Control of Insects and Mites Associated with Citrus in Yuma, Arizona

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ABSTRACT

A variety of insecticides have been tested during the last three years to keep pace with the ever-present demand for effective materials to control mites and thrips on citrus. This need is particularly acute with the recent loss of dicofol (Kelthane), which for years was an industry standard for mite control. Some of the more promising new compounds include Avermectin and NC 21314. Comments are included concerning the registration status of some of the compounds we tested. Cautions are given concerning the development of resistance to compounds which are soon to be available.

INTRODUCTION

Below are the results of five insecticide/miticide trials conducted in Yuma during the last two and a half years. In doing so, I had the help of the following individuals; M. D. Butler, H. S. Costa, E. A. Draeger, C. H. Mullis, B. R. Tickes and D. J. Wild.

CONTROL OF TEXAS CITRUS MITE ON LEMONS, 1984

This efficacy trial evaluated the performance of several acaricides against Texas citrus mites on lemons in an orchard near Yuma, Arizona. The soil type was sandy loam with a pH of 8.1 and 0.15% organic matter. Experimental compounds were compared with Kelthane 1.6EC, the current product of choice, and untreated control plots. A completely random design was utilized with one-tree plots and four replications.

Test materials were applied with a handgun from a John Bean Sprayer operating at 300 psi at a rate of 180 gpa. Applications were made when the trees were in the prebloom stage. At the time of application the temperature was 71°F, with 20% RH, and a 7 kph wind. Mite counts were made on the basis of 20-leaf samples. Leaves were brought into the laboratory for processing.

Where mite populations were low to moderate, all materials produced satisfactory levels of control when compared to the untreated plots through the first 11 days of the test (Table 1). Near the end of that period, FMC 54800 showed some apparent weakening. The same general pattern was manifest throughout, although mite populations in all plots tended to increase gradually toward the end of the test. At the end of the test, plots treated with FMC 54800 were not significantly different from untreated plots. No phytotoxicity was observed from any acaricide application.

Table 1. Texas Citrus Mite Per Sampling Date *

Treatment and lb ai/acre	*Mar 16***	*Mar 20*	*Mar 26*	*Mar 30*	*Apr 5*	*Apr 11*	*Apr 17*
Danitol 2.4 EC, 0.2	12a	0a	13a	38ab	35abc	42abc	51abc
Danitol 2.4 EC, 0.4	40b	1a	21a	31ab	35abc	41abc	42abc
FMC 54800 0.8E, 0.1	1a	1a	76ab	89bc	112cd	119cd	117bcd
FMC 54800 10WP, 0.1	9a	2a	82ab	94bc	103bc	117bcd	121bcd
Advantage 2.5 EC 1.5	1a	2a	26a	37ab	41abc	33a	54abc
Avermectin B1 .15 EC, 0.025 + 1 gal oil	7a	0a	16a	24ab	31abc	29a	42abc
Avermectin B1 .15 EC, 0.05 + 1 gal oil	3a	1a	19a	23ab	27abc	27a	31a
Avermectin B1 .15 EC, 0.01 + 0.25% oil	0a	1a	17a	18ab	23ab	32a	27a
Avermectin B1 .15 EC, 0.25 + 0.25% oil	1a	0a	27a	19ab	21ab	23a	41abc
Kelthane 1.6 EC, 3.0	6a	2a	4a	7	14a	23a	33a
Untreated check	124c	44b	114b	141bc	182d	179d	184d

** Numbers followed by the same letter are not significantly different (P=0.05) DMRT, (these counts include all treatments)*

*** Applications were made Mar 15, 1984 with pretreatment counts of 72 mites on 20 leaves*

TEXAS CITRUS MITE CONTROL ON ORANGES, 1984

Several experimental miticides were evaluated for control of Texas citrus mites on oranges in Yuma, AZ. The soil type in the orchard was sandy loam, with a pH of 8.1 and 0.15% organic matter. The temperature at the time of application was 74°F and the RH was 22%. The test design was completely random with one-tree plots and four replications.

Comparisons were made with applications of Kelthane 1.6 EC, the industry standard, and untreated check plots. Applications were made with a handgun from a John Bean Sprayer operating at 300 psi at a rate of 180 gpa. Applications were made when the trees were in the prebloom stage. Mite counts were made on the basis of 20-leaf samples on Mar 14, 16 and 19 and on 40-leaf samples thereafter. Leaves were brought into the laboratory for processing.

Pretreatment counts were made on Mar 14 when populations stood at 68 mites per 20 leaves. Following the first 4 days of the test, under conditions of low to moderate infestations, all the materials tested gave excellent control when compared with the untreated plots (Table 2). No phytotoxicity was observed resulting from the acaricide applications.

