

RESULTS FROM THE USE OF ZINEB IN CITRUS GROVES DURING THE 1957 & 1958 GROWING SEASONS ¹

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In 1956, Fisher (1957) found that zineb could be used to control citrus fruit russet. For many years sulfur had been the only known material which would satisfactorily kill rust mites, and thus prevent rust mite injury on fruit russetting. Fisher reported outstanding success with zineb. This stimulated considerable interest in the material, and a more detailed report was made by Johnson, et al. (1957) at the 1957 meetings of the Florida State Horticultural Society. They concluded that zineb killed rust mites and that it was very effective when applied during the post bloom, summer and fall spray periods. They reported good results with dosage as low as $\frac{1}{2}$ pound per 100 gallons of spray material.

Work with zineb was started by the Eloise Groves Association in January 1957 in four 40-acre blocks of 12-year-old Valencia oranges. Four rows were set aside in the center of each block. Two of these in each block were sprayed with zineb by a Speed Sprayer driven at $2\frac{1}{2}$ miles per hour and applying approximately 5 pounds of zineb per acre. The other two rows were sprayed with a Speed Sprayer driven at $1\frac{1}{4}$ miles per hour. In both blocks a double-headed machine was used. A similar application was repeated at the post bloom period. In the summer, the two rows where the Speed Sprayer had been driven at $2\frac{1}{2}$ miles per hour were sprayed with a combination of oil-parathion and approximately 5 pounds of zineb per acre. The other two rows in each block were sprayed with a similar combination but at the rate of only $2\frac{1}{2}$ pounds of zineb per acre. In both instances, a Model-36 Sprayer was used and the material was applied at 1 mile per hour with a single head. The remaining portion of all four blocks was sprayed with conventional wettable sulfur programs for rust mite control. In only one of the four zineb-sprayed blocks were additional sulfur sprays required for rust mite control. In this one block, one extra spray was sufficient. In the case of the standard wettable sulfur sprays, at least three additional sprays or dusts were required in each of the four blocks in order to maintain rust mite control throughout the fall. No differences were noted between rates of speed of application or between the amounts of zineb used in the summer application.

RESULTS OF SUMMER SCALICIDE IN 1957

During the summer scalicide period in 1957, zineb was applied in combination with oil or oil-parathion on more than 50% of the total acreage in Eloise Groves Association. In almost all cases zineb was used at 5 pounds per 500-gallon tank and applied at a rate of 10 pounds per acre on oranges, 15 pounds per acre on grapefruit and approximately 5 pounds per acre on trees which averaged about 10 to 12 years of age. In some blocks, this dosage was cut in half so the comparison could be made between the two rates of zineb.

¹ A report presented at the 41st annual meeting of the Florida Entomological Society, August, 1958.

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Zineb was found to be very effective in controlling rust mite infestations.

Table I shows the number of spray or dust applications which were required, following the summer scalicide spray, in order to maintain rust mite control throughout the late summer, fall, and early winter months. The only differences of any consequence will be noted between the presence or absence of zineb in the summer scalicide spray. Wherever zineb was used, regardless of the dosage, less applications were required.

TABLE I. NUMBER OF SPRAY OR DUST APPLICATIONS FOLLOWING SUMMER SCALICIDE SPRAY IN 1957

| Scalicide | Lbs. Zineb per 500-Gal. Tank | | | | | | | |
|------------------|------------------------------|----|-----|------|---------|-----|-----|------|
| | Grapefruit | | | | Oranges | | | |
| | 0 | 2½ | 5 | Avg. | 0 | 2½ | 5 | Avg. |
| Oil | 1.6 | 0 | 0.5 | 1.1 | 1.4 | 0.6 | 0.4 | 0.8 |
| Oil Parathion | 1.7 | — | 0.2 | 1.0 | 2.4 | 0.8 | 0.8 | 1.3 |

Table II shows the actual number of days that elapsed between the time that the summer scalicide spray was applied and the time that an additional application was required for rust mite control. Some of the figures show a plus mark, which indicates that the period was longer than that listed. Thus, in many instances, no additional sprays or dusts were required until the post bloom application in 1958, but the tabulations were terminated during December, 1957. In this table, it becomes obvious that zineb was markedly superior to straight oil or oil-parathion, and that the 2½ pounds per tank were not quite as effective as the 5 pounds. However, the 2½ pounds were sufficiently satisfactory that there appears to be little justification for using the higher dosage. This is in line with results presented by Johnson (1957).

