COMPARISON OF INSECTICIDE SPRAYS AND GRANULES FOR CORN BUDWORM CONTROL

DALTON S. HARRISON AND
EMMETT D. HARRIS, JR.

One of the limiting factors to U. S. Fancy sweet corn production in the Everglades is damage by the corn budworm. Adequate control of the corn budworm, a complex of the corn earworm, Heliothis zea (Boddie), and the fall armyworm, Laphygma frugiperda (J. E. Smith), in the Everglades involves more than the use of carefully selected insecticide materials at appropriate dosages. The method of application may be as important as the selection of an appropriate insecticide. Poor control often results in losses of thousands of dollars from yield reduction and building up of an insect population that will later damage the ears.

The general recommendation for corn budworm control in the Everglades is a DDT or toxaphene spray (Anonymous 1956). Application usually is made with one to three nozzles directly over the row and one to three nozzles on each side. Gallonage per acre ranges from 50 to 150, depending on the height of the plants. Application is made in combination with fungicides, otherwise fewer nozzles probably could be used and consequently a lower gallonage could be applied over most of the season.

Sprays may be applied semi-weekly, weekly, or bi-weekly, depending upon the level of the budworm infestation and success in control.

Insecticide granules have been widely and effectively used for the control of the European corn borer, Pyrausta nubialis (Horn.), in other areas (Anonymous 1958). Because this insect feeds in the whorl on unfolded leaves in the same manner as the budworm, it seemed desirable to compare granules with conventional insecticide sprays used in the Everglades.

The primary purpose of this experiment was to compare sprays and granules for budworm control. Two types of granule applicators, wettable powder sprays, emulsions, and toxaphene and DDT were compared. To make these comparisons each insecticide was applied as a wettable powder spray, emulsion, and granules. The two machines that were compared for granule applications were the Gandy (HI-LO Model 412-6) granule applicator and the Noble (Model T-400) DDT applicator. Eight treatments were compared (Table 1).

MATERIALS AND METHODS

Golden Security corn was planted March 31, 1958, on Everglades peaty muck and broadcast fertilized with 1000 lb./A of 0-8-24, plus copper, zinc, manganese, and boron. Heptachlor was applied at four pounds per acre in the fertilizer. Rows were 36 inches apart and the plants thinned to 12 inches in the drill. The experimental plan was a randomized complete block design, with multiple checks. Every third plot was not treated so that each treatment was bordered on one side by an
untreated check. Each treatment was applied to 4-row plots that were 50-feet in length and replicated four times. Plants in a single row between plots were cut down before insecticide treatments were applied. This rogued row served as a buffer area between plots and as a path for the 2-row sprayer.

Both granule applicators are constructed to treat 4 rows at a time; however, the Noble and Gandy vary in principle of operation. Both machines are the "trail-behind" type, each being powered by a chain drive. In this experiment both applicators were pulled by a high clearance spray rig. The feed mechanism of the Gandy (Hi-Lo Model 412-6) machine is by a rotor and cam gauge. Feed openings are on a 6-inch spacing. Snap-on clips permit the use of any or all of the 25 openings. In this experiment only three openings per row were used, or a total of 12 openings for the four rows. Because the Gandy machine is more adapted to 42-inch rows, the three openings did not fall directly over the 36-inch rows.

The Noble machine (Model T-400) has four separate hoppers as compared to the one broadcast hopper on the Gandy. The feed mechanism is a fluted wheel forced feed. This type of feed is more positive and rates of application can be adjusted more accurately. Although the wheel tread width of both machines is set for 42-inch rows, each hopper of the Noble can be adjusted to set directly over the row, using any normal row spacing.

The two granule applicators were pulled over each plot, the wheels traveling between the outside and adjacent rows of each plot. Sprays were applied with a small self-propelled spray machine, designed and constructed at the Everglades Experiment Station for insect control research (Harrison, Genung and Harris, 1958). Four nozzles (Spraying Systems Tee Jet 8002 flat spray) were used on each row during the first insecticide application. The two overhead nozzles were 6 inches apart and aimed directly into the whorl. The remaining two nozzles were spaced one on each side of the row, 15-inches below the overhead nozzles. Pressure was held constant at 150 p.s.i. The concentration of each spray was 1 pound of actual DDT or toxaphene per 100 gallons. Gallonage was approximately 80 gallons per acre (Table 1), giving approximately 0.8 pound of actual toxicant per acre. The 10 percent granules were applied at 8 lbs. per acre or 0.8 pound of actual toxicant per acre (Table 1). The granules were Attaclay AA, RVM 30/40 mesh3 impregnated with 10% toxaphene or DDT4. Formulations used in the sprays were toxaphene 40% WP, toxaphene EC (8 lbs./gal.), DDT 50% WP, and DDT EC (2 lbs./gal.)4.

