *Chonocephalus* sp. detected a few years earlier. With recovery of the parasitoid now down to less than 1% of 232 borers collected in the area, it was decided to do a wider collection to see to what extent this had occurred within the industry.

These spot checks were conducted over seven months from November 1999 to May 2000, in areas previously known to be colonised by *C. flavipes*. Just fewer than 400 borers were collected from nine locations in two distinctly different ecological zones—mostly in the traditionally high borer-infested, arid-irrigated Clarendon plains on Jamaica’s south coast and the more humid and less highly infested non-irrigated Hampden area in the north.

Fears of a major outbreak of hyperparasitoids, following the find at Rowington, proved unfounded as a thriving population of *C. flavipes* was encountered on neighbouring Springfield farm, where, with 150 borers collected and reared, parasitism exceeded 20% in two fields. Further away at Hampden, the borer population proved extremely low; only 15 specimens were found in a day of sampling, but four of those were parasitised by *C. flavipes*.

**Impact on stalk damage**

Following discontinuation of augmentative releases, it was expected that a new dynamic equilibrium would be established between host and parasitoids, hopefully at a host density level below that causing economic crop loss. Borer infestations, measured in terms of level of stalk borer damage, have fluctuated without showing the desired permanent drop (Figure 1). Indeed, in 1999, the level of borer damage was essentially the same as when the program was restarted in 1980. At Monymusk, New Yarmouth and Innsworth estates, continuously monitored over the period, damage had generally been between 8% and 12% of internodes, or above the commonly accepted economic damage threshold of 5%. There was no clearly discerned trend towards damage reduction. This was contrary to the experience in Barbados, which recorded a drastic and permanent decline in borer levels following introduction of *C. flavipes* (Alam, 1980). The failure to produce similar reduction in stalk damage levels in Jamaica mirrored the Brazilian experience where, after massive continuous releases and successful field parasitism of the borer in Sao Paulo state, damage levels at some mills seemed hardly any different after 10 years (Macedo and Botelho, 1986).

Notwithstanding the general satisfactory levels of *C. flavipes* across the industry, the population depletion at Rowington suggested a need to frequently augment supply of the parasitoid in order to sustain desirable levels of parasitism. Failure to do this might well be the cause of the seeming lack of impact from the program, unless there are other undetermined factors negating the effect of the parasitoids.

**Impact on native parasitoids**

My study also showed that the native parasitoids, *L. diatraeae* and *A. stigmaterus*, retained their relative effectiveness. The former accounted for 17%

![Table 1](chart.png)

**Table 1—Parasitism of sugar cane stalk borers, from spot checks over 7 months during 1999–2000.**

<table>
<thead>
<tr>
<th>Location</th>
<th>Date collected</th>
<th>No.</th>
<th>Killed by parasitoids</th>
<th>Total Parasitism</th>
<th>Other deaths</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Cotesia</em></td>
<td><em>Lixophaga</em></td>
<td><em>Agathis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Rowington #5</td>
<td>30 Nov 99</td>
<td>67</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Rowington #18</td>
<td>20 Dec 99</td>
<td>53</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Rowington #90</td>
<td>10 Jan 00</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>Rowington</td>
<td>21 Jan 00</td>
<td>88</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Hampden</td>
<td>13 Mar 00</td>
<td>15</td>
<td>4</td>
<td>27</td>
<td>3</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>16 Mar 00</td>
<td>18</td>
<td>5</td>
<td>28</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>20 Mar 00</td>
<td>54</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>5 Apr 00</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>20 Apr 00</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>9 May 00</td>
<td>25</td>
<td>9</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Springfield</td>
<td>30 May 00</td>
<td>20</td>
<td>6</td>
<td>30</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Total/Mean</td>
<td></td>
<td>397</td>
<td>31</td>
<td>8</td>
<td>69</td>
<td>17</td>
<td>7</td>
</tr>
</tbody>
</table>
of borer deaths and the latter for just 2% overall. This shows remarkable consistency with a 1983–84 study when *L. diatraeae* parasitised 17.1% and *A. stigmaterus* 3.7% of borers in a survey covering twice as many fields (Falloon, 1985). Where the population of *C. flavipes* was zero, as in Rowington #5 and #90, parasitism by native parasitoid, *L. diatraeae*, rose to its highest, 30% and 33%, respectively. This suggests that there might be some negative impact on native parasitoids by the imported species.

Multiple parasitism was not measured. Borer deaths were ascribed to whichever parasitoid first emerged from the carcasses, though there may well have been instances in which borers might have been host to more than one parasitic species.

**Conclusions**

Cessation of augmentative releases of *C. flavipes* has been accompanied by a reduction of the parasitoid’s field populations, particularly at Rowington. While this parasitoid continues to colonise cane fields, some 13 years after the last release, its impact on stalk damage levels has been minimal. Augmentative releases would therefore appear to be necessary in order to maintain satisfactory levels of parasitism.

Despite the presence of this additional parasitoid in the field, levels of stalk damage remain at an unacceptably high level in the irrigated plains.

Competition between imported and local parasitoids appears to have had a negative, even if marginal, impact on performance of the native species, *L. diatraeae*.

**Acknowledgments**

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**REFERENCES**


EVALUATION DU PROGRAMME DE CONTROLE BIOLOGIQUE DU FOREUR DE LA CANNE A SUCRE, DIATRAEA SACCHARALIS F., APRES DEUX DECENNIES D'ETABLISSEMENT DU COTESIA FLAVIPES (CAMERON) A LA JAMAIQUE

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Résumé


*Mots clés: Diatraea saccharalis, Cotesia flavipes, contrôle biologique.*

EVALUACIÓN DEL PROGRAMA DE CONTROL BIOLÓGICO DEL BARRENADOR DE LOS TALLOS DE LA CANA DE AZÚCAR (DIATRAEA SACCHARALIS F.), DESPUÉS DE DOS DÉCADAS DE ESTABLECIMIENTO DE COTESIA FLAVIPES (CAMERON) EN JAMAICA

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Resumen

_Cotesia flavipes_, el parasitoide importado del barrenador de los tallos de la caña de azúcar, _Diatraea saccharalis_, fue criado en el laboratorio y liberado en los campos de caña de Jamaica desde 1972 hasta 1974 y desde 1980 hasta 1987. El establecimiento del parasitoide se logró hacia 1982, a partir del cual éste se dispersó colonizando la mayoría de las áreas cafeteras. Una vez el establecimiento en el campo fue satisfactorio, se suspendieron las liberaciones. Recolecciones de barrenadores seguidas por observaciones de laboratorio realizadas en 3 centrales entre noviembre 1999 a marzo 2000, indicaron que en el área colonizada inicialmente, en donde hubo niveles de parasitismo de 19.9%, las poblaciones del parasitoide han prácticamente desaparecido. Por otro lado, el daño causado por el barrenador se ha mantenido relativamente alto, por encima del 7% de los entrenudos barrenador, a nivel de todos los campos. Se hallaron niveles de parasitismo por _C. flavipes_ mas altos en una hacienda próxima, al igual que en la Costa Norte. La desaparición virtual de este parasitoide de algunas áreas al cual se le dejó a su propia supervivencia, sugiere la necesidad de liberaciones aumentativas para alcanzar niveles deseados de parasitismo.

*Palabras claves: Diatraea saccharalis, Cotesia flavipes, control biológico.*