

# Efficacy of Insecticides to Citrus Thrips on Lemons in Yuma Arizona 1998<sup>1</sup>

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## Abstract

Two small plot efficacy trials were conducted evaluating different insecticide rotation regimes using commercially available insecticides and the effectiveness of new insecticide chemistries to control citrus thrips. Under the consistently cool conditions experienced during the first four weeks of the trial, Dimethoate, Success, Baythroid, Agri-Mek, Vydate and Carzol all of the offered adequate control and would fit well in the petal fall window. This is in contrast with previous years experiences when high temperatures within a week of petal fall would result in all treatments except Carzol requiring a re-treatment within ten days. All of the rotation schemes evaluated required three insecticide applications to get through the season, and did not appear to be greatly different in controlling thrips and producing high quality fruit under the environmental conditions experienced. However, the Dimethoate - Success - Baythroid rotation scheme was most cost effective. When temperatures were in the 70's to low 80's, Dimethoate and Vydate offered about three weeks control, Success, Carzol, Baythroid and Agri-Mek all offered about four weeks control. When temperatures were in the mid to upper 80's and low to mid 90's, Success provided about three weeks control while Carzol didn't require re-treatment for 4 weeks. Under these same temperature conditions, Dimethoate and Vydate gave about 7 to 12 days control, and Agri-Mek provided 12 to 14 days of control. Other than the one control failure with Baythroid, under warmer conditions, it provided about seven days control. In the experimental test, AZEXP1 appeared to offer knockdown activity at temperatures less than 90 F, and only suppression at higher temperatures. AZEXP2, appeared to be a viable citrus thrips material, with activity similar to Success and Carzol. The knockdown activity of M96 appeared to be enhanced by including Dimethoate or Carzol, but will require multiple applications to achieve the level of repellency experienced in 1997.

## Introduction

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The spring of 1998 was unusually cool relative to previous years. In most years, citrus thrips, *Scirtothrips citri* (Moulton), populations begin to rapidly increase in mid-March. In 1998, treatable populations of citrus thrips did not appear until mid-April, and these populations remained less vigorous than usual due to cooler temperatures that extended into June. Compared to 1997, temperatures in the spring of 1998 were roughly 10 to 15 degrees cooler. As one would expect, these cool temperatures greatly affected our need and ability to manage citrus thrips. Fewer thrips were present, and generation time was slower, which allowed area growers to stretch out their spray intervals. Overall, 1998 was one of the lightest citrus thrips years on record.

In 1998, we conducted two insecticide efficacy trials targeting citrus thrips on lemons on the Yuma Mesa. One trial was designed to evaluate the efficacy of commercially available insecticides used in various rotation patterns. The objectives of this test were 1) to evaluate how the different products performed under different temperature regimes, and 2) to determine the cost effectiveness of the various rotation schemes. The commercial insecticides in this trial included Agri-Mek, Baythroid, Carzol, Dimethoate, Success and Vydate.

The second trial was designed to evaluate how the different experimental insecticides performed relative to a standard rotation scheme. In this trial, three experimental insecticides were evaluated. For two of the insecticides AXEXP1 and AZEXP2 there is currently no information concerning the chemical properties of these products available for public release. Both of these insecticides were evaluated at two rates. The objective for these insecticides was simply to determine if they have efficacy to citrus thrips. The third chemistry tested was M96. M96 is a particle film technology being developed by Engelhard. This product is essentially a whitewash designed to coat the foliage and fruit and repel insects. In trials conducted in 1997, M96 appeared highly effective in its repellent properties when multiple applications were used beginning in late March. The weaknesses of M96, identified in 1997 included: good coverage was essential, high spray volumes were required, and M96 did not appear to offer adequate initial knockdown capabilities of citrus thrips. In 1998, our objectives for M96 were to determine if the addition of a convention insecticide for knockdown would enhance control, and to determine if a single early-season application could provide season-long repellency once a conventional insecticide was used to cleanup the initial thrips population.

## Materials and Methods

Ten year old lemon trees grown on the Yuma Mesa were used in these studies. All small plot tests were randomized complete block designs consisting of four replicates. Each plot (30 ft by 90 ft) consisted of three trees in a row spaced 30 ft apart.