TABLE II. NUMBER OF DAYS BETWEEN SCALICIDE SPRAY AND RECOMMENDATION FOR ANOTHER APPLICATION

| Scalicide | Lbs. Zineb per 500-Gal. Tank | | | | | |
|------------------|------------------------------|----|------|---------|-----|------|
| | Grapefruit | | | Oranges | | |
| | 0 | 2½ | 5 | 0 | 2½ | 5 |
| Oil | 51 | 81 | 104+ | 54 | 114 | 112+ |
| Oil Parathion | 23 | — | 114+ | 24 | 71 | 116+ |
| Avg. | 37 | — | 109+ | 39 | 83 | 114+ |

It should be noted here that, in a few places, russetting did occur following zineb application. This occurred where heavy infestations were not controlled with a zineb spray.

In a commercial operation, if rust mite control can be maintained from June or July for a period of approximately 90 days, it is possible to use sulfur dusts as an effective and economical method of rust mite control. Thus, it would be cheaper to apply an additional one or two dusts at this time than to use the increased amount of zineb during the summer scalcicide spray in order to obtain somewhat longer control.

In three cases where the cost of the spray program was calculated in paired blocks, it was found that the zineb program resulted in savings of 15 cents, \$4.60 and \$1.90 per acre, when labor, equipment and materials were all included at standard cost figures. However, the cost picture does not tell the entire story, since the use of zineb resulted in less necessity for checking the grove for rust mites, and in a much more flexible work program.

RESULTS FROM POST BLOOM SPRAYS IN 1958

Due to the disastrous freezes during the winter of 1957-58, no dormant sprays were made in Eloise Groves Association. Rust mites were at a generally low level throughout the winter, and post bloom sprays were applied during April, 1958. During this operation comparisons were made between sprays containing only sulfur; copper and sulfur; zineb and copper; and zineb alone. Some sprays contained zinc, manganese, or arsenic, but these materials were ignored so far as the results reported here are concerned. All sprays were concentrated and were applied with a Speed-Sprayer, using a double head and driven at 2½ miles per hour. Mature groves received zineb at approximately 5 pounds per acre. Groves in the 10 to 14-year-old category received only 3 pounds per acre. The results of these sprays are shown in Tables III and IV.

Table III shows the results where copper was included in the spray, and Table IV where no copper was present. The groves are divided into four categories depending on age and variety. The number of groves sprayed with each combination is shown; the average percentage number of fruit infested with rust mites is shown for the approximate dates of June 1st and July 1st. Some of the figures for July 1st are shown with a plus mark, which indicates that the populations would have been higher but, of necessity, were sprayed prior to the July 1st count. In the fourth column under each category is shown the percentage of groves in which rust mites were sufficiently high that treatment was required by approximately June 15th.

Zineb was materially superior to sulfur whether or not copper was included, but the inclusion of copper in the spray resulted in a reduced rust mite control with both materials. In spite of the reduction where copper was used with zineb, this was still a superior application to wettable sulfur alone. In no instance was it necessary to re-treat any of the groves sprayed with either zineb or zineb-copper prior to the summer scalcicide.

