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ABSTRACT

A field study was conducted in a sunlight coffee grove of Puerto Rico to determine the population dynamics of *Mirax insularis* Muesebeck, the coffee leafminer (*Leucoptera coffeella* (Guérin-Méneville)) larvae parasitoid. Coffee leaf samples were collected monthly starting at early spring (March) and finishing in late autumn (December) of 2005. The highest parasitism ratio (0.2095) was recorded during August, followed by that of December with 0.1971. The lowest parasitization ratio (0.0120) was obtained in November. The average parasitism percentage obtained during the study was 20.13. Although the parasitism ratio was very low from April to July, in August when the coffee leafminer (CLM) population peaked, *M. insularis* also increased exponentially. However, from September to November a dramatic decrease in the parasitism ratio was observed. Heavy rains occurred during that season decreasing the CLM population and thus affecting the viability of suitable larvae for parasitization.

**Key words:** *Leucoptera coffeella*, Coffee leafminer, *Mirax insularis*

RESUMEN

Dinámica poblacional del parasitoide exótico del minador del café, *Mirax insularis* Muesebeck en una plantación de café al sol en Puerto Rico

Se realizó un estudio de campo en una siembra de café al sol para determinar la dinámica poblacional de *Mirax insularis* Muesebeck, el parasitoide de la larva del minador del café, *Leucoptera coffeella* (Guérin-Méneville) en Puerto Rico. Se recogieron muestras de hojas del cafeto mensualmente comenzando temprano en la primavera (marzo) y terminando al final del otoño (diciembre) del 2005. El cociente más alto de parasitismo (0.2095) se registró durante agosto, seguido por el de diciembre con 0.1971. El cociente más bajo del parasitización (0.0120) se obtuvo en noviembre. El porcentaje promedio del parasitismo obtenido durante el estudio fue 20.13. Aunque el cociente de parasitismo fue muy bajo a partir de abril a julio, en agosto, cuando la población del minador de la hoja del cafeto alcanza su pico, la población de *M. insularis* también aumenta exponencialmente. Sin embargo, de septiembre a noviembre se observó una disminución dramática del cociente de parasitismo. Durante esos meses normalmente llueve torrencialmente disminuyendo la
población del minador del cafeto y afectando así la viabilidad de larvas adecuadas para ser parasitadas.

**Palabras clave:** *Leucoptera coffeella*, Minador de la hoja del café, *Mirax insularis*

**INTRODUCTION**

The coffee leafminer (CLM), *Leucoptera coffeella* (Guérin-Méneville) (Lepidoptera: Lyonetiidae), is the main pest of coffee in Puerto Rico. Damage is caused by the larva and is characterized by large brown spots on the leaves which can reduce yields up to 40%. In Puerto Rico, larvae and pupae of this pest are parasitized by several eulophid wasps and one braconid, *Mirax insularis* Muesebeck (Gallardo, 1988; Sein, 1940; Wolcott, 1947). The braconid parasitoid was introduced to Puerto Rico from Guadeloupe in 1937 (Sein, 1940, 1941-42). In Guadeloupe, the parasitoid destroyed from 65 to 85% of the CLM larvae (Sein, 1940).

The braconid was released during 1937 in shaded coffee groves of Puerto Rico at Lares, Quebradillas and Guaynabo. Recovery tests conducted during 1938 indicated that it became established, although the incidence was very low. Sein attributed that paucity to the seasonal scarcity of its host. After that year, no more recoveries were made until May 1986 when several specimens were collected at Lares (Gallardo, 1988).

During 1985-86, *M. insularis* constituted 32.4% of the total parasitoid population and parasitized 7% of the CLM larvae collected (Gallardo, 1988). A field survey of the CLM conducted during 1992 (Gallardo, unpublished data) demonstrated that *M. insularis* is widely distributed throughout the coffee region of Puerto Rico. The highest parasitism (15.00%) was obtained on the Hacienda Paraiso at Bo. Real Anón, Ponce.

Several studies are needed in order to establish a biocontrol program for the CLM. These include: description of the population dynamics of the CLM in Puerto Rico and the effects of native natural enemies in the population dynamics of the CLM. To determine the seasonality of the CLM in a sunlight coffee grove of Puerto Rico a field study was conducted during 2005. The research focused on the effects of *M. insularis* on the population dynamics of the CLM.

**MATERIALS AND METHODS**

To determine the population dynamics of *M. insularis*, a field study was conducted during 2005 on a coffee grove at Bo. Real Anón, Ponce. Coffee leaf samples were collected monthly within five blocks of unshaded and unsprayed coffee (total area = 2 acres). The collection of samples started at early spring (March, 14) and finished in late autumn (December, 15) of 2005 in accordance with the CLM population peak (Gallardo, 1985).

One hundred coffee leaves were hand collected at random within each block, placed inside a plastic bag in an ice chest, and brought to the laboratory. Mines per leaf were recorded and each leaf was placed individually in a small plastic bag (10.16 x 12.7 cm) and close. Plastic bags were arranged in trays and held under insectary conditions (80 ± 1 °C, 12:12 DL, 40% RH) for about one month or until parasitoid or the CLM emerged. The adults of *M. insularis* that emerged were recorded.
Data were subject to statistical analysis using standard procedures for analysis of regression (ProStat, 2002). The *M. insularis* collected were compared with voucher specimens of *M. insularis* identified in 1986 by Paul Marsh of the USDA Biosystematics and Beneficial Insects Institute at Beltsville, Maryland, U.S.A.

