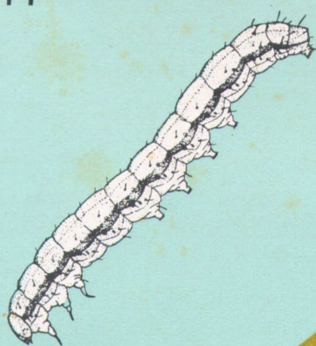
# Insecticides for the Control of Bollworms, *Heliothis spp.* on Cotton



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# *Insecticides for the Control of Bollworms, Heliothis spp. on Cotton*

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THE COTTON BOLLWORM complex, *Heliothis* spp., is one of the major deterrents to profitable cotton production in Alabama and much of the cotton belt. Frequently, damaging bollworm infestations occur following early season insecticide applications for control of the boll weevil, *Anthonomous grandis* Boheman. Populations of beneficial arthropods that normally limit bollworm populations are greatly reduced by early season boll weevil control; thus, bollworm populations may rapidly increase to economic levels. Currently, efforts are being made to develop techniques of pest management that will take advantage of the natural enemies of various cotton pests. Until these systems of pest management are perfected, cotton producers must continue to rely on chemical insecticides as a first line of defense against *Heliothis* spp.

From 1967 through 1969, a series of tests was conducted to evaluate insecticides for *Heliothis* control. The results of these tests are presented herein.

## GENERAL PROCEDURES

Tests to evaluate insecticides for control of *Heliothis* were conducted in two locations from 1967 through 1969. All tests were designed as small replicated field plots in randomized complete blocks.

Insecticides were applied with a high clearance, self-propelled sprayer calibrated to deliver 5 gallons of total spray per acre. Generally, applications were made on a 4- to 6-day schedule. Test materials known to be ineffective for controlling boll weevil were supplemented with azinphosmethyl (Guthion$^R$) at a rate of 0.25 pound per acre.

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Several criteria were used to evaluate the effectiveness of the test materials: (1) number of bollworm eggs per 100 plant terminals, (2) percentage of plant terminals containing live bollworm larvae, (3) percentage of bollworm-damaged squares, (4) percentage of bollworm-damaged bolls, and (5) yield data. Yield data were collected from each treatment by mechanically harvesting the center four or eight rows. These samples were weighed and the data converted to pounds of seed cotton per acre.

Rainfall at the test site was monitored each year. Rainfall during July, August, and September of 1967, 1968, and 1969 was recorded as 13.49 inches, 11.78 inches, and 15.26 inches, respectively.

## 1967 EXPERIMENT

### Methods and Materials

This experiment, at the Wiregrass Substation, Headland, Alabama, consisted of 10 insecticidal treatments and an untreated check, each replicated four times in plots 16 rows wide and 100 feet long. Tiers of plots were separated by 200-foot alleys.

Eleven applications of materials were made, Table 1. At one point during late August, the regular 4- to 6-day application schedule was extended to 13 days. The long interval between insecticide applications was used to induce a bollworm population increase that would allow a more meaningful evaluation of the test materials.

### Results and Discussion

The bollworm population was relatively small during most of the test; however, the extended application schedule during late August allowed an increase in the bollworm population. All materials did an adequate job of controlling bollworm infestations before the bollworm population was allowed to increase, Table 1. Following the population increase, CIBA 9491, Thuricide$^{R}$, and the nuclear polyhedrosis virus did not effectively control the infestation. Based on counts of live bollworms, all other materials achieved effective and statistically equal control.