Temperature data was obtained from the AZMET weather database system, from the weather station located at the University of Arizona Yuma Mesa Station, ca. 300 yd from the test site. Temperature data are presented as an average maximum daily temperature (°F) for each 24 hr period following the most recent insecticide application. Percent infested fruit were estimated by sampling ten fruit per tree for the presence or absence of immature citrus thrips. Insecticide applications and sampling began after petal fall when thrips population density warranted application. Applications and evaluation continued until approximately 80% of the fruit on the tree were 1.5 inch or greater in diameter. Insecticide applications were applied only on an as needed basis, 10% infested fruit was used as the action threshold.

Fruit damage was estimated on 21 Aug, by rating the degree of scarring to the rind. Scarring was rated as: 1=no scarring, 2=slight scarring around the stem, 3=significant scarring around the stem, 4=slight scarring on the side of the fruit and 5=major scarring on the side of the fruit. Fruit with a damage rating of 2 are not considered to be scarred heavy enough to cause a downgrade in quality. Fruit with 3 or higher damage ratings, are considered significantly scarred and subject to downgrading. Differences among insecticide treatments for thrips infestation and fruit damage were separated using ANOVA and an F protected LSD,  $P < 0.05$ .

### **Commercial Insecticides Test**

The various rotation regimes evaluated are presented in Table 1. Agri-Mek applications included NR-415 spray oil at 1.0 gal / A. Other treatments included Kinetic spreader-sticker at 0.1% v/v. Applications including Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v. Treatments were applied on an as needed basis, when the number of fruit infested with immature citrus thrips was 10%. Applications were made using a backpack air-blast sprayer calibrated to deliver 100 gal/acre.

Application dates, rates and costs/acre are also displayed in Table 1. All product costs were estimated using suggested retail prices from a single distributor: Agri-Mek = \$747.16/gal or \$72.97/acre, Baythroid = \$601.33/gal or \$30.07/acre, Carzol = \$40.00/lb or \$60.00/acre, Dimethoate 4E = \$39.55/gal or \$19.78/acre, Success = \$662.34/gal or \$46.57/acre, and Vydate L = \$75.49/gal or \$37.90/acre. To insure fairness in comparisons, high rates were used for all products tested. A cost effectiveness index for each treatment regime was calculated by multiplying the damage rating by the cost (\$/acre). The resultant values provide a relative assessment of the quality of fruit produced in relation to the cost of the treatments.

### **Experimentals Test**

Experimental insecticides were evaluated for their potential for controlling citrus thrips on lemons. All treatment applications except those including M96, included Kinetic spreader-sticker at 0.1% v/v. Treatments with M96 included methanol at 4 gal/25 lbs of M96. Applications including Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v. M96 was mixed by creating a slurry of methanol and M96 in a bucket before transferring to the spray tank and adding the water. Treatments were applied on an as needed basis, when the number of fruit infested with immature citrus thrips was 10%. Applications not including M96 were made using a backpack air-blast sprayer calibrated to deliver 100 gal/acre. Applications including M96 were made using a hand-gun sprayer calibrated to deliver 250 gal/acre. Treatments, application dates and rates are displayed in Table 5.

## **Results and Discussion**

### **Commercial Insecticides Test (Tables 1-3)**

All treatments were applied on 10 Apr, approximately one week after petal fall. All products provided good knockdown at 3 DAT (days after treatment), and continued to provide adequate control for 18 days (Table 2). During this period temperatures were cool, with mean temperature highs in the 70's and low 80's. On 06 May, 26 DAT, Dimethoate and Vydate exceeded the action threshold and required another treatment. In previous year's trials, we have found that the activity of Vydate is similar to Dimethoate. At this time, Baythroid appeared to be close to requiring another treatment with 8.35% of the fruit being infested. On 08 May, an application of Success followed Dimethoate and Carzol followed Vydate. On 11 May, 3 days since the last application and 31 DAT following the first application, thrips infestations in the remaining plots deemed that they should be re-treated. All treatments provided good to excellent knockdown 3 DAT, except where Baythroid followed Success (11.68% of the fruit were infested). The reason Baythroid failed to offer good thrips control at this time is not certain. Although, pyrethroid resistant citrus thrips have been collected in Yuma, I do not believe that resistance was the reason for this control failure. These plots were treated again on 19 May, with Agri-Mek. All the treatments held until 28 May, when all required another treatment except the Agri-Mek treated plots that were sprayed 9 days earlier, and the Carzol treated plots that were sprayed 20 days earlier (Table 3). On 29 May, application 5 was made for those

plots exceeding a 10% infestation level. All the treatments applied on 29 May were not re-treated the remainder of the trial, while those applied before 19 May all required an application on 05 Jun to finish the season.

