

# CORN EARWORM, *HELIOTHIS ZEA*: SUSCEPTIBILITY TO INSECTICIDES<sup>1</sup>

S. H. KERR<sup>2</sup>

Department of Entomology and Nematology,  
University of Florida, Gainesville, Florida 32601

## ABSTRACT

Dosage-mortality relationships between insecticides and the corn earworm, *Heliothis zea* (Boddie), were ascertained by topical micro-application of acetone solutions of technical insecticides. Field-collected larvae of  $50 \pm 25$  mg were tested, as were the same size larvae of laboratory-reared  $F_1$  descendants of the same populations. Base lines of susceptibility established for new insecticides against laboratory-reared populations had  $LD_{50}$ 's of 68.8 ug/g for methomyl and 92.0 for Gardona® (2-chloro-1-[2, 4-dichlorophenyl] vinyl diethyl phosphate).  $LD_{50}$ 's for DDT were 100-200X those reported in 1959 for *H. zea* in North Carolina. The laboratory-reared larvae consistently had greater  $LD_{50}$ 's than the field-collected ones.

Entomologists have often been urged to establish base lines of susceptibility of economically important arthropods to new toxicants, and to monitor developing resistance to toxicants with careful dosage-mortality studies. This is routine work, but quite time consuming, and little has been done except with a few pests of major importance. Given the anarchy in testing, with diverse measuring procedures, only a small part of what has been done can be brought together for direct comparison.

This paper reports base lines for 2 insecticides newly cleared for use on corn against the corn earworm, *Heliothis zea* (Boddie), and measurements of corn earworm susceptibility to some older materials.

Field populations in different locations may have different "vigor" depending on nutrition, climate, diseases, etc. and consequently have dissimilar tolerances to insecticides. These dissimilarities are not necessarily from differences in resistance but may be "vigor tolerances" reflecting local environmental influences. Tolerances of the field populations were measured, but I felt that the tolerances should also be measured after the different populations had been reared under identical conditions for 1 generation. Both measurements should be highly useful, the first showing the degree of susceptibility under conditions growers have to deal with locally, and the second giving a direct comparison of susceptibility under the same, controlled conditions and thus giving a more reliable estimate of resistance.

## METHODS AND MATERIALS

The plan was to sample populations from 3 or 4 representative areas of Florida and establish dosage-mortality regression lines for many insecticides against (a) the field populations and (b) their  $F_1$  laboratory-reared

<sup>1</sup>Florida Agricultural Experiment Stations Journal Series No. 3693.

<sup>2</sup>The technical assistance of Mrs. Mary Lou Schreiber is gratefully acknowledged.

descendants, the latter all having been reared under identical conditions. A small fraction of this information was assembled during 1969 and 1970. With the prospect of little further effort being soon allotted to this project, the available data are being put on the record.

While there are little firm data on migration of *H. zea*, it is surmised by many that this is a vigorous flyer whose individuals may fly many miles. The gene pool in a given location could change greatly from season to season. Thus one must consider that we probably can not monitor the resistance of a given population in a given location; we only measure the tolerance of those corn earworms which appear at that location at given times.

The corn earworms used were from populations in Sanford and Gainesville, Florida in 1969, and from Gainesville in 1970. Corn was brought to the laboratory in Gainesville and the earworms were removed and placed in 1 oz plastic cups. Chunks of corn were provided as food. Typically, the larvae were removed from the corn within 12-24 hr of when the corn was picked, and the larvae were exposed to the insecticides within 24-48 hr of picking. Tiny larvae had to be left several days in the cups to grow large enough to be tested. With the limited number of larvae available for testing, individuals in a rather large weight range were used. The larvae used weighed  $50 \pm 25$  mg; age or instar were not considerations in choice of test insects. Laboratory temperatures were 78-82°F and the photoperiod was 14 hr light: 10 hr dark.

Technical insecticides in acetone solution were applied in 1 ul quantities to the dorsum of the thorax by use of an ISCO Model M microapplicator. Larvae were returned to and held in their individual plastic cups after treatment. Mortality was recorded after 48 hr, with death in this case being the condition of complete moribundity where there was no visible response to prodding.

To get  $F_1$  laboratory-reared descendants, 75-100 larvae from each field sampling were held aside and not tested. Resulting pupae were placed in oviposition cages and from this point on the corn earworms were reared as described by Burton (1969). This involves surface sterilizing the eggs with 0.157% sodium hypochlorite, and rearing the larvae on an artificial diet. When the larvae reached the  $50 \pm 25$  mg size, their susceptibility was ascertained by the same method described above.

Treatments were replicated 3-5 times when sufficient insects were available, and for the more reliable data, each point on the regression line was established with 30-50 larvae. Exceptions are noted in the table. There were 4-6 points on each curve. The probit analysis used was the computerized UCRBL 560 program of the University of California, Riverside.