RESULTS OF SUMMER SCALICIDE IN 1958

As this report is being presented at the Annual Meeting of the Florida Entomological Society, it is impossible to finally evaluate the summer scali-

TABLE III. RUST MITE CONTROL AFTER POST BLOOM SPRAY IN 1958 WHEN COPPER SULFUR IS COMPARED WITH COPPER ZINEB

| | SULFUR | | | | ZINEB | | | |
|---------------------|------------|--------------|--------|-------------------------------|------------|--------------|--------|-------------------------------|
| | No. Groves | % Rust Mites | | % Groves Retreated By June 15 | No. Groves | % Rust Mites | | % Groves Retreated By June 15 |
| | | June 1 | July 1 | | | June 1 | July 1 | |
| Old Grapefruit | 11 | 17 | 34+ | 36 | 7 | 0.5 | 37 | 0 |
| Old Oranges | 5 | 15 | 40+ | 50 | 7 | 0 | 5 | 0 |
| Old Tangerines | — | — | — | — | — | — | — | — |
| Oranges (8-14 yrs.) | 18 | 3 | 14 | 5 | — | — | — | — |
| Avg. | — | 12 | 29 | 30 | — | 7 | 19 | 0 |

TABLE IV. RUST MITE CONTROL AFTER POST BLOOM SPRAY IN 1958 WHEN SULFUR IS COMPARED WITH ZINEB

| | SULFUR | | | | ZINEB | | | |
|---------------------|------------|--------------|--------|-------------------------------|------------|--------------|--------|-------------------------------|
| | No. Groves | % Rust Mites | | % Groves Retreated By June 15 | No. Groves | % Rust Mites | | % Groves Retreated By June 15 |
| | | June 1 | July 1 | | | June 1 | July 1 | |
| Old Grapefruit | 9 | 8 | 35+ | 33 | 10 | 0 | 8 | 0 |
| Old Oranges | 10 | 4 | 15+ | 10 | 25 | 0.4 | 4 | 0 |
| Old Tangerines | 5 | 16 | 25+ | 20 | 7 | 0 | 1 | 0 |
| Oranges (8-14 yrs.) | 2 | 0 | 0 | 0 | 9 | 0.5 | 3 | 0 |
| Average | — | 7 | 19 | 16 | — | 0 | 4 | 0 |

cide sprays. However, certain trends have become obvious and the results are worth noting here.

Zineb was applied in most instances in concentrated oil-parathion combinations with Speed Sprayers driven at 1 mile per hour. Model-40 Sprayers used a double head, and Model-36 Sprayers used a single head. On groves of approximately 10 to 14 years of age, about 3 pounds of zineb were applied per acre. On old oranges approximately 5 pounds were applied per acre, and on old grapefruit about 7 pounds were applied. At approximately 135 locations, rust mites were at a very low level when the summer scalicide was applied. As of the middle of August rust mites have not appeared in sufficient numbers to be cause for alarm in any of these blocks. In 32 locations, 20 grapefruit and 12 orange or tangerine, in which more than 40% of the fruit was infested at the time of the summer scalicide spray, failures were recorded in 75% of the grapefruit and approximately 20% of the orange and tangerine blocks. The criterion of failure was that 25% or more of the fruit was infested. In general, the infested fruit was found inside the tree, usually as clustered grapefruit. Leaves were generally completely uninfested, and outside fruit had a very low rate of infestation.

These results suggest that when high infestations are present at the time that the summer scalicide is applied, it may be well to increase the dosage of zineb. Whether or not this would result in fewer failures remains to be determined, but it is worth considering during the 1959 spray season.

DISCUSSION

The results presented here, as well as those by many other commercial operators in Florida, all point up the fact that zineb gives excellent rust mite control. They show that zineb is effective both at post bloom time and during the summer scalicide period, that it may be applied at as little as 5 pounds per acre on old groves, and that coverage, at least during the post bloom period, is not as critical as may have previously been believed.

The data presented here indicate that none of the failures following the 1958 summer scalicide were groves in which straight zineb was applied at post bloom time. However, three failures followed a post bloom copper/zineb. All other failures followed the use of straight sulfur or copper-sulfur at post bloom. This is certainly suggestive that the use of zineb at post bloom time would result in better rust mite control, not only during the late spring but also following the summer scalicide period. If it can be successfully used when applied at 2½ miles per hour and relatively low dosage, the elimination of failures following the summer scalicide will justify any additional cost of material at post bloom time. Additional information is necessary to establish this as fact, but the suggestion that zineb be used at post bloom time is made for the 1959 season.

