Chemosterilant and Insecticidal Activity of Mixed Aflatoxins against *Anthonomus grandis* (Coleoptera)

**Jack H. Moore, Abner M. Hammond, and Gerald C. Llewellyn**

Department of Biology, University of North Alabama, Florence, Alabama 35630; Department of Entomology, Louisiana State University, Baton Rouge, Louisiana 70803; and Department of Biology, Virginia Commonwealth University, Richmond, Virginia 23284

Received August 20, 1977

A mixture of the four major aflatoxins at 0.06 ppm in food supplied to adult boll weevils, *Anthonomus grandis*, was an effective chemosterilant.

**Key Words:** *Anthonomus grandis*, adult; aflatoxin; aziridine; chemosterilant effects.

**INTRODUCTION**

Certain strains of the fungi *Aspergillus flavus* and *A. parasiticus* produce a group of mycotoxic metabolites commonly known as the aflatoxins (Diener and Davis, 1969). The aflatoxins have been studied extensively since they were found first in peanuts, stored grains, and other agricultural products (Golumbic and Kulick, 1969). Aflatoxin B$_1$ (AFB$_1$) is a known hepatocarcinogen and hepatotoxic agent (Wogan, 1968). Additional aflatoxins include B$_2$ (AFB$_2$), G$_1$ (AFG$_1$), and G$_2$ (AFG$_2$).


Chemosterilant effects were produced by aflatoxin in *Aedes aegypti*, *M. domestica*, and *D. melanogaster* (Matsumara and Knight, 1967); *Sitophilus oryzae* (Srinath et al., 1973); and *T. gigas* (Sannasi and Amirthavalli, 1970).

The present study was undertaken on the boll weevil, *Anthonomus grandis*, comparing aflatoxin with a known chemosterilant (aziridine) to evaluate aflatoxin as a chemosterilant and insecticide.

**MATERIALS AND METHODS**

Aflatoxic corn meal containing 17 ppm of AFB$_1$, 4.3 ppm of AFB$_2$, 30 ppm of AFG$_1$, and 9 ppm of AFG$_2$ was mixed into an agar-liquid weevil food (Vandenzant and Davich, 1961). Three concentrations of aflatoxic corn meal were prepared: 1.000, 0.100, and 0.010%. The corn meal was substituted for a portion of the sucrose (equal weight basis) in the food. Food containing 0.005% aziridine, a known chemosterilant, and a food containing 1.000% toxin-free corn meal as a control were prepared. They were mixed for 3 min at 60°C. Each mixture was poured into glass tubing, 1 cm in diameter, and allowed to cool and solidify. The solidified food was removed from the tube and cut into lengths of 1 cm, each weighing 1.5 g. These were dipped into melted wax to retard desiccation and were stored at 5°C.

Twenty-five marked weevils of each sex (25–30 hr old) were placed together into pint containers. They were maintained at 30°C and 50% RH. One piece of food per five weevils was provided and changed twice daily. Daily observations were made for mortality. The test diets
were provided to the weevils for 3 days and, on the fourth day, were replaced with control food for 4 additional days; on the seventh day, the eggs were harvested by dissection and screen washing (Vanderzant and Davich, 1961). Microbial contamination was controlled by suspending the eggs in a solution of 40% formalin diluted 50:1. Fifty eggs were placed into small depressions in a pour plate of larval diet, one egg per depression. The plates were maintained at 30°C and 50% RH, and the eggs were observed twice daily for 7 days to determine hatch.

RESULTS AND DISCUSSION

The data in Table 1 show that the highest concentration of the aflatoxins studied (0.603 ppm) prevented egg production and 36% of the animals died within 7 days. The toxin was fed for only 3 of the 7 days and approached the LD50 level for the weevils. The second highest concentration (0.060 ppm) was an effective chemosterilant. The lowest concentration (0.006 ppm) had no chemosterilant effect. This group had a hatch value of 113.73 as compared to 100.00 for the control. The middle concentration of the aflatoxins produced a hatch value of 1.96 and aziridine produced a value of 0.00. McHaffey et al. (1972) consider a treatment effective as a chemosterilant if the hatch value is 4.00 or less.

Lalor et al. (1976) found that 1.5 μg/ml of AFB1 reduced the hatching percentage for a specific strain of D. melanogaster (wild type Oregon R) to 35%. No hatching occurred in concentrations above 2.8 μg/ml. Chinnici et al. (1976) found that AFB1-treated D. melanogaster (wild type, Oregon R) males were more sensitive than females during their development from eggs to adults. It is not possible to attribute the chemosterilization observed in this study to any one of the four aflatoxins since they were fed as a mixture. Neither can the sterilization be attributed to a specific sex since both males and females had access to the food.

This potent hepatocarcinogen should be studied more thoroughly. One consideration should be the possibility of bioconcentration and biotransfer of such an agent (Nevins and Grant, 1971). Further studies are planned to identify sex-related responses of the boll weevil to each of the four major aflatoxins.

ACKNOWLEDGMENTS

The boll weevils, aziridine, and laboratory space were provided by Southern Research Institute, Birmingham, Alabama. The corn meal containing the aflatoxins and the analysis were supplied by Dr. Urban Diener and Dr. N. D. Davis, Auburn University, Auburn, Alabama. Mrs. Kathryn Collendra, Virginia Commonwealth University, Richmond, Virginia, assisted with data analysis, technical, clerical, and editorial aspects of the work.

TABLE 1

CHEMOSTERILANT AND INSECTICIDAL ACTIVITY OF MIXED AFLATOXINS AGAINST ANTHONOMUS GRANDIS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Concentration in food</th>
<th>Total number of animals</th>
<th>Mortality after 7 days (%)</th>
<th>Number of eggs plated</th>
<th>Hatch (%)</th>
<th>Hatch valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aflatoxin</td>
<td>0.603 ppm</td>
<td>50</td>
<td>36</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Aflatoxin</td>
<td>0.060 ppm</td>
<td>50</td>
<td>4</td>
<td>100</td>
<td>1</td>
<td>1.96</td>
</tr>
<tr>
<td>Aflatoxin</td>
<td>0.006 ppm</td>
<td>50</td>
<td>8</td>
<td>100</td>
<td>58</td>
<td>113.73</td>
</tr>
<tr>
<td>Apholate</td>
<td>(aziridine) 0.005%</td>
<td>50</td>
<td>8</td>
<td>97</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>0.000</td>
<td>50</td>
<td>2</td>
<td>100</td>
<td>51</td>
<td>100.00</td>
</tr>
</tbody>
</table>

a Treated/Control × 100 = hatch value.
REFERENCES