Table 2. Texas citrus mites per sampling date *

Treatment and lb ai/acre	*Mar 16***	*Mar 19*	*Mar 22*	*Mar 28*	*Mar 30*	*Apr 4*	*Apr 10*	*Apr 16*
2 Danitol 2.4 EC ,0.2	21c	1a	6a	13a	17a	19a	21a	26a
3 Danitol 2.4 EC, 0.4	0	1a	0a	0a	3a	8a	7a	12a
12 NC 21314 50SC, 0.125	3ab	0a	1a	1a	6a	7a	12a	9a
13 NC 21314 50SC, 0.125 + Mitac 1.5 EC, 1.5	1a	1a	0a	0a	3a	9a	6a	12a
14 Ficam 76 WP, 0.75	4ab	0a	2a	6a	9a	13a	12a	17a
15 Ficam 76 WP, 1.00	0a	0a	2a	8a	9a	13a	12a	17a
16 Vendex 50W, 0.43 + Plictran 50W, 0.07	14c	0a	1a	0a	1a	7a	6a	14a
17 Vendex 50W, 0.37 + Plictran 50W, 0.13	0a	19b	3a	5a	7a	6a	10a	11a
18 Vendex 50W, 0.37 + Plictran 50W, 0.25	1a	1a	0a	3a	2a	2a	3a	6a
19 Vendex 50W, 0.5	0a	2a	3a	10a	12a	11a	19a	16a
20 Plictran 50W, 0.5	0a	0a	0a	0a	3a	2a	9a	11a
26 Kelthane 1.6 EC, 3.0	0a	0a	1a	3a	7a	8a	19a	29a
27 Untreated check	7b	7b	74b	79b	82b	81b	103b	127b

** Numbers followed by the same letter are not significantly different (P=0.05) DMRT, (these counts include all treatments)*

*** Applications were made Mar 14, 1984 when pretreatment counts were at 68 mites on 20 leaves*

CONTROL OF CITRUS FLAT MITES ON LEMONS, 1985

A pesticide efficacy trial was conducted at the University of Arizona Mesa Experiment Station in Yuma, Arizona, to evaluate the ability of various miticides to control the citrus flat mite, Brevipalpus lewisi McGregor, on lemons, Citrus lemon (L), Burm .f. 'Lisbon'. The soil type was sandy loam with a pH of 8.1 and 0.15% organic matter. Experimental materials were compared with untreated control plots and Kelthane 1.6 EC, a commonly used acaricide in the desert Southwest. A completely random design was used with three different trees receiving each treatment.

Mite counts were made by examining in the laboratory 10 lemons from each tree and recording the total number of citrus flat mites from each fruit. For statistical analysis, each fruit was considered a replicate, so there were 30 replicates per treatment. The large number of replicates compensated for the nonrandom distribution of the mite population.

On the day of the test, the temperatures ranged from 77 to 106°F. It was 95°F at the beginning of the applications. Wind speed averaged 3.21 kph. Test materials were applied with a handgun from a John Bean Sprayer operating at 300 psi and a rate of 100 gal per acre (one treatment involving Vendex 4L was diluted to 500 gal per acre).

Mite populations in the control plots remained high during the test, beginning at 6.03 mites per lemon on 24 July 1985 and finishing at 5.33 mites per lemon on 20 August 1985 (Table 3). One day following application all treatments, with the exception of low rates of DPX-Y 5893 and Apollo, had significantly fewer mites than untreated plots. Three days following treatment, only the high rate of DPX-Y 5893, the low rate of Avermectin B1 and treatments involving Vendex or Kelthane had significantly fewer mites than the untreated plots. From the seventh day forward, almost no treatment had mite counts significantly lower than those found in the control plots. In fact in many cases, treated lemons had significantly more mites.