The first insecticide treatment was applied to each plot May 16, 1958, after the build up of a moderate population of budworms. The corn was in the mid-whorl stage (Batchelder, 1946).

---

1 Minerals and Chemicals Corporation.
2 Florida Agricultural Supply Company.
A second application was made May 26, ten days after the first. At that time the corn was in the early green tassel stage (Batchelder, 1946). Rates of application were 100 gallons per acre for the sprays and 10 pounds per acre for the granules, giving approximately 1 pound of actual toxicant per acre. Sprays were applied at 100 p.s.i. and one nozzle was added to each side of the row.

The plots were scored for budworm injury five days after the first insecticide application. Total and freshly injured plants were counted in each row of the four row plots. At that time the corn was in the late whorl to early green tassel stage (Batchelder, 1946). Plants per 50 feet of row averaged 46, with little variation between rows.

On May 22 a total of 40 budworms were collected from plants in the untreated outside buffer rows. All of these were found to be the fall armyworm, *Laphygma frugiperda*. The corn earworm, *Heliothis zea*, frequently causes the same type of damage but was not observed.

A hypothetical check value for each treated plot was calculated by multiplying the number of damaged plants in the check plot adjacent to the treated plot by two and adding the result to the value for the untreated check plot that was next nearest to the treated plot and dividing the sum by three. Co-variance analyses adjusted treatment means for regression of treated plots on untreated plots, to correct for differences among treated plots that were caused by variation in the distribution of the budworm population and not by the treatment. The number of damaged plants for each plot, including the hypothetical untreated check plots, was transformed to its square root and multiplied by 100 before analyses of co-variance.

**Results and Discussion**

Five days after the first application, when the number of budworm injured plants in the

Table 2. Comparison of DDT and toxaphene and methods of application for budworm control five days after first application.

<table>
<thead>
<tr>
<th>Insecticide and Method of Application</th>
<th>Average number of injured plants per plot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual number</td>
</tr>
<tr>
<td>Toxaphene Emulsion</td>
<td>23.8</td>
</tr>
<tr>
<td>Toxaphene Granules - Gandy</td>
<td>19.5</td>
</tr>
<tr>
<td>Toxaphene WP Spray</td>
<td>19.3</td>
</tr>
<tr>
<td>DDT WP Spray</td>
<td>18.0</td>
</tr>
<tr>
<td>DDT Granules - Gandy</td>
<td>11.0</td>
</tr>
<tr>
<td>Toxaphene Granules - Noble</td>
<td>12.5</td>
</tr>
<tr>
<td>DDT Emulsion</td>
<td>7.8</td>
</tr>
<tr>
<td>DDT Granules - Noble</td>
<td>6.3</td>
</tr>
</tbody>
</table>

a/ Means joined by the same line are not significantly different; means not joined by the same line are significantly different.

b/ Means adjusted for regression on untreated plots. \( r: 0.663^{**} \); \( b: 0.62 \).

c/ Number of injured plants per plot when figured from means of transformations.
treated plots were adjusted for the number of untreated plants in the hypothetical check, DDT granules applied by the Noble machine gave significantly less budworm damage than any other treatment (Table 2). When the means were not adjusted for regression on untreated plots, DDT granules applied by the Noble machine gave significantly fewer budworm damaged plants than all other treatments except DDT emulsion. Toxaphene granules applied by the Noble applicator gave significantly fewer budworm injured plants per row than all other toxaphene treatments. There were no significant differences among the other toxaphene treatments. DDT granules applied by the Gandy applicator gave significantly better results than the DDT wettable powder spray. DDT gave highly significantly better budworm control than toxaphene. The average number of damaged plants among the untreated checks was 18 per plot.

Comparison of mean squares of variance and co-variance analyses indicated that adjustment of the analysis for regression of treated plot values on untreated plot values greatly increased the precision of the experiment. The reduction of the error mean square due to regression was highly significant, as was the correlation coefficient \( r = 0.663^{**} \). The data indicated that the relative efficiency of the experiment was increased 95 percent by considering the regression of treated means on untreated means.

One day after the second or 11 days after the first insecticide application, DDT emulsion and DDT granules applied by the Noble applicator gave significantly less budworm injury than the other treatments, whether the treatment means were adjusted or unadjusted for regression on the untreated checks. When the values were unadjusted, toxaphene granules applied by the Noble machine gave signif-

Table 3. Comparison of DDT and toxaphene and methods of application for budworm control one day after second application.

