FIELD CONTROL WITH ZINEB AND SOME OTHER COMPOUNDS FOR THE CONTROL OF RUST MITES ON CITRUS IN FLORIDA [1]

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Fisher (1956) first found that zineb controlled russetting on citrus in Florida. As a result small amounts of zineb were used commercially in 1957, and since that time zineb has been generally the miticide of choice for control of citrus rust mite, *Phyllocoptruta oleivora* (Ash.). Johnson et al (1957) reported on the use of zineb in more detail. They showed that chlorobenzilate was also quite effective, but nabam (sodium ethylene bis-dithiocarbamate) and nabam plus zinc sulfate were found to be markedly inferior as compared with zineb. They also stated "although no variation in thoroughness of application was attempted, it is believed that thorough coverage of all fruit and leaf surfaces are needed for optimum rust mite control with zineb."

Johnson (1960) reported that copper reduced the efficacy of zineb and he again recommended thorough applications. As a result of continued work, he reported in 1961 that a combination using chlorobenzilate at post-bloom time, zineb in the summer, and wettable sulfur in the fall of the year was a satisfactory program for citrus rust mite control.

Griffiths (1960) discussed the use of zineb in a commercial grove operation during 1958 and 1959. He concluded that zineb in combination with copper was not as effective as zineb alone and that where severe infestations occurred at the time of application, the efficacy of zineb was materially reduced. Under these circumstances, increasing the zineb appeared to improve results.

During the five years, 1957 through 1961, that zineb has been in use as a miticide on Florida citrus, materially different results have been obtained during the last two years as compared with the first three. Between 1957 and 1959 rust-mite control following zineb applications was almost spectacular. In many instances sprays applied in June or July resulted in extremely low rust-mite populations throughout the remainder of the summer and fall and even until the post-bloom application was made the following spring. During the summer of 1960 an entirely different situation arose. In many cases rust-mite control lasted only 30-60 days. Rust-mite control was difficult throughout the winter of 1960-61 and populations were extremely high during the spring of 1961. Both spring and summer applications of zineb in 1961 were often ineffective.

The data presented here were obtained in an effort to determine the comparative effectiveness of wettable zineb (zinc ethylene bis-dithiocarbamate) and a tank-mix of the diammonium salt reacted with zinc sulfate; to test the necessity for thorough coverage when zineb was used; and to find some basis for an explanation of the inferior control obtained with zineb in 1960 and 1961.

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Eloise Groves Association has under its control approximately 7,000 acres of citrus grove. Since 1958 this acreage has been almost exclusively on zineb as a miticide for rust-mite control. Since other workers had not reported on tests with the ammonium salt of ethylene bis-dithiocarbamate, it was decided in the fall of 1960 to compare the effectiveness of zineb as a wettable powder with a tank-mix material, zimix[3]. Theoretically, zimix should be chemically identical with zineb. A pint of the zimix contains the equivalent in active ingredient of a pound of 65% wettable zineb. However, in the tests reported here, a pint of zimix was compared with a pound of 75% wettable zineb.

Experimental plots were initially set up in two blocks; one composed of pink Marsh seedless grapefruit, approximately 20 years of age; and the other of Parson Brown oranges of approximately 35 years of age. The trees were comparable in size and similar dosages were used in both blocks. Miticide treatments were duplicated in the oranges and triplicated in the grapefruit.

The first experiment was applied on October 3, 1960. All materials were applied with a power sprayer which was driven at two speeds, 1¼ and 2½ miles per hour. All miticides were applied as concentrates and were tested on the basis of a given amount of material per row across a 40 acre block. A row was equivalent to approximately 0.9 of an acre. In this experiment, zineb was applied at 5 pounds per row at 1¼ and 2½ mph and at 10 pounds per row at 2½ mph. Five and 10 pints of zimix were applied at the same speeds. Immediate kill was effected in all plots. After six months, populations were still lower than 5% in all plots. No differences occurred due to source of material, dosage, or speed of application.

The next test was made between April 5 and 14, 1961 in the same blocks. The results are shown in Table 1. Copper which is often applied at the post-bloom time was included in this experiment at the rate of six pounds of tribasic copper per row. In addition, on the grapefruit only, four pounds of lead arsenate was applied per row for early maturity. All sprays were applied by a sprayer at 2½ mph. Zineb was used at 5, 7½, and 10 pounds of material per row and was compared with 5, 7½ and 10 pints of zimix per row. This afforded an opportunity to determine if increased amounts of miticide resulted in improved rust mite control when copper was included in the spray mixture.

