INFLUENCE OF CORN SILKS ON CORN EARWORM FEEDING RESPONSE

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ABSTRACT

A 2-year study was conducted in both the field and laboratory on the silk-feeding responses of the corn earworm, Heliothis zea (Boddie), to selected corns when the exposed silks were either left intact and/or removed. Exposed silk masses limited early earworm penetration into the ear in 1976 but not in 1978. An exception was the exposed silks of 'Zapalote Chico' in which antibiosis appeared to be the overriding factor preventing penetration into the ear rather than the physical characteristics expressed in the case of the other corn entries. Significantly smaller larvae were produced on silks of 'Zapalote Chico' as compared to other resistant and susceptible lines, and, in general, on all corn lines when earworms were fed silks that were 6 or more days past full silk, as compared to larvae fed fresher silks.

RESUMEN

Un estudio fue llevado a cabo en el laboratorio y en el campo durante 2 años para determinar la actividad alimenticia de Heliothis zea (Boddie) en relación a las barbas de mazorca (estigmas) expuestas o intactas y/o removidas, usando líneas seleccionadas de maíz. Las barbas expuestas limitaron físicamente la penetración temprana en la mazorca en 1976 pero

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1Lepidoptera: Noctuidae.
2In cooperation with the University of Georgia College of Agriculture Experiment Stations, Coastal Plain Station, Tifton, GA 31793.
no en 1978. La variedad 'Zapalote Chico' fue excepcional, pues, parece que la antibiosis era el factor más importante en prevenir la penetración de las larvas, y no las características físicas de las barbas. Las larvas que se criaron sobre las barbas de 'Zapalote Chico' resultaron significativamente más pequeñas que las que se criaron sobre otras líneas resistentes o susceptibles. En todas las líneas, las larvas que se criaron sobre las barbas de seis días pasados de maduración resultaron más pequeñas que las que se criaron sobre barbas frescas.

Numerous studies have been conducted at the Southern Grain Insects Research Laboratory on many aspects of plant resistance to the corn earworm, *Heliothis zea* (Doddie) (McMillian and Wiseman 1972). In recent years, Wiseman et al. (1976) identified 2 resistance mechanisms—tolerance and antibiosis—in 2 different corn lines. Later, they identified some of the physical characteristics related to these 2 plant resistance mechanisms (Wiseman et al. 1977); and more recently, they described larval behavior on ears of the tolerant and antibiosis types of corn (Wiseman et al. 1978).

We report here a 2-yr study on the feeding responses of corn earworm larvae, as measured by ear penetration and larval weight gains, on selected corn lines on which the outer silks have been either left intact or removed and on which the ears were infested at varying intervals past full silk.

**Materials and Methods**

Five corn hybrids and 1 population, previously known for their resistance or susceptibility (Wiseman et al. 1976 and 1977), were planted in randomized complete blocks in a split-split plot design on 27 April 1976, and 30 March 1978, for each of 5 replicates. The resistance mechanisms were antibiosis for 'Zapalote Chico' and tolerance for 'Dixie 18' and 471-U6 x 81-1 (Wiseman et al. 1977). Plantings made in 1977 were abandoned because they were contaminated by excessive natural infestations. Plots were 0.76 m apart and consisted of 2 rows 6.1 m long. Whole plot treatments were days (0 day = full silk and 3, 6, 9, and 12 = days after full silk) at which 3 laboratory-reared 1st-instar corn earworms were placed on silks of individual ears. The first split was corn entries and the second split was silk treatment (normal and silk removal down to husk tip). Larvae were allowed to feed for 6 days before damage ratings were made where 0 = no infestation; 1 = larvae in upper 1/3 of silk channel; 2 = larvae in mid 1/3 of silk channel; 3 = larvae in lower 1/3 of silk channel; 4 = larvae on ear tip, feeding on silk; 5 = larvae on ear tip, feeding on ear; and 6-n = larval penetration down the ear at increments of 1 cm and feeding on kernels (Wiseman and McMillian 1973).

