Efficacy of New Insecticides Against the Bollworm and Their Effects on Cotton Yield, Maturity, and Fiber Properties in West Tennessee

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Abstract: In small-plot field tests on cotton in West Tennessee in 1980-82, treated plots generally had significantly less damage compared to the untreated checks. High-rate pyrethroid treatments produced significantly greater yields than did the untreated check in 1981 when five applications were required. Yield differences between treated and untreated plots lacked significance in 1980 and 1982 when only three applications were required. New insecticides had no effect on maturity, gin turnout or fiber properties.

Key Words: Insecticides, Heliothis control, cotton fiber properties, plant maturity, fruit damage, yield.

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The bollworm, Heliothis zea (Boddie) and the tobacco budworm, H. virescens (Fabricius) are major pests of cotton in the United States. Both species were susceptible to methyl parathion in Arizona in 1972 (Lentz et al. 1974), but by 1977, H. virescens populations in central Arizona had become 12 times more tolerant to methyl parathion (Crowder et al. 1979). In a review of Heliothis spp. resistance (Sparks 1981), H. zea was reported to be resistant to organophosphorus insecticides in six cotton producing states, three of which border Tennessee, and resistance of H. virescens to these insecticides was reported in 13 states, including Tennessee.

Development of insecticide resistance among Heliothis populations hastened the introduction of pyrethroid insecticides for pest suppression in cotton. The pyrethroid insecticides permethrin and fenvalerate, frequently referred to as first-generation pyrethroids, first became available to growers in 1978. Second-generation pyrethroids, effective against Heliothis spp. at rates approximately one-half the rate of first-generation pyrethroids, include flucythrinate, cypermethrin, cyfluthrin (BAY FCR 1272), and fluvalinate. Some of these second-generation pyrethroids now are available to producers while others are in advanced stages of registration.

New organophosphate and carbamate insecticides also have been introduced to suppress Heliothis spp. Hopkins et al. (1977) and DuRant (1979) reported on the effectiveness of new pyrethroid, organophosphate, and carbamate insecticides against Heliothis spp. in the Southeast. Pfimmer (1979) reported the effectiveness of new insecticides against Heliothis spp. in the Mid-South.

The effects of these new insecticides on parameters other than efficacy and lint yield have not been well documented. Both lint percentage and micronaire were significantly affected by insecticide treatments containing methyl parathion.
thiodicarb, and chlorpyrifos (Weaver et al. 1979). New insecticides (including pyrethroids, organophosphates and a carbamate), per se, had no effect on maturity, germination of seed, fiber length, or fineness (Hopkins and Moore 1980).

These studies were conducted at the northern extreme of the cotton belt to determine the efficacy of new insecticides against *Heliothis* spp. and the effect of these materials on yield, maturity, gin turnout and fiber properties.

**MATERIALS AND METHODS**

The insecticides evaluated were acephate WP (75% wettable powder), and the emulsifiable concentrates chlordimeform EC (480 g/liter), cyfluthrin EC (BAY FCR 1272) (240 g/liter), cypermethrin EC (300 g/liter and 360 g/liter), EPN – methyl parathion EC (360 + 360 g/liter), fenvalerate EC (288 g/liter), flucythrinate (AC 222,705) EC (300 g/liter), fluvalinate EC (240 g/liter), methomyl EC (216 g/liter), methyl parathion EC (480 g/liter), permethrin EC (240 g/liter and 384 g/liter), prophenofos EC (719 g/liter), sulprofos EC (719 g/liter), thiodicarb EC (500 g/liter), toxaphene EC (719 g/liter), toxaphene – methyl parathion EC (719 + 360 g/liter), and O-[4-(4-chlorophenyl)thiophenyl] O-ethyl S-propyl phosphorothioate (RH-0994) EC (480 g/liter).