On June 2nd rust mite infestations in the plots in the orange grove averaged about 25%. There were no differences between amount or source of material. Ordinarily in June, infestations of this magnitude should be sprayed. This was done on June 17th.

In the grapefruit, control was effective until after June 30th. At that time there were no differences between treatments, but the summer scalicide was applied routinely as noted below.

The third experiment was performed on June 17th in the orange block only and included a comparison between 5, 7½ and 10 pounds or pints of miticide. Two weeks had elapsed since the last rust mite count and it is possible that the population had increased considerably in the interim.

[3] Zimix is a trade name for diammonium ethylene bis-dithiocarbamate reacted in the spray tank with zinc sulfate to form the zinc salt.

Approximately a month later on July 25th, populations averaged 44% where zineb had been applied and 41% where zimix was used. Once again there was no difference between the dosage or material. All were ineffective.

TABLE 1.—COMPARISON OF THREE LEVELS OF ZINEB AND ZIMIX IN COMBINATION WITH COPPER APPLIED BETWEEN APRIL 5 AND 14, 1961

Miticide	Miticide Per Row	% Infestation in Orange Plots			% Infestation in Grapefruit Plots		
		Pre Spray	May 9	June 2	Pre-spray	June 2	June 30
Zineb	5 lbs.	20	23	25	0	3	20
	7½ lbs.	40	43	28	3	3	12
	10 lbs.	2	8	32	0	3	10
Avg. % Infestation		31	25	28	1	3	14
Zimix	5 pts.	20	25	22	3	3	9
	7½ pts.	17	35	23	0	3	6
	10 pts.	8	8	25	0	0	9
Avg. % Infestation		15	23	23	1	2	8

Another spray application was made on the grapefruit plots on July 4th. Zineb and zimix were used at 5, 7½ and 10 pounds or pints per row. Copper, oil and parathion were included in all sprays. After only 50 days, the zineb plots averaged 64% infestation and the zimix 42%. As in the post-bloom application when copper was used, increasing the amount of miticide did not improve rust-mite control.

On July 26, the oranges were resprayed with the same materials that had been used in the July 4 spray on grapefruit except that no oil was included in the spray. After only 30 days the zineb plots averaged 23% and the zimix 47% and respraying was necessary. As in the grapefruit plots, increasing the miticide did not improve control.

By August 1961, it was obvious that the use of zineb in June and July scalicide sprays in commercial groves had not resulted in satisfactory rust mite control. As a result chlorobenzilate was included in subsequent tests with zimix and zineb.

Table 2 shows the results from the experiment which was applied on August 31 in the above mentioned blocks. Chlorobenzilate was included at the rate of 1 quart per row and was applied at 1¼ and 2½ mph. Zineb and zimix were used at 7½ pounds and 7½ pints per row, respectively, and were also compared at 1¼ and 2½ mph. In the grapefruit plots, only three weeks after spraying, on September 21st, rust mites were still so prevalent in the zineb sprayed plots that it was necessary to respray these. In view of the fact that populations were somewhat higher in the zineb plots at the time that the spray was applied, it is highly questionable that any conclusions should be drawn. On November 10, all other treatments were still satisfactory in both blocks. Speed of application did not appear to be a factor in control.

TABLE 2.—A COMPARISON OF CHLOROBENZILATE AND ZINEB, AND ZIMIX WHEN APPLIED AT TWO DIFFERENT RATES OF SPEED ON ORANGES AND GRAPEFRUIT ON AUGUST 31, 1961

Miticide	Miticide Per Row	Speed of Sprayer	% Infestation in Orange Plots		% Infestation in Grapefruit Plots		
			Pre Spray	Nov. 10	Pre Spray	Sept. 21	Nov. 2
Chlorobenzilate	1 qt.	1¼ mph	22	0	68	4	0
	1 qt.	2½	48	0	53	3	0
Avg. % Infestation			35	0	61	4	0
Zineb	7½ lbs.	1¼ mph	—	—	70	58*	—
	7½ lbs.	2½	18	5	53	46*	—
Avg. % Infestation			18	5	62	52	—
Zimix	7½ pts.	1¼ mph	40	0	44	16	3
	7½ pts.	2½	40	5	28	20	17
Avg. % Infestation			40	3	36	18	10

* Required respraying at this time.

Another experiment was conducted in a block of 14 year old Jaffa oranges. Experimental sprays were applied by Sprayer at 2½ mph on September 5th, 1961. Three treatments were compared: six pints of zimix per row; two pints of zimix and one pint of chlorobenzilate per row; and 1⅔ pints of chlorobenzilate per row. Infestations averaged about 75% at the time of application. Plots were replicated four times. By October 17 the plots averaged infestations of 15%, 5% and 2½% respectively. On November 20 the averages were 27, 17, and 24% respectively, and the infestations was found primarily at the north end of all plots and appeared to be a function of location rather than treatment.