*Table 3. Average Number of Citrus Flat Mites Per Fruit**

Treatment and lb (AI)/acre	*July 24*	*July 26*	*July 30*	*Aug 13*	*Aug 20*
Danitol 2.4 EC, 0.4	0.13a	2.53abcd	1.77a	0.80ab	2.03ab
DPX-Y 5893 50 WP, 0.0313	2.73abc	3.07abcd	4.37ab	1.30abc	3.50ab
DPX-Y 5893 50 WP, 0.0313 + dicofol, 1.0	1.53ab	0.77ab	7.40ab	3.55abc	3.07ab
DPX-Y 5893 50 WP, 0.0625	0.43a	0.43ab	3.33ab	3.77abc	9.53bc
Pyrenone CS, 0.0078	1.13a	6.73cd	5.50ab	5.93c	6.80ab
Pyrenone CS, 0.0234	1.23a	5.50bcd	5.40ab	4.70bc	16.73c
Avermectin B1 0.15, 0.00625 EC + 1 gal oil	1.47a	1.67abc	2.20ab	5.87c	8.77bc
Avermectin B1 0.15, 0.0125 EC + 1 gal oil	2.40ab	3.63abcd	5.77ab	2.67abc	7.20ab
Apollo 50 SC, 0.156	4.86bc	6.13cd	9.50b	2.70abc	6.40ab
Apollo 50 SC, 0.312	1.50ab	6.7cd	6.00ab	2.10abc	9.73 bc
Apollo 50 SC, 0.625	0.77	3.23abcd	7.27ab	1.63abc	7.47ab
Vendex 4L + 1 gal oil, 1.5	0.65a	0.25ab	1.10a	1.85abc	1.35ab
Vendex 4L + 1 gal oil**,	0.77a	0.10a	0.47a	0.00a	0.00a
Mavrik EC, .10	2.53ab	5.70bcd	5.33ab	6.03c	10.30bc
Dicofol EC, 1.0	0.37a	0.33ab	0.73a	1.17ab	2.27ab
Control	6.03c	7.83d	5.07ab	3.10abc	5.33ab

** Means in a column followed by the same letter are not significantly different (P < 0.05, SNK)*
***Diluted in 500 gal. of water per acre*

CONTROL OF CITRUS FLAT MITES ON ORANGES, 1986

A field trial was conducted at the University of Arizona Mesa Experiment Station in Yuma, Arizona, to evaluate the ability of various miticides to control the citrus flat mite, Brevipalpus lewisi McGregor, on oranges, Citrus sinensis (L.) 'Valencia'. The soil type was sandy loam with a pH of 8.1 and 0.15% organic matter. Experimental materials were compared with untreated control plots and Dicofol 1.6 EC. A completely random design was used.

A single tree constituted a plot and each treatment was replicated four times. On each sampling day, 10 oranges were taken from each tree and the total number of mites recorded. During the time of treatment, the temperatures ranged from 86 to 102° F. Wind speed averaged < 3 kph. Test materials were applied with a handgun from a John Bean Sprayer operating at 300 psi. A rate of 50 gal per acre was used because trees were less than 2.1 m tall.

Post-treatment mite populations in the unsprayed plots were moderate throughout the test (Table 4). On 13 Aug., the day after the application, they averaged 45.25 mites per 10 oranges. On 3 September, or Day 28, populations averaged 27.5/10 oranges.

Dicofol greatly outdistanced other materials so that no mites were found on those trees following the first week of application. On Day 1, dicofol was the only compound to give control that was significantly different from populations seen in untreated plots ($P < 0.05$). On Day 7 all compounds, with the exception of the low rates of ABG 6211 and MK 936 and the midlevel rate of Apollo, gave control that was significantly less than the populations seen in untreated plots ($P < 0.05$). On Day 14, only the low rate of ABG 6162 and Dicofol provided significant control. Twenty-eight days following application, 10 Aug, only the two rates of MK 936 failed to provide control so that populations were significantly less that those in untreated plots. This was undoubtedly due to an absence of oil in those applications.

*Table 4. Average Number of Citrus Flat Mites per 10 Oranges**

Treatment and lb (AI)/acre	*13 Aug***	*20 Aug*	*27 Aug*	*10 Aug*
ABG 6162, 0.066	35.5ab	10.0a	2.0ab	7.25ab
ABG 6162, 0.132	21.5ab	8.5a	4.0abc	2.0a
ABG 6211, 0.066	41.5ab	18.0ab	3.75abc	5.0a
AGG 6211, 0.132	40.5ab	4.5a	2.75abc	2.0a
MK 936 .15 EC, 0.0125	22.25ab	12.25ab	23.25abcd	52.25d
MK 936 .15EC, 0.025	17.0ab	10.5a	11.5abcd	31.25cd
Apollo 50 SC, 0.16	34.5ab	8.0a	9.5abcd	26.75bc
Apollo 50 SC, 0.31	65.25b	17.0ab	7.0abcd	12.0abc
Apollo 50 SC, 0.44	29.75ab	9.5a	17.75bcd	5.25a
Dicofol 1.6 EC, 1.0	2.25a	0.0a	0.0a	0.0a
Control	45.25b	29.75b	20.5cd	27.5d

* *Means in a column followed by the same letter are not significantly different according to SNK ($P < 0.05$).*

** *Applications made on 12 Aug when pretreatment counts averaged 67.75 mites per 10 oranges.*

CONTROL OF CITRUS THRIPS ON LEMONS, 1986

This efficacy trial evaluated the performance of several insecticides against citrus thrips on lemons in an orchard near Yuma, Arizona. The soil type was sandy loam with a pH of 8.1 and 0.15% organic matter. Experimental compounds were compared with Dimethoate 4E, one current product of choice, and untreated control plots. A completely random design was utilized.

