CORN EARWORM CONTROL — SPRAYING METHODS

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The rapid rise in the acreage planted to sweet corn in Florida began with the growing season of 1947-48. Scruggs (1950) reports 6,000 acres for that year, 12,000 acres for the following season and a doubling of the acreage again during the 1949-50 season. Prior to the 1947-48 season small acreages of various varieties were planted in many of the vegetable growing areas of the State. This very rapid increase in sweet corn acreage is attributed to the introduction of hybrid varieties adapted to Florida growing conditions and the development of DDT as a control measure for the corn earworm (Heliothis armigera Hbn.).

Russell, in 1944, reported on the first use in Florida of DDT dust for the control of Heliothis armigera. In 1945 Blanchard and Satterwait reported on their experiments with DDT in oil solutions and in emulsions, and in June 1949 Blanchard et al. made recommendations for field applications of a white mineral oil and 25 percent DDT emulsion for the control of corn earworm on sweet corn. Kelsheimer et al. published, in 1950, results of their experimental work and recommended the use of a five percent DDT dust.

During December 1950 Dr. E. G. Kelsheimer, N. C. Hayslip and the writer decided to devote the coming season to a study of the use of oil and DDT emulsion. An experimental plan of procedure was drawn up. The problem was divided into three phases, with Kelsheimer to study number and timing of spray applications at Bradenton; Hayslip to study insecticide formulations at Ft. Pierce, and the writer to study spraying methods at Sanford. Later W. H. Thames was asked to study number and timing of spray applications at Belle Glade.

This paper reports on the experimental work conducted at Sanford during the past spring (1951).

METHODS: All of the spray treatments were applied by a high pressure Myers spray pump with a 25-gallon tank mounted on a Farmall model A tractor. Agitation was obtained by carrying the overflow to the bottom of the tank by means of a half-inch pressure hose. This arrangement gave adequate agitation,

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1 Florida Agricultural Experiment Station Journal Series, No. 20.
because at no time during the spraying operations was free oil observed on the top of the spray solution in the tank. A four-row boom, adjusted to the height of the ears, delivered the spray to the plants. This spray boom was so constructed that it was possible to use five nozzles to each row. One nozzle was placed directly over the row and sprayed straight down, one on each side of the row about six inches below the top nozzle, and another on each side of the row and about 18 inches below the first pair of side nozzles. These side nozzles could be turned through an arc of 180 degrees. Thus it was possible to direct the spray at any angle or height required to reach the silks.

Two plantings of corn were made. The first was Ioana, planted March 18, and the second was Calumet planted March 26, 1951. The plots were four rows wide, 40 feet long and the rows 30 inches apart, with about 12-inch spacings between plants in the row. Alleyways 12 feet wide separated each block and two rows were skipped between each two plots to allow for driving the tractor along one side of each plot. Each treatment was replicated six times. The Ioana corn was treated April 26 and May 2 for budworm control with one quart of 25\% DDT emulsion per 100 gallons of spray, applying about 85 gallons of spray material per acre. The Calumet corn was similarly treated for budworm control but the dates of these treatments were not recorded.

The Ioana corn began to tassel May 2 and the Calumet on May 21. First silks appeared in the Ioana planting May 7 and the first spray applications were made May 8. First silks appeared in the Calumet planting May 24 and the first spray applications followed the next day. Spray applications were spaced at three-day intervals, with a total of four for the Ioana and five for the Calumet plantings. The 25\% DDT emulsion was prepared in the laboratory, using the following formula:

\[
25\% \text{ DDT (by weight)} \quad \text{Setting point } 89^\circ\text{C.}
\]

\[
72\% \text{ Xylene (by weight)}
\]

\[
3\% \text{ Triton x 155 (by weight)}
\]

The mineral oil was Blandol, supplied by L. Sonneborn Sons, Inc., having the following specifications: water white, U.S.P., viscosity 90° to 95° Seyboldt. The basic mixture consisted of 3 quarts of the above described 25\% DDT emulsion, 2.5 gallons of Blandol and water to make 100 gallons of spray. Details of the treatments are given in Table 1.
TABLE 1.—DETAILED EXPLANATION OF TREATMENTS APPLIED TO SWEET CORN PLOTS AT SANFORD, FLORIDA, DURING THE SPRING OF 1951.