#### RESULTS AND DISCUSSION

Fortunately, the most reliable data are those most wanted—base lines with laboratory-reared corn earworms for methomyl and Gardona® (2-chloro-1-[2, 4-dichlorophenyl] vinyl diethyl phosphate). It is disappointing that there are not data from more populations and that there are not reliable data from field populations. Repeated samplings brought in from a given field were quite variable, and sometimes the more replicates attempted on field populations the more the difficulties. Larval field popula-

TABLE 1. SUSCEPTIBILITY OF FIELD AND LABORATORY POPULATIONS OF CORN EARWORM LARVAE OF  $50 \pm 25$  MG TO INSECTICIDES.

Insecticide	Population	LD <sub>50</sub> in ug toxicant per g body weight	95% confidence limits	
			Lower	Upper
Gardona	Field, Gainesville	11.4	6.6	16.3
Gardona	Field, Sanford	about 1.5*		
Gardona	Lab, Sanford	92.0	72.3	120.5
Methomyl	Field, Gainesville	about 5*		
Methomyl	Lab, Gainesville	68.8	39.4	120.5
DDT	Field, Gainesville	4,550	1,593	27,680
DDT	Field, Sanford	8,129	2,981	542,190
DDT	Lab, Sanford	36,550	25,430	74,190
Mevinphos	Field, Sanford	13.6**	4.7	22.7
Carbaryl	Field, Sanford	126.9**	13.7	340.2

\*Eye-fitted lines. Data did not fit equation adequately.

\*\*Not replicated. Data from 1/3-1/2 as many larvae as for others.

tions in the latter part of the 1969 season became increasingly heavily diseased.

When DDT was considered the material of choice for corn earworm control, Gast (1959) reported the LD<sub>50</sub> to be  $40 \pm 6$  ug/g for North Carolina field populations of larvae close to the same size used here. Methomyl and Gardona were considerably more toxic than that against field populations in the present test (Table 1). Mevinphos showed about the same toxicity as the latter 2, with its LD<sub>50</sub> being about 4X that reported by Gast for mevinphos. Carbaryl's LD<sub>50</sub> was considerably higher than for these other insecticides and this is reflected in the more limited efficacy of carbaryl in field control trials.

The present tests revealed a 100-200 fold increased tolerance to DDT over the figure given by Gast. In tests conducted similarly to the present one, Wolfenbarger and Lowry (1969) showed a dose of 640 ug/g to cause only 8% mortality to a Texas corn earworm population. As others have also noted, it is practically impossible to get accurate data with DDT when so much is required. The heavy doses applied would literally coat the thorax with crystallized DDT.

The LD<sub>50</sub>'s for laboratory-reared corn earworms were consistently higher than for field collected larvae. This was not specific but applied to all toxicants, with about a 5-15 fold increase involved. Others have noted the same phenomenon, with no suitable explanation given. I surmise that I selected for vigorous larvae in using those that survived the handling and rearing under artificial conditions; the biochemical or biophysical mechanism involved in the greater tolerance is still unknown, however.

#### LITERATURE CITED

- Burton, R. L. 1969. Mass rearing the corn earworm in the laboratory. USDA ARS-33-134. May, 1969. 8p.

- Gast, R. T.* 1959. The relationship of weight of lepidopterous larvae to effectiveness of topically applied insecticides. *J. Econ. Entomol.* 52:1115-7.
- Wolfenbarger, Dan A., and W. L. Lowry.* 1969. Toxicity of DDT and related compounds to certain lepidopteran cotton insects. *J. Econ. Entomol.* 62:432-5.

The Florida Entomologist 54(2) 1971

### BOOK REVIEW

THE SYSTEMATICS OF THE TRIBE PLECTODERINI IN AMERICA NORTH OF MEXICO (Homoptera: Fulgoroidea, Achilidae). Lois Breimeier O'Brien, University of California Press, Berkeley and Los Angeles, California. University of California Publications in Entomology Vol. 64, 1971. 79 p., 157 Fig., and 1 plate of 8 photographs. \$3.00.

Refinements in the systematics of the Fulgoroidea have come at a slower pace than in the closely related cicadelloidea. Primarily this is due to the greater economic importance of leafhoppers. Occasionally a significant work comes along on planthoppers, and the tribal revision by Dr. Lois O'Brien is one of these. It is a thorough treatment of the Plectoderini in North America but has valuable comparisons with the world achilid fauna, particularly that of the neotropics.

Before this revision, the 32 previously known plectoderine species in North America were all referred to the genus *Catonia*. Now Dr. O'Brien proposes that these and 8 new species belong to 6 genera. The majority of the species are western in distribution. Arizona is the only state where more than 3 genera are found (5 of the 6 genera). Florida has 3 genera and at least 10 species. All taxa can be keyed without the use of male genitalic characters, although line drawings are included for each species. A supplementary key based on the male genitalia is provided for *Catonia*.

The revision is based on an evaluation of morphology and host associations. Notes on distribution, ecology, life history, and behavior make the publication valuable to the general worker as well as to the specialist and others who will make good use of it as an identification manual. The author points out that much remains to be learned about the food habits of achilids, but in general, the adults feed on the sap of trees and shrubs, and the nymphs are believed to feed on fungi. The quality of the paper, printing, and reproductions is consistent with the usual high standard of the series.

F. W. MEAD  
Division of Plant Industry,  
Florida Dept. of Agriculture and  
Consumer Services