RESULTS OF THE USE OF CONCENTRATED SPRAYS IN CITRUS GROVES IN FLORIDA

By John R. King and James T. Griffiths, Jr.
Citrus Experiment Station, Lake Alfred, Florida

During the late spring and summer of 1947, grasshoppers of the species Schistocera americana (Drury) inflicted damage on citrus groves in western Polk and southeastern Hillsborough counties in Florida. The outbreak and recommendations for grasshopper control in citrus groves were reported by Griffiths et al (1947), who recommended three insecticides: chlordane at 1½ to 2 lbs. of technical chlordane per acre, chlorinated camphene at 3½ to 4½ lbs. of toxicant per acre, and benzene hexachloride at 0.4 to 0.5 lb. of gamma isomer per acre. All three materials were used as dusts and as wettable powders. Chlordane and chlorinated camphene were also tried as emulsions. As dusts they were distributed both by airplane and by ground equipment, while as sprays, they were applied with a “Speed Sprayer.” The “Speed Sprayer” is a power machine in common use in citrus groves in Florida. It delivers the spray under low pressure through a large number of nozzles into an air stream which is set up by a large fan. The sprayer is capable of delivering enough air volume to completely replace the air in and around a tree with new air. Leaves throughout the tree are turned over and thorough coverage is obtained if the sprayer is driven slowly enough and sufficient gallonage is used. Usually the sprayer is pulled through the grove at about 1½ to 2 miles per hour.

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2 Entomologists with Florida State Plant Board and Florida Citrus Experiment Station, respectively.
During recent months considerable experimental work has been reported on the use of concentrated sprays on various crops. It appeared possible that concentrated sprays might be feasible for grasshopper control in citrus grove land. Since two different machines were available to the Citrus Experiment Station, they were tested for grasshopper control.

The Bureau of Entomology and Plant Quarantine (United States Department of Agriculture) furnished a modified Buffalo Turbine spray and dust machine. This machine had been redesigned by the Bureau as a spray machine for use in Japanese beetle control work in the eastern United States. It was capable of handling either wettable or emulsifiable materials at concentrated levels. Basically, it consisted of a pump and turbine blower. The fluid was pumped from two nozzles into the air stream under a pressure of 30 lbs. per square inch and distribution of the insecticide was dependent upon the air volume coming from the blower. In the experiments reported below two nozzles with 0.54 in. openings were used to deliver 10 gallons of emulsion per acre.

The other machine was a Hesson Microsol Generator. It was built to deliver aerosol size particles into an air stream set up by a fan and was designed for use with either emulsions or solutions. In the experiments described below, it was set to apply 10 gallons of emulsified spray per acre.

Two experiments were performed in citrus groves with these machines in August and September 1947. In both instances the spray machines were mounted on trucks which were driven at 2 to 3 miles per hour up and down each middle. The spray was directed at the lower 6 to 10 feet of the trees and at the cover crop, but no effort was made to cover the tops of the trees. Both groves were heavily infested with fourth and fifth instar nymphs.

In the first experiment, technical chlordane and chlorinated camphene were used as concentrated emulsions. With the modified Buffalo Turbine machine, chlorinated camphene was used at the rate of 4.5 lbs. of toxicant (derived from a 70% stock emulsion) per 10 gallons of emulsion, and chlordane (40% stock emulsion) was used at 1.5 lbs. of technical chlordane per 10 gallons of emulsion. These were compared with 1.5 lbs. of chlordane (40% stock emulsion) per 10 gallons of emulsion applied with the Hesson Microsol generator. In addition, a chlorinated camphene dust was included as a standard grasshopper treat-
ment. It was dusted with a conventional ground duster at 45 lbs. per acre of a 10% material (4.5 lbs. toxicant per acre). All plots were one acre in size and unsprayed acre plots served as buffers between treated plots. Results are summarized in Table 1.