Late in the test, bollworm infestations were monitored by examining bolls for damage. Two such examinations were made. Protection afforded by the insecticides was variable. Although all insecticide-treated plots had significantly fewer damaged bolls

TABLE 1. DESCRIPTION OF TREATMENTS, SEASONAL BOLLWORM INFESTATIONS, AND YIELD OF SEED COTTON, BOLLWORM CONTROL TEST, HEADLAND, ALABAMA, 1967[1]

| Treatment | Rates per acre[2] | Live worms per 100 terminals[3] | Bollworm-dam. bolls per 10 row-ft.[4] | Yield per acre |
|---|---|---|---|---|
| | *Lb.* | *No.* | *No.* | *Lb.* |
| EPN + methyl parathion | 0.5 + 0.25 | 4.39 a | 10.33 a | 1,909 a |
| EPN | 1.0 | 4.41 a | 27.11 abc | 1,931 a |
| TDE | 1.0 | 4.82 a | 5.67 a | 1,911 a |
| Am Cy 47470 | 0.5 | 6.30 ab | 9.11 a | 1,639 bcd |
| Azodrin | 0.6 | 7.50 abc | 26.00 abc | 1,884 ab |
| Furadan (Nia. 10242) | 0.5 | 8.12 abc | 37.33 cd | 1,607 cde |
| DDT | 1.0 | 8.13 abc | 14.00 ab | 1,819 abc |
| CIBA 9491[5] | 0.5 | 9.60 bcd | 36.22 bcd | 1,502 def |
| Thuricide (IMC) | 2 qt. | 11.38 cd | 57.00 de | 1,359 ef |
| Viron/H (IMC N.P. Virus) | 100 LE[6] | 13.38 d | 64.11 e | 1,491 def |
| Check | | 19.14 e | 86.78 f | 1,331 f |

[1] Means followed by same letter are not significantly different at 0.05 level.
[2] Application dates: 6/29, 7/6, 7/11, 7/17, 7/21, 7/26, 8/4, 8/9, 8/14, 8/18, 8/31.
[3] Based on nine weekly counts.
[4] Based on two counts: 8/25, 8/30.
[5] Missed application on 8/18.
[6] LE = larval equivalents.

than the untreated check, plots sprayed with several of the materials, particularly the two pathogenic formulations, were heavily damaged.

Based on the infestation data, most of the materials did an adequate job of controlling young, early-instar bollworms feeding in the terminal of cotton plants. However, the ineffectiveness of some test materials (Thuricide, CIBA 9491, and the nuclear polyhedrosis virus) in controlling the more mature bollworms that normally infest bolls was reflected in the yield data. Thus, plots treated with these materials did not yield a statistically greater amount of seed cotton than the untreated check.

## 1968 EXPERIMENT

### Methods and Materials

During 1968, 13 insecticidal materials were tested for their effectiveness in controlling the bollworm on cotton. This test, conducted at the Wiregrass Substation, Headland, Alabama, compared insecticides currently recommended for bollworm control as well as several other materials. Each treatment was replicated four times with individual plots 16 rows wide and 100 feet long. Tiers of plots were separated by 25-foot alleys.

Applications of an insecticide (Guthion) for boll weevil control were begun in all plots on June 20 and continued on a 4- to 6-day schedule until the test began. In order to achieve a large population of bollworms in the test area, the first application of test materials was not made until July 22. After the test was initiated, Guthion was included in the spray formulation of test materials known to be ineffective for controlling the boll weevil.

### Results and Discussion

An examination made prior to the test indicated an average infestation of 70 bollworm larvae and 40 bollworm eggs per 100 plant terminals in the plots. Subsequent examinations of terminals during the remainder of the season indicated that all materials suppressed further bollworm population buildup. However, the large initial population was destructive to the cotton crop as indicated by the numbers of bollworm-damaged squares and bolls and yield records, Table 2. There were no significant differences in the seasonal average counts of live bollworms in plant terminals in treated plots, an indication that all test insecticides performed equally well against the early instar larvae that normally infest cotton plant terminals. However, these same materials were not equal in their protection of cotton squares and bolls, and significant differences in effectiveness were evident.

Methyl parathion and seven other treatments resulted in the least amount of bollworm damage to squares. However, all test materials except Gardona (SD 8447) had fewer bollworm-damaged squares than the untreated check.

All plots sustained a considerable amount of boll damage. All test materials provided some boll protection; all materials except Dursban, Gardona, and CIBA 9491 gave statistically equal boll protection.

Yield records indicated the severe bollworm pressure encountered in this test. Even plots treated with materials that provided the greatest measure of square and boll protection yielded a relatively small amount of seed cotton. All insecticide-treated plots except those treated with Viron/H and Dursban yielded significantly more seed cotton than the untreated check.