Identical plantings were made for a concurrent laboratory experiment to determine larval weight gains. Silks were excised to the ear tip and classified as exposed or nonexposed (silk channel). The separated silks were placed in diet cups containing a small portion of slightly moistened paper towel. One 1st-instar corn earworm was placed in each of 10 cups/entry/plant. Laboratory tests were held in a constant temperature room at 80 ± 2°F and 70 ± 2% RH. The larvae were allowed to feed for 6 days and then mortality and larval weights were recorded. Analysis of variance was made of the
laboratory and field data; and combined means of larval silk penetration and larval weights, as separated by Duncan's multiple range test, are presented for each year.

RESULTS AND DISCUSSION

Table 1 shows the corn earworm larval silk penetration on the ears of the resistant and susceptible corn lines. Larvae penetrated more deeply into the ears of susceptible than resistant lines. In 1976, significant differences in larval penetration were found between the normal and nonexposed silk treatments (4.1 cm vs 4.3 cm); however, in 1978, no differences were found. In the case of 'Zapalote Chico', it appeared that larval penetration was not affected by silk treatment (exposed or nonexposed) or by age at the time of silk treatment. This may be due, in part, to the antibiosis mechanism of resistance. Walss et al. (1979) recently discovered a flavone glycoside, maysin, in the silks of 'Zapalote Chico' that retards growth of corn earworm larvae. This chemical appears to be responsible not only for retarding larval growth but also could be responsible for slowing ear penetration by the earworm. However, the maysin content quickly disappears (unpublished data). Therefore, it is believed the physical characteristics of 'Zapalote Chico' complement the early influence of the maysin compound and thus alter the normal feeding behavior to the point that ear penetration rarely occurs.

For the tolerant and susceptible entries, however, greater penetration generally occurred when the outer silks were removed. Therefore, those entries with exposed silks of good quality and quantity (maintained ca. 90% moisture and were large enough so that larvae could complete development), as described by Wiseman et al. 1977, in some way delayed larval penetration. This is also true when age of silk is considered (Table 2): the older the silks at the time of infestation, the greater the degree of penetration. This probably occurred because the larvae were not stopped at the silk tip on the older silks and therefore penetrated further before feeding was initiated (Wiseman and McMillian 1973).

Larval weights differed significantly among corn entries (Table 1). The

<table>
<thead>
<tr>
<th>Entries**</th>
<th>Silk penetration</th>
<th>Larval weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Zapalote Chico' (R)</td>
<td>1.04 a</td>
<td>0.60 a</td>
</tr>
<tr>
<td>'Dixie 18' (R)</td>
<td>3.06 b</td>
<td>1.95 b</td>
</tr>
<tr>
<td>471-U6 x 81-1 (R)</td>
<td>3.33 b</td>
<td>2.35 c</td>
</tr>
<tr>
<td>'Asgrow A204' (S)</td>
<td>5.26 c</td>
<td>4.15 d</td>
</tr>
<tr>
<td>'Stowell's Evergreen' (S)</td>
<td>5.78 d</td>
<td>4.80 e</td>
</tr>
<tr>
<td>'Ioana' (S)</td>
<td>6.60 e</td>
<td>5.05 f</td>
</tr>
</tbody>
</table>

* Averages within the same year followed by the same letter are not significantly different at F = 0.05 as separated by Duncan's Multiple Range Test.
** Resistance is antibiosis for 'Zapalote Chico' and tolerance for 'Dixie 18' and 471-U6 x 81-1.
TABLE 2. SIX-DAY AVERAGE* CORN EARWORM SILK PENETRATION (CM) AND LARVAL WEIGHTS (MG) AFTER FEEDING ON SILKS OF RESISTANT OR SUSCEPTIBLE CORN AT VARYING DAYS AFTER FULL SILK.