Section A. Amount of liquid spray per acre.
Basic formula composed of 3 quarts of 25% DDT emulsion, 2.5 gallons of Blandol in 100 gallons of water using a pump pressure of 100 pounds per square inch, and 4 nozzle per row. In each case the plan was to apply 3 quarts of 25% DDT emulsion and 2.5 gallons of oil per acre. The spray solutions were mixed on the assumption that the amount of liquid applied would be approximately the same as the nozzle rating.

Treatment Number
1. Teejet Nozzle No. 650050, rated at 15 gallons per acre.
2. Teejet Nozzle No. 6501, 25 gallons per acre.
3. Teejet Nozzle No. 6502, 50 gallons per acre.
4. Teejet Nozzle No. 6503, 100 gallons per acre.
5. 5% DDT dust applied by rotary hand duster.

Section B. Kind of nozzles.
All plots treated with spray composed of 3 quarts of 25% DDT emulsion, 2.5 gallons of Blandol in 100 gallons of water, pump pressure of 100 pounds per square inch and 4 nozzles per row.

Treatment Number
1. Teejet Hollow Cone Nozzle.
3. Teejet Flat Fan No. 6503.
4. Tiger Nozzle (Manufactured by Field Force Sprayer Co.).
5. Untreated Check.

Section C. Number of Teejet Flat Fan No. 6503 Nozzles per row.
All plots treated with same formula and pressure as used in Section B.

Treatment Number
1. Two nozzles per row (low and directed downward).
2. Three nozzles per row (2 as in Treatment No. 1 and other over row).
3. Four nozzles per row (1 high and 1 low each side of row).
4. Five nozzles per row (4 as in Treatment No. 3 and 1 over row directed straight down).

Section Da. Operating pressure.
All plots treated with same formula as used in Section B., with 4 nozzles per row arranged as in Section C-3. The Teejet Flat Fan No. 6503 was the nozzle used.

Treatment Number
1. 60 pounds per square inch.
2. 100 pounds per square inch.
3. 200 pounds per square inch.
Section Db. Operating pressure.

All factors same as in Section Da except that the Teejet disc type nozzle was used.

Treatment Number
1. 60 pounds per square inch.
2. 100 pounds per square inch.
3. 200 pounds per square inch.

Counts of the number of eggs on silks of twenty ears of corn selected at random from each treatment were made on May 15 in the Ioana planting and on May 26 for Calumet. On these dates the percent of silks upon which earworm eggs were found ranged from 20 to 70 in the Ioana planting and from 50 to 90 in the Calumet planting.

RESULTS AND DISCUSSION: A record was made of the amount of spray applied to the six plots of each treatment at the time of the second spraying of the Ioana planting and last spraying of the Calumet planting. Since the tractor was operated in the same gear and presumably at the same speed it was assumed that the amount of liquid applied to the plots of each treatment would remain constant. A comparison of the data presented in Table 2 for the Ioana planting and Table 3 for the Calumet planting shows a wide variation in the amounts of liquid recorded for the same treatment in the two plantings. One explanation for this variation is that slight errors in the measurement of the liquid used would be magnified when calculated on an acre basis.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Liquid Spray Applied, Gals.</th>
<th>Oil, Gals.</th>
<th>Tech. DDT, Lbs.</th>
<th>Worm Free Ears No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A. Amount of liquid spray per acre.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Teejet No. 650050 ..........</td>
<td>72</td>
<td>12.0</td>
<td>7.20</td>
<td>120</td>
<td>50.0</td>
</tr>
<tr>
<td>2. Teejet No. 6501 ..........</td>
<td>81</td>
<td>8.1</td>
<td>4.86</td>
<td>216</td>
<td>90.0</td>
</tr>
<tr>
<td>3. Teejet No. 6502 ..........</td>
<td>144</td>
<td>5.2</td>
<td>3.12</td>
<td>150</td>
<td>62.5</td>
</tr>
<tr>
<td>4. Teejet No. 6503 ..........</td>
<td>144</td>
<td>3.6</td>
<td>2.16</td>
<td>193</td>
<td>80.4</td>
</tr>
<tr>
<td>L.S.D. (19-1) ...............</td>
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<td></td>
<td></td>
<td>24</td>
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TABLE 2.—AMOUNTS OF LIQUID SPRAY, OIL AND TECHNICAL DDT APPLIED TO PLOTS OF THE IOANA PLANTING, CALCULATED ON AN ACRE BASIS, AND THE NUMBER OF WORM FREE EARS HARVESTED.
Section B. Kinds of nozzles.