Agronomic practices recommended for cotton production in Tennessee were used in bollworm control experiments conducted from 1980 through 1982. Materials were tested in fields of 'Stoneville 213' or 'Hancock' cotton planted in late April or early May. Early-season insect controls were applied to these fields as required. Plots were four rows wide (96 - 102 cm spacing) and 10.7 - 15.2 m long. Treatments were applied with a four-row CO₂ pressurized boom which was attached to an IH 660 high clearance sprayer. The boom, with three hollow-cone nozzles per row, was operated at 2.8 kg/cm² and 4.8 km/h and delivered ca. 87.8 liters total spray/ha. Treatments, replicated at least 4 times in a randomized complete block design, were applied as the degree of infestation dictated. Efficacy and yield data were taken from the two center rows of each plot. Plots were machine harvested twice with a modified spindle picker. Gin turnout was determined by ginning first-harvest samples on a modified commercial gin at the West Tennessee Experiment Station, Jackson, TN. Classer's and fiber data were determined by the Board of Cotton Examiners, USDA, Agricultural Marketing Service, Memphis, TN, from the ginned first-harvest samples. Data were analyzed by analysis of variance and means separated by Duncan's New Multiple Range Test where appropriate (P = 0.05).

**RESULTS**

Although several cotton pests were present in these tests, the only one considered of economic importance was the bollworm, *H. zeae*. Occasionally moths of the tobacco budworm, *H. virescens*, were observed in these plots.

Bollworm pressure in Test 1 was heavy beginning 8 August (95 eggs, 40 larvae/100 terminals). Egg numbers declined, but larval numbers remained high on 13 August (4 eggs, 48 larvae/100 terminals). Larval numbers declined by 18 August to 12 larvae/100 terminals. Pyrethroid-, thiodicarb-, and RH-0994-treated plots had significantly less boll damage 22 and 27 August than the methyl parathion-treated plots, but were not different from plots treated with EPN-methyl parathion (Table 1). Damage in the sulprofos-treated plot was significantly greater (P < 0.05).
Table 1. Bollworm damage, cotton yields, maturity, and fiber characteristics following treatment with bollworm insecticides in West Tennessee, 1980 - 1982.