Test materials were applied on 13 May with a handgun from a John Bean Sprayer. The sprayer was operated at 300 psi with a dilution rate of 200 gpa. Applications were made when new fruit was approximately 2.5 cm in diameter. At the time of application the temperature was 73°F, with 10% RH, and a 5 kph wind. Thrips counts were made on a basis of 16 terminals per treatment, four from four different trees.

Thrips populations were high throughout the test, ranging from 4.06 to 24.25 per terminal (Table 5). Danitol 2.4 EC at 0.2 and 0.4 lb ai/acre was consistently one of the most effective compounds. Also, MK936 and Spur, for the most part, gave satisfactory levels of control through the first two weeks of the test. Conversely, plots treated with ABG 6162A at no time during the test had significantly fewer thrips than were found in untreated plots ($P < 0.05$). By the end of the 21-day period, all plots had unacceptable populations of thrips. No readily apparent symptoms of phytotoxcity were seen on any treated tree.

*Table 5. Citrus Thrips Per Terminal**

Treatment and lb ai/acre	*14 May*	*16 May*	*20 May*	*27 May*	*3 June*
ABG 6162A 1.5 EC, 0.066	11.25AB	5.00BC	3.44AB	9.88B	25.12C
ABG 6162A 1.5 EC, 0.132	6.56AB	4.19ABC	3.81AB	6.06AB	18.12ABC
DANITOL 2.4 EC, 0.2	1.56A	1.94AB	4.44AB	3.69AB	11.31A
DANITOL 2.4 EC, 0.4	2.38A	1.31AB	2.44AB	1.81A	12.62AB
MK 936 O.15 EC, 0.01	5.5AB	1.19A	1.69AB	7.94AB	16.88ABC
MK 936 0.15 EC, 0.02	5.69AB	1.12A	1.50AB	6.19AB	13.44ABC
SPUR 22 EW, 0.1	4.81AB	2.12AB	1.12A	3.25A	13.75ABC
SPUR 22 EW, 0.2	5.81AB	2.00AB	4.69B	7.12AB	15.44ABC
DIMETHOATE 4 E, 1.0	3.06A	1.81AB	1.94AB	3.81AB	16.25ABC
CONTROL	16.25B	6.31C	4.06AB	10.06B	24.25BC

* *Numbers followed by the same letter are not significantly different ($P < 0.05$) DMRT.*

Many of the compounds we tested were experimental, but others were industry standards. What follows are general remarks concerning the registration status of some of these materials on citrus.

Avermectin B1 (MK 936). An application is currently pending with the Environmental Protection Agency for a temporary tolerance. If it is granted, wide-scale testing of the material will be conducted in 1987 under an Experimental Use Permit program. This will lead to applications for registration in the near future. It is currently only available for use on ornamentals.

Capture (FMC 54800): For budgetary reasons there were no trials in 1986, but FMC remains interested. To date, no residue studies have been attempted so application for registration will not happen for some time.

Kelthane (Dicofol): In a ruling by the Environmental Protection Agency this summer, dicofol registrations were cancelled. Specifically, material formulated prior to 29 June 1986 can be sold until 31 October. This material can be applied in the field only until 30 June 1987. The apparent cause for this cancellation stems from dicofol being contaminated with DDT and DDT-like compounds.

Pyrenone: Has been registered for use on citrus.

Mavrik: Zoecon submitted for a citrus registration over a year ago, but the application is still pending. It is expected that it will be acted upon in the near future.

Danitol: A great deal of field work has been completed, but more needs to be done before an application can be made for registration. It is expected that that will take place in 1989.

Appolo: An Experimental Use Permit for 1988 will be applied for, with registration expected in 1989. Nor-Am is definitely interested, but citrus is not a high priority.

ABG-6211 and ABG-6198: These two experimental compounds are some distance away from registration, although Experimental Use Permits, which will allow for large-scale field tests, have been applied for.

ADDENDUM

In a recent article in the Journal of Economic Entomology (79:565-570) Drs. J. G. Morse and O. L. Brawer of the University of California at Riverside warn of the possible development of resistance on the part of citrus thrips populations to dimethoate, avermectin and several pyrethroids. Because of this, those materials must be applied prudently only when control measures are absolutely necessary.