## 1969 EXPERIMENT

### Methods and Materials

This experiment was initiated at the Wiregrass Substation, Headland, Alabama; however, during the early growing season,

TABLE 2. DESCRIPTION OF TREATMENTS, SEASONAL BOLLWORM INFESTATION, AND YIELD OF SEED COTTON, BOLLWORM CONTROL TEST, HEADLAND, ALABAMA, 1968[1]

| Treatment | Rates per acre[2] | Live worms per 100 terminals[3] | Bollworm-dam. sqs.[4] | Bollworm-dam. bolls[5] | Yield per acre |
|---|---|---|---|---|---|
| | *Lb.* | *No.* | *Pct.* | *Pct.* | *Lb.* |
| EPN +methyl parathion | 0.5 + 0.5 | 24.3 a | 16.0 ab | 32.5 a | 907 ab |
| Amer. Cyanamid 47470 | 0.75 | 24.7 a | 19.0 abcd | 35.3 abc | 1,038 a |
| Thuricide (IMC) | 2 qt. | 24.7 a | 25.2 de | 34.2 abc | 708 cd |
| DDT | 1.0 | 24.9 a | 18.0 abcd | 38.2 abc | 991 a |
| Gardona (SD 8447) | 0.75 | 23.7 a | 29.7 ef | 40.7 bc | 736 bc |
| Viron/H (IMC N.P. virus) | 60 LE[6] | 24.8 a | 23.3 bcde | 33.0 ab | 675 cd |
| Zolone (RP 11974) | 1.0 | 26.2 a | 15.3 ab | 34.3 abc | 889 ab |
| Methyl parathion | 1.0 | 26.5 a | 12.5 a | 34.1 abc | 1,027 a |
| Supracide (GS 13005) | 1.0 | 26.2 a | 23.2 bcde | 32.5 ab | 933 a |
| Phosvel (VCS-506) | 1.0 | 26.2 a | 14.5 a | 31.3 a | 1,052 a |
| Guthion + methyl parathion | 0.25 + 1.0 | 25.5 a | 17.0 abc | 30.0 a | 1,056 a |
| CIBA 9491 | 1.0 | 27.7 a | 20.3 abcd | 42.0 c | 981 a |
| Dursban | 0.5 | 27.0 a | 24.5 cde | 40.2 bc | 679 cd |
| Check | ---- | 57.0 b | 35.7 f | 61.0 d | 533 d |

[1] Means followed by same letter are not significantly different at 0.05 level.
[2] Application dates: 7/22, 7/26, 7/31, 8/5, 8/6, 8/12, 8/16, 8/21, 8/22.
[3] Based on six weekly counts.
[4] Based on three weekly counts.
[5] Based on five weekly counts.
[6] LE = larval equivalents.

inclement weather and mechanical difficulties with the spray apparatus were encountered and the test was transferred to the Agricultural Engineering Research Unit near Marvyn, Alabama.

Ten insecticidal treatments were included in this test. A lack of cotton at the test site prevented the inclusion of an untreated check and standard treatment in the test. However, a related test conducted adjacent to this experiment supplied an untreated check and standard treatment for comparative purposes. Thus, test data were not analyzed statistically. All plots were 16 rows wide and 100 feet long; each treatment was replicated four times.

Seven applications of the test insecticides were made at 4- to 6-day intervals beginning on August 4. Prior to initiation of the test, Guthion + DDT @ 0.25 + 1.0 pound per acre was applied three times at 5- to 6-day intervals for control of all cotton insects. All plots were treated similarly during the pre-test period; the last pre-test application of insecticide was made one week prior to the start of the test. During the test Guthion @ 0.25 pound per acre was included in all the spray formulations known to be ineffective for controlling the boll weevil.