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Rate (kg AI/ha)</th>
<th>Bollworm damaged squares</th>
<th>Lint yield (kg/ha)</th>
<th>% First harvest</th>
<th>Gin turnout</th>
<th>Classer's Grade or Code No.</th>
<th>Staple in 32s</th>
<th>Microaire</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test 1. (3 application, 8/4-8/19, 1980)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenvalerate</td>
<td>0.11</td>
<td>0.25 a†</td>
<td>834</td>
<td>88.0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Thiodicarb</td>
<td>0.84</td>
<td>1.00 a</td>
<td>883</td>
<td>86.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flucythrinate</td>
<td>0.04</td>
<td>2.00 a</td>
<td>833</td>
<td>87.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Permethrin 240</td>
<td>0.11</td>
<td>2.75 a</td>
<td>893</td>
<td>90.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH-0994</td>
<td>0.84</td>
<td>6.00 ab</td>
<td>877</td>
<td>89.9</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permethrin 384</td>
<td>0.11</td>
<td>6.25 ab</td>
<td>868</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>EPN-methyl parathion †</td>
<td>0.84 + 0.84</td>
<td>6.25 ab</td>
<td>842</td>
<td>85.7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Acephate</td>
<td>0.84</td>
<td>11.00 bc</td>
<td>796</td>
<td>88.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulprofos</td>
<td>0.84</td>
<td>14.00 c</td>
<td>844</td>
<td>89.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Methyl parathion</td>
<td>1.12</td>
<td>15.75 c</td>
<td>798</td>
<td>88.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated check</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test 2. (5 applications, 8/4-9/11, 1981)</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Cypermethrin 300</td>
<td>0.04</td>
<td>0.00 a†</td>
<td>941</td>
<td>85.7</td>
<td>31.1</td>
<td>82†</td>
<td>34</td>
<td>3.2</td>
</tr>
<tr>
<td>Cypermethrin 360</td>
<td>0.07</td>
<td>0.25 ab</td>
<td>872</td>
<td>82.6</td>
<td>30.2</td>
<td>82</td>
<td>34</td>
<td>3.4</td>
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<td>Permethrin 384</td>
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<td>0.00 a</td>
<td>831</td>
<td>83.6</td>
<td>30.0</td>
<td>82</td>
<td>35</td>
<td>3.2</td>
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<tr>
<td>Permethrin 240</td>
<td>0.11</td>
<td>0.25 ab</td>
<td>818</td>
<td>81.3</td>
<td>29.7</td>
<td>SGO+</td>
<td>35</td>
<td>3.2</td>
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<tr>
<td>Flucythrinate</td>
<td>0.04</td>
<td>1.00 a</td>
<td>812</td>
<td>83.1</td>
<td>30.1</td>
<td>82</td>
<td>35</td>
<td>3.0</td>
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<tr>
<td>Fenvalerate</td>
<td>0.11</td>
<td>0.00 a</td>
<td>797</td>
<td>79.4</td>
<td>28.7</td>
<td>SGO</td>
<td>34</td>
<td>3.2</td>
</tr>
<tr>
<td>RH-0994</td>
<td>0.84</td>
<td>1.25 cd</td>
<td>766</td>
<td>85.2</td>
<td>30.4</td>
<td>SGO</td>
<td>35</td>
<td>3.3</td>
</tr>
<tr>
<td>Fenvalerate + methomyl</td>
<td>0.06 + 0.14</td>
<td>0.25 ab</td>
<td>759</td>
<td>78.6</td>
<td>28.8</td>
<td>82</td>
<td>34</td>
<td>3.3</td>
</tr>
<tr>
<td>Methyl parathion</td>
<td>1.12</td>
<td>1.25 cd</td>
<td>758</td>
<td>75.8</td>
<td>28.2</td>
<td>82</td>
<td>34</td>
<td>3.4</td>
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<tr>
<td>Thiodicarb</td>
<td>0.50</td>
<td>0.50 a-c</td>
<td>750</td>
<td>80.6</td>
<td>29.2</td>
<td>82</td>
<td>35</td>
<td>3.2</td>
</tr>
<tr>
<td>Flucythrinate</td>
<td>0.028</td>
<td>0.00 a</td>
<td>724</td>
<td>76.5</td>
<td>28.6</td>
<td>82</td>
<td>35</td>
<td>3.2</td>
</tr>
<tr>
<td>RH-0994 + methomyl</td>
<td>0.56 + 0.14</td>
<td>0.25 ab</td>
<td>724</td>
<td>80.3</td>
<td>28.4</td>
<td>82</td>
<td>33</td>
<td>3.4</td>
</tr>
<tr>
<td>Toxaphene + fenvalerate</td>
<td>2.24 + 0.06</td>
<td>1.00 cd</td>
<td>711</td>
<td>77.6</td>
<td>27.7</td>
<td>82</td>
<td>34</td>
<td>3.4</td>
</tr>
<tr>
<td>Fenvalerate + chlordimeform</td>
<td>0.06 + 0.14</td>
<td>0.00 a</td>
<td>690</td>
<td>75.8</td>
<td>28.0</td>
<td>82</td>
<td>33</td>
<td>3.2</td>
</tr>
<tr>
<td>Product Combination</td>
<td>Conc.</td>
<td>Yield (kg/ha)</td>
<td>Test 3 (3 applications, 8/20-9/1, 1982)</td>
<td>9/9-9/22</td>
<td>Percent</td>
<td>Rate, mg/l</td>
<td></td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Methyl parathion +</td>
<td>1.12 + 0.14</td>
<td>0.25 ab</td>
<td>3.00 a-c</td>
<td>672 c-f</td>
<td>74.0</td>
<td>27.3</td>
<td>82</td>
<td>33</td>
</tr>
<tr>
<td>methomyl</td>
<td>0.84</td>
<td>0.75 a-c</td>
<td>5.67 cd</td>
<td>648 c-f</td>
<td>74.3</td>
<td>28.1</td>
<td>82</td>
<td>33</td>
</tr>
<tr>
<td>Profenofos</td>
<td>0.84</td>
<td>1.00 b-d</td>
<td>3.00 a-c</td>
<td>632 d-f</td>
<td>77.5</td>
<td>24.9</td>
<td>82</td>
<td>33</td>
</tr>
<tr>
<td>Sulprofos</td>
<td>0.84</td>
<td>0.25 ab</td>
<td>2.00 ab</td>
<td>615 ef</td>
<td>74.9</td>
<td>27.6</td>
<td>82</td>
<td>34</td>
</tr>
<tr>
<td>EPN-methyl parathion</td>
<td>0.84</td>
<td>1.12 ab</td>
<td>5.00 b-d</td>
<td>585 f</td>
<td>75.2</td>
<td>27.8</td>
<td>82</td>
<td>34</td>
</tr>
<tr>
<td>Toxaphene-methyl parathion</td>
<td>3.90 + 1.90*</td>
<td>0.75 a-c</td>
<td>5.00 b-d</td>
<td>585 f</td>
<td>75.2</td>
<td>27.8</td>
<td>82</td>
<td>34</td>
</tr>
<tr>
<td>Untreated check</td>
<td>–</td>
<td>1.75 d</td>
<td>9.67 e</td>
<td>584 f</td>
<td>77.5</td>
<td>27.9</td>
<td>GO+</td>
<td>34</td>
</tr>
</tbody>
</table>