1. Teejet Hollow Cone ........................................ 198 4.95 2.97 172 71.6
2. Christian .................................................. 108 2.70 1.62 143 59.6
3. Teejet Flat Fan .......................................... 99 2.47 1.48 173 72.1
4. Tiger ...................................................... 189 4.72 2.83 131 54.6
5. Check ...................................................... 9 3.7
   L.S.D. (19-1) ................................................. 28

Section C. Number of Teejet Flat Fan Nozzles per row.

1. Two ......................................................... 90 2.25 1.35 62 25.8
2. Three .................................................... 108 2.70 1.62 165 68.7
3. Four ...................................................... 126 3.15 1.89 192 80.0
4. Five ...................................................... 198 4.95 2.97 201 83.7
   L.S.D. (19-1) ................................................. 18

Section Da. Operating pressure, 4 flat fan nozzles.

1. 60 lbs./sq. in. ........................................... 117 2.92 1.75 192 80.0
2. 100 lbs./sq. in. ....................................... 146 3.65 2.19 185 77.1
3. 200 lbs./sq. in. ....................................... 207 5.17 3.10 209 87.1

Section Db. Operating pressure, 4 Teejet disc nozzles.

1. 60 lbs./sq. in. ........................................... 107 44.6
2. 100 lbs./sq. in. ....................................... 72 1.80 1.08 114 47.5
3. 200 lbs./sq. in. ....................................... 90 2.25 1.35 155 64.6
   Differences in Sections Da and Db not significant.

TABLE 3.—AMOUNTS OF LIQUID SPRAY, OIL, AND TECHNICAL DDT APPLIED TO PLOTS OF THE CALUMET PLANTING, CALCULATED ON AN ACRE BASIS, AND THE NUMBER OF WORM FREE EARS HARVESTED.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Liquid Spray Applied, Gals.</th>
<th>Oil, Gals.</th>
<th>Tech. DDT, Lbs.</th>
<th>Worm Free Ears No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A. Amount of liquid spray per acre.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Teejet No. 650050</td>
<td>108</td>
<td>2.70</td>
<td>1.62</td>
<td>46</td>
<td>19.2</td>
</tr>
<tr>
<td>2. Teejet No. 6501</td>
<td>144</td>
<td>3.60</td>
<td>2.16</td>
<td>100</td>
<td>41.7</td>
</tr>
<tr>
<td>3. Teejet No. 6502</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>39</td>
<td>16.3</td>
</tr>
<tr>
<td>4. Teejet No. 6503</td>
<td>135</td>
<td>3.37</td>
<td>2.02</td>
<td>20</td>
<td>8.7</td>
</tr>
<tr>
<td>L.S.D. (19-1)</td>
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<td></td>
<td></td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

Section B. Kinds of nozzles.

1. Teejet Hollow Cone ........................................ 171 4.27 2.56 72 30.0
2. Christian .................................................. 153 3.82 2.29 33 13.7
3. Teejet Flat Fan .......................................... 135 3.37 2.02 25 10.4
4. Tiger ...................................................... 144 3.60 2.16 13 5.4
5. Check ...................................................... 5 2.1
   L.S.D. (19-1) ................................................. 22
Section C. Number of Teejet Flat Fan Nozzles per row.