Although temperatures were cooler in 1998, relative efficacy results were consistent with previous year's data. High rates of Carzol and Success, and Vydate and Dimethoate were similar in activity, especially in regard to length of control. When temperatures were in the 70's to low 80's, Dimethoate and Vydate offered about three weeks control, Success, Carzol, Baythroid and Agri-Mek all offered about four weeks control (Table 2). When temperatures were in the mid to upper 80's and low to mid 90's, Success provided about three weeks control while Carzol didn't require re-treatment for 4 weeks (Table 3). Under these same temperature conditions, Dimethoate and Vydate gave about 7 to 12 days control, and Agri-Mek provided 12 to 14 days of control. Other than the one control failure with Baythroid, under warmer conditions, it provided about seven days control.

Under the consistently cool conditions experienced during the first four weeks of the trial, all of the treatments appeared to offer adequate control and would fit well in the petal fall window. This is in contrast with previous years experiences when high temperatures within a week of petal fall would result in all treatments except Carzol requiring a re-treatment. All of the rotation schemes evaluated required three insecticide applications to get through the season, and did not appear to be greatly different in controlling thrips and producing high quality fruit under the environmental conditions experienced (Table 3).

Based on the cost effectiveness indexes, treatment regime no. 2 was the most cost effective (Table 4). This regime consisted of Dimethoate - Success - Baythroid. Early-season cool temperatures eliminated the need for a relatively quick follow-up shot following Dimethoate. This in conjunction with the mid-season long residual activity of Success and the end of season clean up with Baythroid made this regime cost effective. Treatment regimes nos. 3, 4 and 5, included Agri-Mek at the 12.5 oz/acre rate. These regimes were at a disadvantage due to the high cost of this application (\$72.79/acre).

#### **Experimentals Test (Tables 4-6)**

All treatments were applied on 10 Apr, approximately one week after petal fall (Table 5). Under the cool temperatures experienced in Apr, all the products tested provided good knockdown (Table 6). Additionally, all the treatments except the low rate of AZEXP1, provided at least four weeks of control. AZEXP1-L gave about three weeks control, and M96 + Carzol gave about five weeks control. On 15 May, AZEXP1-H, both rates of AZEXP2, M96 + Dimethoate and Dimethoate alone, all received an additional treatment. The AZEXP1 and AZEXP2 treatments were not rotated with other insecticides, while the M96 + Dimethoate plots were treated with Success, and Dimethoate alone was followed up with Baythroid. Following the third set of applications, temperatures warmed to the mid 80's to mid 90's. The AZEXP1 treatments provided three days control when temperatures were in the 80's, and no observable control when temperatures were in the 90's (Table 7). At best, AZEXP1 should be viewed only as a cool temperature knockdown material. This product required five applications to get through the season. AZEXP2 proved to be much more efficacious, requiring only two applications, one following petal fall and then mid-season. Similarly, When M96 was tank mixed with Carzol or Dimethoate, and then followed by Success mid-season, only two insecticide applications were required. This contrasts to the commercial standard rotation where an initial application of Dimethoate was followed by a mid-season application of Baythroid, and then had to be treated again late in the season to achieve season long control of the thrips populations. The addition of Carzol or Dimethoate with M96 did alleviate the knockdown weakness of the M96. However, it was evident that multiple applications of this material are going to be required to achieve adequate control. It is certain that as the fruit and flush continued to expand as the season progressed, the trees out grew the M96 coverage. Future evaluations should consist of multiple applications of this material.

Based on fruit scarring damage ratings, it was evident that the AZEXP1 treatments were inferior, and if not for the cool temperatures and resultant early-season suppression of thrips populations, would have probably been much worse (Table 7). The M96 tank mixes followed by Success and the AZEXP2 treatments all produced the highest quality of fruit. The commercial standard was slightly inferior, probably because Baythroid was used at the mid-season application instead of Success. During this period, the Baythroid treated plots average 1.79% thrips

infested fruit per day, relative to 0.37% infested fruit per day following Success. This suggests that using a highly efficacious and long residual material mid-season is a better thrips management strategy than using short-lived materials.