Test 3. (3 applications, 8/20-9/1, 1982) | 9/9-9/22

- Cyfluthrin 0.029 | 1.50 ab§ | 1734 | 81.9 | 35.2 | LM | 36 | 4.0 |
- Cypermethrin 360 | 0.04 | 1.00 ab | 1637 | 82.9 | 34.2 | LM | 35 | 4.0 |
- Flucythrinate 0.04 | 2.25 ab | 1595 | 82.0 | 32.7 | LM | 35 | 4.0 |
- Permethrin 384 | 0.11 | 1.00 ab | 1594 | 80.9 | 33.8 | LM | 35 | 3.9 |
- Cypermethrin 300 | 0.07 | 2.50 ab | 1590 | 80.3 | 34.0 | LMLtSp | 35 | 3.8 |
- Flucythrinate 0.028 | 2.25 ab | 1578 | 81.3 | 33.7 | LMLtSp | 36 | 3.8 |
- EPN-methyl parathion 0.84 + 0.84 | 2.25 ab | 1574 | 83.8 | 33.9 | LMLtSp | 35 | 4.0 |
- Cypermethrin 300 | 0.04 | 3.50 ab | 1561 | 84.0 | 34.7 | LM LtSp | 36 | 3.9 |
- Permethrin 240 | 0.11 | 4.00 bc | 1555 | 79.5 | 33.8 | LM | 35 | 4.1 |
- Sulprofos 0.84 | 3.50 ab | 1553 | 79.4 | 33.6 | LM | 35 | 3.9 |
- Cypermethrin 360 | 0.07 | 0.50 a | 1543 | 83.1 | 34.3 | LM LtSp | 35 | 3.8 |
- Fenvalerate + acephate 0.06 + 0.43 | 2.50 ab | 1540 | 80.4 | 34.1 | LM LtSp | 35 | 3.8 |
- Fenvalerate 0.11 | 0.50 a | 1530 | 81.3 | 34.2 | LM | 35 | 3.9 |
- Profenofos 0.84 | 1.00 ab | 1519 | 80.1 | 32.9 | LM | 36 | 4.1 |
- Fenvalerate + methomyl 0.06 + 0.14 | 2.00 ab | 1487 | 79.1 | 33.2 | LM | 36 | 3.8 |
- Thiodicarb 0.50 | 2.25 ab | 1476 | 78.6 | 33.8 | LMLtSp | 35 | 4.0 |
- Cypermethrin 300 | 0.02 | 1.25 ab | 1454 | 79.4 | 33.2 | LM LtSp | 35 | 3.8 |
- Cyfluthrin 0.012 | 2.50 ab | 1411 | 78.7 | 32.6 | LM LtSp | 36 | 3.9 |
- Flucythrinate 0.04 | 3.00 ab | 1407 | 74.9 | 32.2 | LM LtSp | 35 | 4.1 |
- Untreated check | – | 6.75 c | 1432 | 87.3 | 33.5 | LM | 35 | 3.9 |