No results observed by the author give any indication of deleterious results from the use of zineb. This does not mean that such will not be the case in the future, as it may take several years for adverse results to become evident. Since zineb is a fungicide, it is to be expected that there may well be an increase of some insect or mite populations, perhaps even of insects or mites that have normally been considered to be of no economic importance in the past. It is possible that the elimination of sulfur from

a spray program may also have deleterious effects, but no such results have yet become evident.

During both the 1957 and 1958 seasons, various combinations of zineb and wettable sulfur were tried. These varied from dosages of 1 pound of zineb with 50 pounds of wettable sulfur to 3 pounds of zineb with 25 pounds of wettable sulfur per 500-gallon tank, with approximately 1 tank of material being applied per acre of old grove. The replications of these dosages were too small to present here as averages. However, even the addition of 1 pound of zineb in a 500-gallon tank appears to have resulted in materially enhanced rust mite control. There have been no instances when these combinations as compared with wettable sulfur were not strikingly better than the wettable sulfur applications. Comparisons are too scanty for valid conclusions to be drawn, but they are very suggestive that such combinations should be further studied as they may represent a very satisfactory application for some periods of the year. If it becomes evident that sulfur is needed for the control of some insects, it may well be that zineb-sulfur combinations offer the correct answer. Certainly these combinations are well worth considering as a permanent part of a spray program during the coming years.

At the present time it is impossible to speak with authority on the type of over-all spray program that should be carried out in citrus groves in Florida today, but so far as the Eloise Groves Association is concerned, it is anticipated that zineb-sulfur sprays will be used for rust mite control during August, September and perhaps October, with sulfur dusts applied thereafter. Miticides for the control of purple mites or Texas citrus mites will be used only where infestations become relatively heavy during the fall months. Whether or not a routine dormant application will be made will have to be determined as the result of mite infestations and weather conditions during the late fall and early winter.

It is quite conceivable that citrus may well be placed on a program which involves no more than 3 spray applications, and in many instances, only two. It is quite possible that the elimination, or virtual elimination, of sulfur from the spray program will result in lowered purple mite infestations. If this be true, it may be possible to go through the winter in many groves without the necessity for purple mite control. This is perhaps wishful thinking, but it further emphasizes the fact that careful checking of groves during the fall and winter months will be essential in order to be certain that neither six-spotted mites, purple mites, nor Texas citrus mites are increasing.

SUMMARY AND CONCLUSIONS

Zineb was applied on groves belonging to Eloise Groves Association during the 1957 and 1958 seasons in such a manner that comparisons on methods of application and dosage could be made.

(1) Zineb was found to be very effective for rust mite control, but russetting did occur after the application of zineb in a few groves where rust mites were not satisfactorily controlled.

(2) Dosages in old orange groves as low as 5 pounds per acre were found to be quite effective.

(3) Excellent results were obtained with such dosages at post bloom

time when applied with a double-headed Speed Sprayer driven at 2½ miles per hour.

(4) Failures of zineb in the summer scalcide in 1958 appear to be the result of heavy rust mite populations at the time of spray. These infestations were related to the use of sulfur combinations at post bloom time. None was recorded where zineb had been used at post bloom.

(5) It is suggested that combinations of zineb and wettable sulfur may be practical for use at some times of the year on citrus.

LITERATURE CITED

Fisher, Fran E. 1957. A summer application of Zineb for the control of citrus fruit russet. *The Citrus Industry.* 38(5):5-6.

Johnson, R. D., John R. King, and J. J. McBride, Jr. 1957. Zineb controls citrus rust mite. *Proc. of the Fla. St. Hort. Soc.* 70:38-48.

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