<table>
<thead>
<tr>
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<th></th>
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<th>7</th>
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<tbody>
<tr>
<td>1.</td>
<td>Two</td>
<td>162</td>
<td>4.05</td>
<td>2.43</td>
</tr>
<tr>
<td>2.</td>
<td>Three</td>
<td>162</td>
<td>4.05</td>
<td>2.43</td>
</tr>
<tr>
<td>3.</td>
<td>Four</td>
<td>135</td>
<td>3.37</td>
<td>2.02</td>
</tr>
<tr>
<td>4.</td>
<td>Five</td>
<td>198</td>
<td>4.95</td>
<td>2.97</td>
</tr>
<tr>
<td>L.S.D. (19-1)</td>
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<td></td>
<td></td>
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Section Da. Operating pressure, 4 flat fan nozzles.

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<th></th>
<th></th>
<th>94</th>
<th>39.2</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>60 lbs./sq. in.</td>
<td>......</td>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td>2.</td>
<td>100 lbs./sq. in.</td>
<td>135</td>
<td>3.37</td>
<td>2.02</td>
</tr>
<tr>
<td>3.</td>
<td>200 lbs./sq. in.</td>
<td>......</td>
<td>......</td>
<td>......</td>
</tr>
</tbody>
</table>

Section Db. Operating pressure, 4 Teejet disc nozzles.

<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th>3</th>
<th>1.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>60 lbs./sq. in.</td>
<td>81</td>
<td>2.02</td>
<td>1.21</td>
</tr>
<tr>
<td>2.</td>
<td>100 lbs./sq. in.</td>
<td>99</td>
<td>2.47</td>
<td>1.48</td>
</tr>
<tr>
<td>3.</td>
<td>200 lbs./sq. in.</td>
<td>108</td>
<td>2.70</td>
<td>1.62</td>
</tr>
</tbody>
</table>

Differences in Sections Da and Db not significant.

An additional treatment consisted of 5% DDT dust applied by a rotary type hand duster with the nozzle directed slightly above the silks of the upper ears of corn. Applications were started in the early morning of the same day as the first spray applications and continued at 2-day intervals for a total of six applications for the Ioana planting and seven applications for the Calumet planting. It is interesting to note that for the Ioana planting 50 percent of the ears harvested were worm-free, as compared with 3.7 percent from the untreated check, and for the Calumet planting 8.7 percent worm-free ears were harvested from the DDT dust plots as compared with 2.1 percent worm free ears from the check.

CONCLUSIONS: From the data presented it is concluded that the Teejet nozzle No. 650050 had too small an orifice, breaking the spray droplets into such small particles that there was an insufficient deposit of the oil-DDT on the silks. In both the Ioana and the Calumet planting the highest number of worm-free ears was harvested from plots treated with the Teejet Flat Fan nozzle No. 6501.

In the Ioana planting the Teejet Hollow Cone nozzle and the Teejet Flat Fan No. 6503 were equally effective. In the Calumet planting the Teejet Hollow Cone nozzle was the most effective. Both of these are wide-angle nozzles. That is, the spray is delivered over a wide area, increasing the chances of wetting all of the silks.
There was no significant difference between the number of worm-free ears harvested from the plots treated with 4 and 5 nozzles to the row in the Ioana planting. Five nozzles to the row was the most effective arrangement in the Calumet planting. Differences between the various pressures used were not significant in either the Ioana or the Calumet plantings. However, the highest number of worm-free ears was harvested from plots treated with the Teejet Flat Fan nozzle No. 6503 in both plantings.

After the third application of spray materials the treated plots of the Ioana planting were noticeably yellow in color when compared with the untreated plots. No differences between treated and untreated plots could be detected after five applications in the Calumet planting. Total yield figures for both plantings did not indicate a reduction in yield due to the effects of the oil-DDT treatments.

**LITERATURE CITED**


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