*Means followed by the same letter are not significantly different (P > 0.05), by DMRT. Absence of letters indicates nonsignificance. Classer's and gin turnout data could not be analyzed statistically.
†Percent.
‡No. per 4 row meter.
§No. per 1.5 row meter.
∥Code No.: 32 — below grade.
*Rate reduced to 2.24 + 1.12 on 11 September.
than in plots treated with new compounds and EPN-methyl parathion. Damage in
the sulprofos-treated plot was not significantly different from that in the methyl
parathion- and acephate-treated plots but was significantly less than in the
untreated check. No significant yield differences ($P > 0.05$) occurred at first or
total harvest. Maturity was not affected by any treatment.

Bollworm pressure in Test 2 on 3 August was moderate compared to Test 1
the previous year (20 eggs, 10 larvae/100 terminals). Pressure declined by 26
August to 10 eggs and 8 larvae/100 terminals. By 9 September, the damaged
square level in the untreated check was 13% and 5.7% of the squares were
infested with larvae. Square damage in most treated plots was significantly less
than that in the untreated check. Square damage in plots treated with the high
rates of pyrethroids was significantly less than that in the methyl parathion-treated
plots, but not in the EPN-methyl parathion-treated plots.

Compared to the untreated check, boll damage was reduced by all treatments
except RH-0994 + methomyl. All treatments except methyl parathion, RH-0994 +
methomyl, profenofos, and toxaphene-methyl parathion provided protection equal
to the best treatment.

In Test 2 in 1981, cypermethrin (300EC) produced the highest lint yield which
was significantly greater than from all treatments except first- and second-generation
pyrethroids used at the high rates and RH-0994. Only yields from high-rate
pyrethroid treatments were significantly greater than from the untreated check. In
contrast to previous experiments (unpublished data and Test 1), yields resulting
from treatment with the higher rate of pyrethoids (except fenvalerate) were
significantly greater than from the standard EPN-methyl parathion. However,
yields from most pyrethroid treatments were not significantly different from the
other standard, methyl parathion.

Maturity values ranged from 85.2 to 74.0%, the lower value coming from the
methyl parathion + methomyl treatment. Delayed maturity and yield reductions
occurred following full season applications of methyl parathion (Bradley and Corbin
1974). Even when used only in mid to late season, methyl parathion, compared to
pyrethroids, appeared to delay maturity (Pfrimmer 1979). Although these data
tend to support a delayed maturity since percent first harvest values for all
treatments containing methyl parathion were 75% or less and values from high-
rate pyrethroid treatments were 79% or more, the differences were not statistically
significant.

Gin turnout values averaged 6.5% lower in 1981 compared to unpublished
1980 values and 1982 values in Test 3. Although staple lengths were good,
averaging 34, micronaire values were low, indicating moisture stress during fiber
maturation. All micronaire values were below 3.5. Discounts are imposed on the
grower if micronaire values do not fall in the acceptable range of 3.5 to 4.9
(Hopkins and Moore 1980). Cotton from only three treatments were of sufficient
quality to receive the minimum grades.