<table>
<thead>
<tr>
<th>Insecticide and Methods of Application</th>
<th>Average number of injured plants per plot&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Actual number</th>
<th>Adjusted number&lt;sup&gt;b, c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxaphene WP Spray</td>
<td>30.0</td>
<td>28.4</td>
<td></td>
</tr>
<tr>
<td>Toxaphene Granules - Gandy</td>
<td>27.8</td>
<td>28.2</td>
<td></td>
</tr>
<tr>
<td>DDT WP Spray</td>
<td>24.3</td>
<td>24.6</td>
<td></td>
</tr>
<tr>
<td>Toxaphene Emulsion</td>
<td>23.8</td>
<td>22.7</td>
<td></td>
</tr>
<tr>
<td>DDT Granules - Gandy</td>
<td>25.0</td>
<td>19.8</td>
<td></td>
</tr>
<tr>
<td>Toxaphene Granules - Noble</td>
<td>19.5</td>
<td>16.2</td>
<td></td>
</tr>
<tr>
<td>DDT Emulsion</td>
<td>12.5</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>DDT Granules - Noble</td>
<td>11.0</td>
<td>9.4</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Means joined by the same line are not significantly different; means not joined by the same line are significantly different.

<sup>b</sup> Means adjusted for regression on untreated plots. \( r: 0.523^*; \) \( b: 0.37 \).

<sup>c</sup> Number of injured plants per plot when figured from means of transformations.
significantly less budworm injury than toxaphene wettable powder spray or toxaphene granules applied by the Gandy machine. With adjusted means the Noble applicator gave significantly better budworm control than all the other toxaphene treatments (Table 3). The average number of damaged plants among the untreated checks was 30 per plot.

Considering all methods of application and formulations, DDT resulted in significantly less budworm injury than toxaphene. Co-variance analysis resulted in a significant F value for comparison of methods of application, but regular analysis did not. The correlation coefficient for the regression of treated plots upon untreated plots was significant but the reduction of the error mean square due to regression was not significant.

**LITERATURE CITED**


---

**CHEMICAL CONTROL OF NEMATODES PARASITIC ON TURF AND SWEET CORN**

William Lautz

Nematologist, U. S. D. A.
Sanford

In central Florida, soil fumigation with ethylene dibromide has been extensively used for control of plant parasitic nematodes in soil to be planted to vegetables. While this method has been successful, investigations of nematicides and application methods are continuing in hopes of improving present practices. Similar work has been reported from other parts of Florida, notably by Burgis and Overman (1) who have reported good results with Mylone at 50 pounds per acre. Turf in central Florida is often damaged by nematodes and little information on control is available.

**MATERIALS AND METHODS**

For experiments with control of nematodes in field soil, plots of Leon Fine Sand located at the Central Florida Experiment Station at Sanford were used. This soil had a moisture content of 11 to 14% of the dry weight at time of treatment and a temperature at a depth of 6 inches of 80 to 85°F. Plots were 7 by 12 feet and there were 5 or 6 replications of each treatment in randomized arrangement with 23 untreated control plots. Plots were separated by 2-foot grass strips.

Nemagon liquid was applied by injection at a depth of 6 inches with application points at 12-inch intervals in rows 12 inches apart. Emulsible Nemagon, mixed with water, was applied at the rate of 4,000 gallons per acre by sprinkling on the soil surface. An additional 1,000 gallons of water was applied immediately afterward. DBCP granules were distributed over the soil surface and incorporated into the top 6 inches of soil by turning with a potato fork.

Telone was injected as described for Nemagon liquid, and PRD and Mylone were applied as suspensions as described for application of Nemagon emulsion. Two weeks after application of the chemicals, all plots were planted to sweet corn and soybean, which were frost-killed within a month. Five months later sweet corn was planted in all plots.

The effect of the chemicals on the nematode populations of the plots was measured 4 and 8 months after treatment by extracting and counting the plant-parasitic nematodes from a 200-gram soil sample made up from a composite of 4 soil cores taken with a 2-inch soil sampling tube.

Three randomized blocks, each containing 5 plots to be treated with chemicals and 2 untreated control plots were marked out on the practice fairway of the Mayfair Country Club, Sanford, Florida. Plots were 5 by 5 feet. The Nemagon emulsion was applied with a hose proportioner, which mixed it with approximately 6,500 gallons of water per acre; an additional 1,000 gallons of water was applied immediately afterward. The PRD granules to

---

1 Cooperative research of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture and the Central Florida Experiment Station.