FIELD EXPERIENCE ON SOME NEW MITICIDES DURING THE PAST TWELVE MONTHS ON CITRUS IN FLORIDA

J. T. Griffiths

The advent of several new miticides has required a re-evaluation of how best to control rust mites and red spiders on citrus in Florida. The problem is concerned with which program or material will be the most effective and which will be the most economical. Because of prolonged control, the most expensive material per pound may actually be the cheapest in terms of cost per acre.

During the past several years, Eloise Groves Association has made an effort to compare different miticides at different rates and under different circumstances in order to better acquaint ourselves with the most advantageous way of handling these miticides in the field. The discussion presented below is concerned with some specific experiments as well as with results in general field practice on something over 5,000 acres of citrus grove.

RUST MITE CONTROL

The author reported at this meeting a year ago that, although Zineb might completely replace wettable sulfur and/or liquid lime sulfur, there was some indication that combinations of wettable sulfur and Zineb might be effective at certain times of the year, and that sulfur alone might still be the miticide of choice in the fall and winter months. During the past twelve months, most of the groves in this organization have been sprayed only twice, at post-bloom time and again during June or July. Miticides for red spider control were used in only about 20% of the groves during the fall and winter months, and applications for rust mite or scale control were made only where necessary. Wettable sulfur only, Zineb-sulfur, and zineb only gave quite satisfactory control when applied from November through February, and only one application was necessitated during that period in any one grove. Many of the properties were actually unsprayed between the time of the June or July scalicide in 1958 and the post-bloom spray in the spring of 1959.

At the post-bloom application in 1959, most of the groves in this organization were sprayed with Zineb only, but a few groves had copper included in the spray, and a few were sprayed with combinations of wettable sulfur and Zineb. The only groves in which rust mites appeared in large numbers in June, prior to the time for the application of the summer scalicide, were those sprayed with Zineb-sulfur or copper-Zineb. In these groves the summer spray of oil-parathion-Zineb was applied approximately a week early, and the amount of Zineb was increased by 50%-100% in order to compensate for the high rust mite infestations.

On bearing groves, all summer sprays contained oil, parathion, and Zineb, and were applied at one mile per hour with a Speed Sprayer. Model 36 sprayers were used with a single head, and Model 40 sprayers with a double head application. Zineb was used at rates of 5-6 pounds per acre.

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1 A paper presented at the 42nd Annual Meeting of the Florida Entomological Society, Miami, September 10-12, 1959.
2 General Manager, Eloise Groves Association, Winter Haven, Florida.
TABLE 1.—Results from Differential Mites applied December 26, 1959 in 3-Year-Old, Pineapple-Orange Block at Rates of 2 1/2 Gallons per Tree.*

<table>
<thead>
<tr>
<th></th>
<th>% Citrus Red Mite</th>
<th>Amount % Spider Injury †</th>
<th>% Rust Mites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feb. 2</td>
<td>Feb. 25</td>
<td>May 20</td>
</tr>
<tr>
<td>Kelthane-Wet. Sul.</td>
<td>5 pt. - 50 lb.</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Kelthane-Zineb</td>
<td>5 pt. - 3 lb.</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Tedion-Wet. Sul.</td>
<td>2 1/2 lb. - 50 lb.</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Tedion-Zineb</td>
<td>2 1/2 lb. - 3 lb.</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Trithion</td>
<td>1 qt. -</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Trithion-Zineb</td>
<td>1 pt. - 3 lb.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Wettable Stulfur</td>
<td>- 50 lb.</td>
<td>24</td>
<td>46</td>
</tr>
<tr>
<td>Zineb</td>
<td>3 lb.</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>DN-Zineb</td>
<td>2 1/2 - 3 lb.</td>
<td>7</td>
<td>13**</td>
</tr>
</tbody>
</table>

* 65% rust, 5% p.m. and 10% Texas mites when sprayed.
** High populations not corrected between these dates.
† Graded 1 (none); 2 (some); 3 (severe, as judged by etching or graying of the foliage). No mesophyll collapse was present.
on most mature oranges and grapefruit, 3 pounds per acre on 10 to 15-
year-old trees, and at the rate of 3 pounds per 500 gallon tank on trees
that were sprayed by hand. In all instances where known rust mite popu-
lations were high at the time of the scalicide application, Zineb concen-
tration was increased. As of September 1st, only 30 acres of red grapefruit
out of a total of 5,000 acres of citrus have had to be resprayed, and rust
mite populations are generally at a low level. This is a better record than
was obtained in either of the last two years. In 1958, failures in August
were related to the presence of high rust mite infestations at the time of
the summer spray. It appears that an increase in the Zineb concentra-
tion alleviated this problem.