Bollworm pressure in Test 3 in 1982 was less than in 1981 (damaged boll
counts in the untreated check averaged 6.75 compared to 9.67). Two applications
were made when larval numbers just exceeded the threshold of 4/100 terminals
and the third applied at just below the threshold.

Bollworm damage in all treatments except permethrin 240EC was significantly
different from the untreated check. Damage in cypermethrin 360EC- (0.06 rate)
and fenvalerate-treated plots was significantly less than that observed in the
permethrin 240EC and untreated check plots. No significant yield differences ($P > 0.05$) occurred at first or total harvest and treatment yields were not significantly different from the untreated check.

Crop maturity was not significantly affected by treatment. Gin turnout, grades, and fiber properties were all acceptable in this experiment and no treatment effects were noted.

Three-year average lint yields from treatments common in 1980-1982 tests and registered for use in 1983 are presented in Table 2. Yields from pyrethroid-treated plots were not significantly different from those treated with EPN-methyl parathion or sulprofos, but were significantly greater than from the untreated check. Yields from plots treated with EPN-methyl parathion and sulprofos were not significantly different from those of the untreated check.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (kg AI/ha)</th>
<th>Lint yield in kg/ha*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permethrin 240</td>
<td>0.11</td>
<td>1089 a</td>
</tr>
<tr>
<td>Flucythrinate</td>
<td>0.04</td>
<td>1080 a</td>
</tr>
<tr>
<td>Permethrin 384</td>
<td>0.11</td>
<td>1098 a</td>
</tr>
<tr>
<td>Fenvalerate</td>
<td>0.11</td>
<td>1054 a</td>
</tr>
<tr>
<td>EPN-methyl parathion</td>
<td>0.84 + 0.84</td>
<td>1010 ab</td>
</tr>
<tr>
<td>Sulprofos</td>
<td>0.84</td>
<td>1010 ab</td>
</tr>
<tr>
<td>Untreated check</td>
<td>-</td>
<td>928 b</td>
</tr>
</tbody>
</table>

*Means followed by the same letter are not significantly different ($P > 0.05$), by DMRT.

DISCUSSION

Results from these experiments indicate that treatment for suppression of bollworms under Tennessee conditions will not always provide a yield increase. Several factors, such as crop stage, time of initial infestation, pest population density, and the length of time crop is susceptible to damage, must be considered.

The potential for heavy losses can readily be seen by comparing the experiments of 1980 and 1981. In both cases, bollworms had invaded the crop before mid-August. The stage of crop was such that fruiting might continue and bolls already set were still susceptible to bollworm damage. Failure to treat in 1981 would have resulted in significant losses depending on the insecticide which could have been selected. The bollworm control program which utilized cypermethrin 300EC at 0.04 kg AI/ha produced a 248 kg yield increase over the untreated check, while toxaphene-methyl parathion produced a nonsignificant increase of 1 kg. Failure to treat in 1980 would not have resulted in significant losses, probably due to decreased bollworm pressure and the lack of crop susceptibility, neither of which could be known when treatments were initiated. In 1981, none of the three standards (methyl parathion, EPN-methyl parathion, or toxaphene-methyl parathion) provided yield increases which were significantly different from the untreated check. High-rate pyrethroid treatments, however, provided significant yield increases.
These studies indicate that, under these experimental conditions, the use of new insecticides for bollworm control did not affect maturity. Although treatments did not show any consistent effect on lint quality, differences in micronaire were as great as the significant differences obtained by Hopkins and Moore (1980), even though all micronaire values were within acceptable limits.

A high level of management is necessary for cotton producers to achieve maximum returns. Bollworm management decisions require a knowledge of the stage of crop maturity, the species and levels of insects present, and methods necessary to suppress pest populations.

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REFERENCES CITED

DuRant, J. A. 1979. Effectiveness of selected insecticides and insecticide combinations against the bollworm, tobacco budworm, and beet armyworm on cotton. J. Econ. Entomol. 72: 610-613.