TABLE 3. DESCRIPTION OF TREATMENTS, SEASONAL AVERAGE BOLLWORM INFESTATIONS, AND YIELD OF SEED COTTON, BOLLWORM CONTROL TEST, MARVYN, ALABAMA, 1969[1]

| Treatment | Rates per acre[3] | Live worms per 100 terminals[5] | Bollworm-dam. sqs.[6] | Bollworm-dam. bolls[5] | Yield per acre |
|---|---|---|---|---|---|
| | *Lb.* | *No.* | *Pct.* | *Pct.* | *Lb.* |
| Fundal-Galecron | 1.0 | 7.2 | 17.5 | 9.2 | 1,992 |
| Guthion + DDT[2] | 0.25 + 1.0 | 8.8 | 14.5 | 9.0 | 2,097 |
| Stauffer N-2596 | 1.0 | 11.6 | 21.8 | 12.6 | 2,498 |
| Bay 93820 | 0.75 | 12.2 | 21.3 | 17.0 | 2,633 |
| Phosvel (VCS-506) | 1.0 | 12.4 | 18.5 | 17.8 | 2,415 |
| IMC Virus (VH 690) | 40 LE[4] | 14.4 | 23.0 | 13.0 | 2,449 |
| CIBA 9491 | 1.0 | 15.4 | 26.3 | 14.8 | 1,811 |
| CIBA 2307 | 1.0 | 16.4 | 29.8 | 19.4 | 2,557 |
| IMC Virus (VH 691) | 40 LE[4] | 16.6 | 15.5 | 12.4 | 2,356 |
| IMC Virus (VH 69C) | 40 LE[4] | 25.8 | 25.5 | 16.4 | 2,118 |
| IMC Virus (VH 69M) | 40 LE[4] | 28.2 | 28.3 | 13.8 | 2,078 |
| Check[2] | ---- | 38.3 | 46.8 | 37.7 | 1,206 |

[1] Data not analyzed statistically because two treatments were not in same field as other treatments.
[2] Treatments shared with nearby related test.
[3] Application dates: 8/4, 8/8, 8/13, 8/19, 8/22, 8/27, 9/3.
[4] LE = larval equivalents.
[5] Based on five weekly counts.
[6] Based on four weekly counts.

## Results and Discussion

Bollworms were abundant during this test. Random samples of *Heliothis* spp. collected from the test plots during August indicated that almost half of the population consisted of *H. virescens* (Fab.), the tobacco budworm. This occurrence was abnormal; in past years, the *Heliothis* population during August was almost entirely the common bollworm, *H. zea.*

Counts of live bollworms in plant terminals indicated that Fundal-Galecron was the most effective material tested, Table 3. Most of the other experimental materials were adequate on controlling early-instar bollworms in the plant terminals; however, none of the other test materials was equal to the standard (Guthion + DDT). Counts of bollworm-damaged squares and bolls indicated a similar pattern of effectiveness.

Yield data generally followed the trends established by the bollworm infestation data. However, yields from the Fundal-Galecron plots were not as high as expected from the infestation data. All insecticide-treated plots produced good yields despite heavy bollworm pressure throughout the test.

## AGRICULTURAL EXPERIMENT STATION SYSTEM OF ALABAMA'S LAND-GRANT UNIVERSITY

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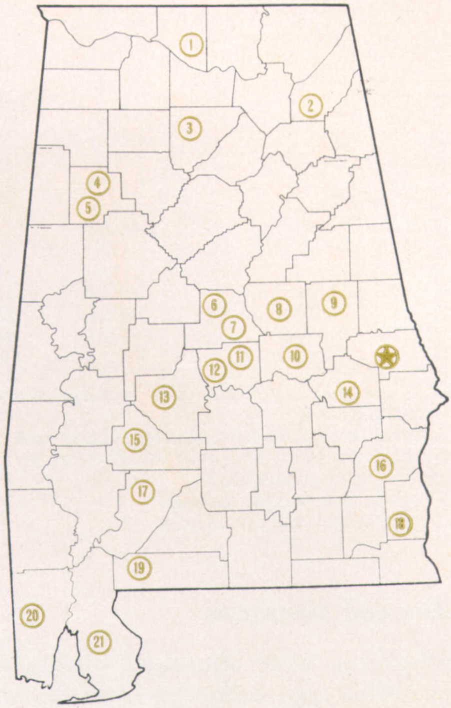

### Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.