In the second experiment chlordane was used with both machines at 1½, 2, and 2½ lbs. of technical chlordane per acre. As in the previous test, 10 gallons of emulsion were applied per acre. Plots were randomized in single acre plots which were adjacent to each other. Accurate pre-population counts were not made, but there was apparently a uniform population throughout the treated areas. Twenty-four and seventy-two hours after the applications, estimates of control were made. These were based on a comparison of the number of live grasshoppers remaining in the treated areas. Although dead individuals were present in all plots, the best treatment was obtained with 2½ lbs. of chlordane per acre distributed by the Buffalo machine. In general, it took an additional ½ lb. of toxicant per acre for the Hession machine to equal the Buffalo Turbine. This is in agreement with the data presented in Table 1.

These two experiments represent the first field scale trials of concentrated sprays on citrus trees by the Citrus Experiment Station in Florida. Although they demonstrated that grasshoppers could be controlled with such equipment, they also demonstrated certain weaknesses which would appear to be inherent in concentrated spray equipment.

In order to produce satisfactory control of most insects on a citrus tree, it is absolutely essential that thorough coverage of leaves be obtained. Thorough coverage implies the application of insecticide to both sides of the leaves and to the wood where insects may be found. Where properly used, conventional grove sprayers are capable of this type of coverage. Thus, where a "Speed Sprayer" was driven at the proper speed (less than 2 miles per hour), but where only 10 gallons were used on a tree that required twice that much, it was found that the insecticide was applied only to the leaves on the outside of the tree. This was in spite of the fact that at this speed there was more than ample air volume available to replace all the air inside the tree. However, there was not enough fluid volume to cover first the outside and then the inside foliage of the tree. This phenomenon demonstrates the inherent disadvantage of the use of a concentrated spray material. Actually, it is impossible to spread as
little as 10 gallons of a liquid evenly over the entire leaf surface presented by an acre of citrus. An equal amount may be applied per tree, but this will be represented by small droplets of insecticide on a relatively small number of leaves. This type of distribution controlled grasshoppers and it is conceivable that it would also control insects such as the southern green stink bug or the leaf-footed plant bug (*Leptoglossus gonagra*) on citrus. However, these are large, free moving insects and the control of such forms as purple scale, citrus red mites, rust mites, etc. presents an entirely different problem. They would not be controlled unless insecticide thoroughly covered all of the leaves and twigs. Therefore, lack of complete coverage would appear to eliminate the use of concentrated sprays for routine grove spraying. Since conventional dusters and sprayers do as good or a better job than the concentrated spray machines used on grasshopper control, and since the concentrated spray equipment does not appear adaptable to other types of insect control on citrus, it may be concluded that, as now constructed, such equipment has no place in the citrus pest control program.

**TABLE 1.—NUMBER OF GRASSHOPPERS ¹ BEFORE AND AFTER TREATMENT WITH INSECTICIDES.**

<table>
<thead>
<tr>
<th>Type of Machine</th>
<th>Toxicant</th>
<th>Lbs. Toxicant per acre</th>
<th>Before Spray</th>
<th>After Spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo Turbine</td>
<td>Chlorinated camphene</td>
<td>4.5</td>
<td>130</td>
<td>4</td>
</tr>
<tr>
<td>Buffalo Turbine</td>
<td>Chlordane</td>
<td>1.5</td>
<td>142</td>
<td>20</td>
</tr>
<tr>
<td>Hessian Duster</td>
<td>Chlordane</td>
<td>1.5</td>
<td>55</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Chlorinated camphene</td>
<td>4.5    (10% dust)</td>
<td>59</td>
<td>1</td>
</tr>
<tr>
<td>Untreated (Avg.</td>
<td></td>
<td>114</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>of 5 plots)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ All counts based on 100 sweeps of insect net per plot.

**SUMMARY AND CONCLUSIONS**

In the summer of 1947 two concentrated spray machines were tested for the control of the grasshopper, *Schistocera americana* (Drury), in citrus groves in Florida. The equipment is described and the results of two experiments are presented. The machines demonstrated fair to good control where chlordane (1½ to 2½ lbs. per acre) and chlorinated camphene
(4.5 lbs. per acre) were used at 10 gallons per acre of a concentrated emulsion. It is concluded that although these types of equipment offer some possibility for the control of insects such as grasshoppers in a citrus grove, there are certain inherent defects which prevent them from practical or general use in groves.

LITERATURE CITED