DISCUSSION

Griffiths (1960) had previously suggested where heavy rust-mite infestations were found, that by increasing the zineb by 50 to 100% more effective control was attained. Similarly he suggested that by increasing the amount of zineb when copper was used, more satisfactory control resulted. This was especially true during the 1958-59 seasons but during 1961, these conclusions were not substantiated. Field usage in 1960 and 1961 strongly suggests that a material such as chlorobenzilate offers much more effective control during the spring and summer months than does zineb if copper is to be used in the spray or if high rust mite infestations are present.

The difference in rust-mite control between the 1957-59 and 1960-61 seasons naturally gives rise to speculation that the continued use of zineb has resulted in the development of resistance on the part of the citrus rust-mite population. Although this conclusion cannot be positively discounted, there is a considerable body of evidence which suggests that the differences in control have been the result of population differences rather than resistance to miticides.

Examination of population trends in sprayed groves, using a scheme developed by Dr. W. A. Simanton of the Florida Citrus Experiment Station, indicated that rust-mite populations have behaved in a different manner when the years 1960-61 are compared with 1957-59.

In the three years, 1957-59, rust-mite populations peaked sharply at the end of July. This peak was followed by a rapid population decrease. During the 1960-1961 seasons, there was no sharp population increase during July, but rather a prolonged period of relatively high population throughout the summer. Exactly how this has affected rust-mite control with zineb is at present unknown, but it is probable that it is a major factor in the difference in the degree of effectiveness of zineb. A careful study of rust-mite population trends in unsprayed groves might offer a satisfactory answer to the diametrically opposed results when 1957-59 is compared with 1960-61.

Field data do not appear to justify a conclusion that resistance is a problem. There are numerous groves under the care of the author which have been sprayed regularly with zineb for four years and which had excellent results with zineb during 1961. The data reported here indicate that in some plots where zineb has been in continous use for several years prior to the initiation of these experiments, and where zineb was a failure during the spring and summer months, its application in September or in late August was a complete success. This control is certainly suggestive that resistance was not the problem, and that some other factor was responsible.

The use of the tank-mix material, zimix, was suggested because it could be sold on a more economical basis than could zineb wettable powder. As noted above, Johnson et al (1957) reported that when the sodium salt was used results were unsatisfactory, but he did not report on the use of the ammonium salt. Results here are certainly indicative that zimix as used in these experiments was as satisfactory, or in some cases as ineffective, as was zineb. It would appear that the two were interchangeable and that cost or convenience of use would be the deciding factor rather than the source of material. This has been essentially true in the grove operations under the author's supervision where a considerable amount of zimix was used during the 1961 season, and it was certainly as effective as was zineb wettable powder.

Conclusions

On the basis of field observations as well as specific experiments reported here, it is concluded that rust-mite control in Florida citrus groves followed different patterns in 1960-61 than in 1957, 1958 and 1959. This was evidenced by the fact that rust-mite populations were not as effectively controlled as during the preceding three years.

Zineb (ethylene bis-dithiocarbamate) wettable powder and zimix (diammonium ethylene bis-dithiocarbamate plus zinc sulfate reacted in the spray tank) were found to be equally effective for rust mite control. Although an increase in dosage had shown improved control when applied either with copper or on severe infestations in the past, during the summer of 1961 such improvement was not evident.

Varying the speed of application by a power sprayer from 1¼ to 2½ mph did not have any effect on rust-mite control.

During the summer of 1961, field results indicated that chlorobenzilate was perhaps more effective than zineb. This was particularly true where heavy infestations of rust mites were found. However, by September 1st, data from experimental plots suggested that chlorobenzilate was losing its advantage and during late September and October it appeared both in experimental plots and commercial spray operations that zineb, zimix, chlorobenzilate, and/or combinations with chlorobenzilate were all equally effective even when high populations of rust mites were encountered.

Literature Cited

Fisher, Fran E. 1957. Control of citrus fruit russet in Florida with zineb. Phytopath. 47 (7):433-437.

Griffiths, J. T. 1960. Field experience on some new miticides during the past twelve months on citrus in Florida. Fla. Ent. 43 (1):29-35.

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

Johnson, R. B. 1960. The effect of copper on rust mite control with four rust mite miticides. Proc. Fla. St. Hort. Soc. 73:84-89.

Johnson, R. B. 1961. Spray programs to control citrus rust mites in Florida Jour. Econ. Ent. 54(5):977-979.