In December of 1958, an experiment was set up in a 3-year-old Pineapple
orange block to compare several miticide combinations. These mixtures
and the results from their use are shown in Table 1. Kelthane, Tedion,
Trithon and DN were compared. Kelthane and Tedion were used with
both wettable sulfur and Zineb; Trithon was used alone, and at half
strength with half-strength Zineb; and DN was used with Zineb. These
were compared with wettable sulfur and Zineb only. At the time of appli-
cation, during the last week of December, there was a 65% rust mite in-
festation over the block. All sprays gave excellent rust mite control and,
as late as February 25th, very few mites were present. No additional
counts were made until the 20th of May. At that time, rust mite popula-
tions were increasing in all plots, and at that date only DN-Zineb showed
a relatively low rust mite population. There was a tendency to have
fewer rust mites where Zineb was used rather than wettable sulfur, and
Kelthane showed some evidence of being better than the Tedion or the
Trithon combinations. These results are of little consequence, however.
All materials gave satisfactory commercial control and, since post-bloom
sprays should have been applied in April, all sprays would have been com-
pletely satisfactory from the standpoint of initial reduction and length of
control. The Trithon-Zineb combination is of some interest in view of
the fact that there is some evidence that, at the recommended dosage for
Trithon, rust mite control is no better than with sulfur, and initial red
spider control often is better than required. This combination is lower in
cost and apparently offers better length of rust mite control.

The Zineb recommendations, as they are given by the research organi-
zations of the State, are usually stated in terms of pounds per 100 gallons
with the suggestion that an application comparable to a scalicide spray be
made. As previously reported, this organization has had excellent results
with Zineb when applied at speeds in excess of 2 miles per hour with a
Speed Sprayer, and our recommendations have been based primarily in
terms of pounds of Zineb to be applied per acre. Neither the optimum
speed of application nor the optimum rate of Zineb has been adequately
determined under our circumstances. In order to get some information on
this, experiments were run in 1959 on 13 and 14-year-old orange trees to
study the amount of Zineb required per acre, or per tree, to accomplish
satisfactory results.

Two experiments were made in the spring; one with combinations of
Zineb and wettable sulfur and the other with Zineb only. Results of these
are presented in Tables 2 and 3. Although rust mite counts were made
in both experiments between the time of the application and the dates which are shown in the tables, rust mite populations were so low during those periods as to be of no significance.

On this size tree, the practice in the field has been to use 3 pounds of Zineb per 65 trees or on one 1320-foot row across 40 acres. In the Zineb experiment dosages were varied from as low as 2 pounds to as high as 4 pounds per 65 trees, and were applied on both Valencia and Jaffa oranges.

**TABLE 2.—Per Cent of Rust Mites Found on June 12 in 80 Acres of 18-Year-Old Valencia and Jaffa Oranges After Differential Rates of Zineb Were Applied on April 8, 1959.**

<table>
<thead>
<tr>
<th>Lbs. Zineb per 65 Trees</th>
<th>% Rust Mites</th>
<th>Valencia</th>
<th>Jaffa</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>3</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>2½</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>3½</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**TABLE 3.—Per Cent Rust Mites Found on Two Dates on 14-Year-Old Valencia Trees After Differential Rates of Wettable Sulfur and Zineb Were Applied on April 9, 1959.**