<table>
<thead>
<tr>
<th>Days after full silk</th>
<th>Silk penetration</th>
<th>Larval weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.3 a</td>
<td>2.0 a</td>
</tr>
<tr>
<td>3</td>
<td>3.2 b</td>
<td>2.8 b</td>
</tr>
<tr>
<td>6</td>
<td>4.0 c</td>
<td>3.3 c</td>
</tr>
<tr>
<td>9</td>
<td>5.3 d</td>
<td>3.7 c</td>
</tr>
<tr>
<td>12</td>
<td>6.2 e</td>
<td>4.4 d</td>
</tr>
</tbody>
</table>

*Averages (combined over entries) within the same year followed by the same letter are not significantly different at P = 0.05 as separated by Duncan's Multiple Range Test.

Silks of the tolerant corns, 471-U6 x 81-1 and 'Dixie 18', produced larvae that weighed as much as those fed on susceptible silk. However, corn earworm larvae fed silks of 'Zapalote Chico' were much smaller than those from all other corn entries. These results are in agreement with our earlier findings (Wiseman et al. 1976) and with those of Waiss et al. (1979) for the influence of maysin on corn earworm growth. However, significant differences were found between weights of larvae fed on exposed and nonexposed silks. In 1976 and 1978, respectively, weights of larvae fed exposed and nonexposed silks were 23.7 vs 61.2 mg and 22.9 vs 67.1 mg. Weights were reduced when larvae fed on silk ≥ 6 days old. Mortality at 6 days was much higher (29%) for larvae that were fed on exposed silks than for those fed on nonexposed silks (6%). The greatest mortality (32%) occurred when larvae were fed the 12-day-old silks for the 6-day period as compared to 10% larval mortality with 0-day silks.

In summary, exposed silk masses limited early earworm penetration in some cases, the exceptions being when antibiosis ('Zapalote Chico') was present and when the silks had aged before infestation. It is felt that the antibiosis in 'Zapalote Chico' was the overriding factor in limiting earworm feeding in the early developmental stages of the ear. In addition, although physical characteristics were important in altering the normal earworm feeding behavior, they appear to be even more important in further limiting ear penetration by the earworm during later ear development. The potential of planting corns with this type of resistance (antibiosis) has been indicated as a result of a 3-year study (Wiseman et al. 1978) where it was shown that the resistance of 'Zapalote Chico' could reduce corn earworm populations by 60%. The corn entry 'Zapalote Chico' would still be preferred, and thus, corn earworm moths would oviposit readily on this corn entry. However, due to the ear characteristics and the high antibiosis of 'Zapalote Chico', indications are that corn earworm populations would be drastically reduced in large plantings. But, if corn entries of the tolerant type were planted (Wiseman et al. 1972) then corn earworm numbers would not be reduced since the tolerance mechanism of resistance is more of a plant response and does not affect the insect's biology. Therefore, both the tolerant and susceptible corn entries would be capable of producing one corn earworm larva/ear,
but corn varieties that possess tolerance and especially the 'Zapalote Chico'
type of resistance could be used as an integral part of an IPM program.

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OXYTELUS INCISUS MOTSCHULSKY AND
O. PENNSYLVANICUS ERICHSON
(COLEOPTERA, STAPHYLINIDAE, OXYTELINAE)
IN FLORIDA

J. H. Frank AND M. C. Thomas

ABSTRACT

The coprophilous staphylinids Oxytelus incisus Motchulskey and O. penn-
sylvanicus Erichson are reported from Florida (U.S.A.) for the first time.
Distinguishing characteristics and a key are provided to adults of the 5
Oxytelus species now recorded thence. Other new records are: O. incisus
from Texas (U.S.A.) and Costa Rica, O. pennsylvanicus from Georgia
(U.S.A.), O. sculptus Gravenhorst from Haiti, and Anotylus insignitus
(Gravenhorst) from Costa Rica and Honduras.

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