**RESULTS AND DISCUSSION**

Table 1 summarizes data of the CLM and the exotic parasitoid survey. The braconid, *M. insularis*, was always obtained from the coffee leaf samples collected. The highest parasitism ratio (0.2095) was recorded during August, followed by that of December with 0.1971. The lowest parasitism ratio (0.0120) was obtained in November. During the study, the average percentage of parasitism by *M. insularis* was 20.13. This result is similar to that obtained during the 1992-1993 survey in which the average percentage of parasitism was 15.00% (Gallardo, unpublished data).

Table 1. Coffee leafminer, *Leucoptera coffeella* (Guérin-Méneville) and *Mirax insularis* Muesebeck survey, 2005.

<table>
<thead>
<tr>
<th>Date (2005)</th>
<th>Mines/leaf</th>
<th>Parasitoid /mines</th>
<th>Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar\15</td>
<td>2.00</td>
<td>0.053678</td>
<td>---</td>
</tr>
<tr>
<td>Apr\20</td>
<td>1.48</td>
<td>0.070345</td>
<td>6.15</td>
</tr>
<tr>
<td>May\16</td>
<td>2.54</td>
<td>0.072308</td>
<td>13.14</td>
</tr>
<tr>
<td>Jun\10</td>
<td>4.08</td>
<td>0.035784</td>
<td>6.31</td>
</tr>
<tr>
<td>Jul\21</td>
<td>2.89</td>
<td>0.01413</td>
<td>3.16</td>
</tr>
<tr>
<td>Aug\17</td>
<td>4.89</td>
<td>0.2095</td>
<td>4.32</td>
</tr>
<tr>
<td>Sep\21</td>
<td>1.69</td>
<td>0.022189</td>
<td>8.58</td>
</tr>
<tr>
<td>Oct\26</td>
<td>1.39</td>
<td>0.039557</td>
<td>6.69</td>
</tr>
<tr>
<td>Nov\16</td>
<td>1.50</td>
<td>0.012058</td>
<td>3.58</td>
</tr>
<tr>
<td>Dec\13</td>
<td>3.53</td>
<td>0.19710</td>
<td>6.44</td>
</tr>
</tbody>
</table>

*^ Mirax insularis, ^Monthly average (inches) of rainfall in south coast slopes (Real Anón, Ponce).*

The population of the CLM starts increasing from April through July and peaks in August (Figure 1); from September to November it decreases and in December starts peaking. This periodic fluctuation of the CLM population was described by Gallardo-Covas (1988) and a negative correlation between the CLM infestation and rain was determined; however, during this study no correlation was detected. Two rainy seasons are well defined in the coffee region of Puerto Rico, one short that start at the beginning of late spring up to the beginning of summer followed by a short dry season during summer and finishing at the beginning of August; the other from September to November.
Figure 1. Seasonality of the coffee leafminer, *Leucoptera coffeella*, and rainfall in a sunlight plantation in Puerto Rico, 2005.

The same trends were observed for the population fluctuation of the parasitoid (Figure 2). Although the parasitism ratio was very low during the months of April to July, in August when the CLM population peaked, *M. insularis* also increased. However, from September to November a dramatic decrease in the parasitism ratio was observed. Probably the heavy rains that occurred during that season throughout the coffee region determined the scarcity of the host and thus influenced the viability for suitable CLM larvae for parasitization. A positive correlation ($r^2 = 0.9532$) was detected between mines/leaf vs. parasitoid/mines when data were fit in a polynomial curve (Figure 3).

Figure 2. Population dynamics of *Mirax insularis*, the coffee leafminer parasitoid, in sunlight coffee groves in Puerto Rico.
Although this study reveals that *M. insularis* is acting upon the CLM larvae and that there is a seasonality of its host, further studies are needed that address the interactions of the natural enemy’s community of the CLM. In Brazil, Reis et al. (2000) warned that biological control programs of the CLM should be based on knowledge of food web interactions, rather than simply on strategies involving introduction of exotic natural enemies based on negatively effects of predatory wasps over build up of parasitoids.

In Puerto Rico, Wolcott (1947) reported 10 parasitoid species reared from the CLM larvae in Puerto Rico. Gallardo (1988) in a survey done in 1985-86 through the coffee region of Puerto Rico, found five eulophids, namely: *Achrysocharoides* sp., *Chrysonotomyia* sp., *Cirrospiloideus* sp., *Zagrammosoma* sp., *Horismenus* sp., and a braconid, *Mirax insularis*, attacking larvae of the CLM. Despite being a suitable host to more than eight parasitoid species, all occurring simultaneously, the CLM too often presents populations far above the damaging level for the coffee plantation.

CLM seasonal studies based on rain intensity over time should be conducted for revealing temporal changes in the structure of the coffee.

This observation needs to be considered if we are going to initiate an augmentation program of *M. insularis* for controlling the CLM population before it reaches the peak of infestation. This piece of information is of great value for the determination of appropriate time for field releasing of the braconid adults. The results suggest that the sampling had revealed the seasonality of the CLM and *M. insularis* in the natural community, but further interactions among parasitoids species need to be detected with additional studies.