<table>
<thead>
<tr>
<th>Lbs. per 65 Trees</th>
<th>% Rust Mites</th>
<th>Zineb</th>
<th>Wet. Sul.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>½</td>
<td>14</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>5/6</td>
<td>26</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>1½</td>
<td>13</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>1¾</td>
<td>8</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2½</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3½</td>
<td>8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 4.—Per Cent Rust Mites Found on August 27, 1959, on 13-Year-Old Valencia Oranges After Differential Treatments of Zineb Were Applied on July 10, 1959.**

<table>
<thead>
<tr>
<th>Lbs. Zineb per 65 Trees</th>
<th>% Rust Mites</th>
<th>Block 18</th>
<th>Block 21</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>70*</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2½</td>
<td>80*</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3½</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

*Counts made on Aug. 12 and plots resprayed with same rate of Zineb. Not included in avg.
by a Speed Sprayer driven at 2½ miles per hour. All treatments were in
duplicate. It will be noted that, during the period from the time of appli-
cation on April 8th until the time that the summer scaldicide was made
shortly after June 12th, satisfactory control was obtained in all blocks,
but there was a tendency for a few more mites to be found on the lower
rates.

The companion experiment which tested combinations of Zineb and wet-
table sulfur is shown in Table 3. Here, the scaldicide was delayed until
July, and higher rust mite infestations occurred. The results are sugges-
tive that the most important factor was the amount of Zineb, but more
results are essential for proper evaluation. Control was generally satis-
factory until mid-June, but there were too many mites by early July in
the lower Zineb levels. Although control with wettable sulfur-Zineb com-
binations was still satisfactory in mid-June in this experiment and they
represent a means of saving money in the post-bloom application, the re-
sults here as well as in field trials, are suggestive that control should not
be expected to be as long as with full strength Zineb sprays. However,
Zineb-sulfur combinations may be satisfactory if it be anticipated that an
early scaldicide spray can be applied.

In July of 1959, another Zineb rate experiment was set up in two 40-acre
blocks of 18-year-old Valencia oranges. These were applied in combina-
tion with oil and parathion by a Model 40 Speed Sprayer driven double-
headed at 1 mile per hour. All plots were in quadruplicate, and the results
are shown in Table 4. In early August, the two low rates of Zineb in one
of the two 40-acre blocks had entirely too many rust mites and it was ne-
necessary for them to be resprayed. The results of this experiment, as well
as those shown in Tables 2 and 3, seem to indicate that rates, below 3
pounds per 65 trees of this size, are very apt to be too low. They further
suggest that additional amounts of Zineb are of no particular value when
low infestations are sprayed. Additional work is essential in order to work
out the exact amounts that are required on a given-sized tree.

Red Spider Control

As noted above, this organization did not apply materials for red spider
control in most groves during the winter of 1958-59. In those Valencia
orange blocks where heaters or firewood were placed in the middles for frost
protection, it was believed to be desirable to apply a miticide in November
so that there would be no need for disturbing the frost protection equip-
ment during the remainder of the winter. Both Tedion and Trithon were
tried out in this manner. Results were inconclusive in view of the fact that
mites did not develop either on the sprayed blocks or in unsprayed oranges
which were adjacent and under similar cultural practice. Although miti-
cides were not applied on grapefruit, six-spotted mite populations did not
develop in the Spring.

Two experiments comparing levels of Tedion and Trithon were tried on
15 year old Parson Brown oranges, and were applied in October and No-
ember. Red spiders never developed in either of these two blocks even
during the relatively late spring of 1959, so that no information on dosage
was obtained. Although numerous field trials were made in one 1,000-
acre grove where individual 40-acre blocks were divided into two parts
with different levels of Tedion or Trithion being applied, red spiders did not develop and no information on their control was obtained.

It was noted, however, that Trithion as compared with Tedion-Zineb was not satisfactory for prolonged rust mite control at the rates used, and there were some places where an additional sulfur and/or Zineb was required for rust mite control. This was not true where Tedion-Zineb or where wettable sulfur only was applied. While some blocks were satisfactory where Trithion was used, it is suggestive that this material should not be considered as a primary control for rust mites if control is desired from early November until post-bloom time. It will give satisfactory results for a shorter period, and there are many times when only a short period of control is required.

Comparison of control of red spiders was made between Kelthane, Tedion and Trithion and the results are shown in Table 1. As indicated in the table, the material was applied at approximately 2½ gallons per tree on 3-year-old Pineapple trees. The applications were made on December 26th and treatments were in triplicate. Counts were made at periodic intervals throughout the winter and spring, but no counts were made between February 25th and May 20th. By that time, purple mite populations had reached high levels in the wettable sulfur and Zineb plots; and in the DN-Zineb plots had already reached a high level and were then declining. In the other experimental treatments, populations were only beginning to increase on May 20th when an additional spray was applied. At this late date, there was very little to choose between the Kelthane, Tedion and Trithion for red spider control. It should not be concluded from these results, however, that the three materials are comparable under the conditions of greater population stress. There were practically no citrus red mites and only a 30% Texas citrus mite infestation when the experiment started. The Texas mites were killed easily and never became a problem thereafter.

On May 20th, tree condition was graded in each plot. This was an effort to note the amount of etching, or stippling, from the result of either purple mite or Texas citrus mite feeding on the foliage. Results are shown in Table 1. The plots sprayed with wettable sulfur, Zineb, or DN-Zineb looked hungry, and the leaves were heavily etched as the result of feeding. These plots were outstanding from this standpoint and were easily noted in driving across the plots. All other treatments were in reasonably good condition. It will be noted that there is a tendency for the treatments with Zineb and a purple miticide to look just a little better than the other treatments. This perhaps is correlated with the fact that, at the time of grading, rust mite populations were somewhat lower on the Zineb treatments, and it is the opinion of the author that heavy rust mite infestations contributed to the look of malnutrition.

**DISCUSSION**

It is recognized that the results recorded here are fragmentary, and in themselves are insufficient for making general recommendations for control of mites on citrus. As a result of observations in the field, it is believed that Zineb is the material of choice for the control of rust mites in the spring and summer. It may be combined with sulfur satisfactorily during
the early fall, and sulfur alone will probably be a satisfactory material
during the period from mid-November through February. During the post-
bloom period this organization will continue to use Zineb in all locations,
but additional trials in combination with sulfur will be made at post-bloom
time. Until more information concerning the prevalence of broad mites
and Brevipalpus mites following the use of Zineb alone is made, this type
of combination should still be considered.

For prolonged control of citrus red mite or Texas mite, results from
all sources seem to indicate that Tedion is the material of choice. If this
material is released by the Federal authorities, it will be the one which
this organization will use in blocks where spider control is desired from
October or November through the winter months, but we will continue to
test other materials since prices and results may change somewhat. It
is the present plan to apply Tedion on all blocks in October which are on
sour orange, sweet orange or Cleopatra root stock, but bearing groves on
rough lemon will receive no miticide until spider populations have built to
proportions to justify such an application. Non-bearing groves may re-
ceive materials for red spider control under either of two conditions: if
rust mites become prevalent and an application is indicated for this mite,
or if red spiders become a problem. Materials for both spider and rust mite
control will be applied in those Valencia blocks where it is undesirable to
have to use any spray equipment during the period when frost protection
is necessary.

Whether or not the low citrus red mite population during the winter
of 1958-59 was due to weather conditions, or whether it was due to the gen-
eral use of Zineb or a combination of both, cannot be ascertained at the
present time. It is anticipated that the general reduction in the use of
sulfur will materially reduce the necessity for applying materials for the
control of citrus red mites. This offers sufficient justification to refrain
from the use of any miticide until such times as populations warrant it.
This means that adequate checks must be made periodically in all groves.
This is considerably more economical than applying materials as a prevent-
ive spray.

SUMMARY

The results of the use of miticides on 5,000 acres of citrus suggest that,
although Zineb gives the best rust mite control, combinations with sulfur
may be satisfactory in the fall, winter and spring. Experiments on dosage
indicate that Zineb at the rate of 3 pounds on 65 13-year-old orange trees
is a satisfactory level, that more is not indicated, and that less will not
give good results. This appears to be true whether applied at 2½
or at 1 mile per hour with a Speed Sprayer. Because of low infestations,
test with miticides for the control of red spiders was generally inconclusive
in 1958-59.

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