Overall, as previously stated, AZEXP1 appears to offer knockdown activity at temperatures less than 90 F, and only suppression at higher temperatures. AZEXP2, appears to be a viable citrus thrips material, with activity similar to Success and Carzol. The knockdown activity of M96 appears to be enhanced by including Dimethoate or Carzol, but will require multiple applications to achieve the level of repellency experienced in 1997.

Table 1. Application timings and rates of insecticide applied in the commercial test, 1997.

Treatment Regime <sup>ab</sup>	Insecticide	Rate	Application Date					Total Applications	\$/A Chemicals <sup>c</sup>
			10 Apr	08 May	15 May	19 May	29 May		
1.	Untreated							0	
2.	Dimethoate	2 lbs-ai/A	X					3	\$96.39
	Success	9 oz/A		X					
	Baythroid	6.4 oz/A					X		
3.	Success	9 ozs/A	X					3	\$149.61
	Baythroid	6.4 oz/A			X				
	Agri-Mek	12.5 oz/A				X			
4.	Baythroid	6.4 ozs/A	X					3	\$140.94
	Agri-Mek	12.5 oz/A			X				
	Vydate L	1.0 lbs-ai/A					X		
5.	Agri-Mek	12.5 oz/A	X					3	\$170.87
	Vydate L	1.0 lbs-ai/A			X				
	Carzol	1.5 lbs/A					X		
6.	Vydate L	1.0 lbs-ai/A	X					3	\$117.68
	Carzol	1.5 lbs/A		X					
	Dimethoate	2 lbs-ai/A					X		
7.	Carzol	1.5 lbs/A	X					3	\$126.35
	Dimethoate	2 lbs-ai/A			X				
	Success	9 oz/A					X		

X indicates when an application of the insecticide within each treatment regime was made, a blank spot indicates no insecticide was applied.

<sup>a</sup>All treatments were applied as needed based on a threshold of 10 or more immature citrus thrips per 100 fruit.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except Agri-Mek, which included 1.0 gal/acre of NR-415 spray oil. Applications containing Carzol or Dimethoate contained Neutralizer Buffer at 0.125% v/v.

<sup>c</sup>All product costs were estimated using suggested retail prices from a single distributor: Agri-Mek = \$747.16/gal or \$72.97/acre, Baythroid = \$601.33/gal or \$30.07/acre, Carzol = \$40.00/lb or \$60.00/acre, Dimethoate 4E = \$39.55/gal or \$19.78/acre, Success = \$662.34/gal or \$46.57/acre, and Vydate L = \$75.49/gal or \$37.90/acre.

Table 2. Commercial Test, 1998. Percentage of fruit infested with immature citrus thrips on lemons following applications 1, 2 and 3.

Applications and mean percentage fruit infested with immature citrus thrips (CT)										
Treatment Regime <sup>ab</sup>	10 Apr	13 Apr	16 Apr	21 Apr	28 Apr	06 May	08 May	11 May	15 May	18 May
	Application # 1	3 DAT CT (74.3 F) <sup>c</sup>	6 DAT CT (72.7 F)	11 DAT CT (79.6 F)	18 DAT CT (82.1 F)	26 DAT CT (83.5 F)	Application # 2	3 DAT CT (84.3 F)	Application # 3	3 DAT CT (94.3 F)
1.	Untreated	15.00 a	20.00 a	10.00 a	11.67 a	20.00 a	Untreated	26.70 a	Untreated	51.65 a
2.	Dimethoate	0.83 cd	0.83 c	1.67 b	2.50 b	10.83 bc	Success	1.68 b	none	4.18 c
3.	Success	0.83 cd	3.33 bc	0.83 b	0.00 c	4.18 c	none	16.68 a	Baythroid	11.68 b
4.	Baythroid	5.83 b	6.67 b	2.50 b	0.00 c	8.35 bc	none	22.48 a	Agri-Mek	4.15 c
5.	Agri-Mek	5.00 bc	1.67 c	2.50 b	0.83 bc	4.98 bc	none	20.85 a	Vydate	1.65 c
6.	Vydate	0.83 cd	5.00 bc	0.00 b	2.50 b	12.50 ab	Carzol	1.65 b	none	0.83 c
7.	Carzol	0.00 d	1.67 c	0.00 b	0.00 c	5.83 bc	none	16.65 a	Dimethoate	6.68 bc

Means in a column followed by the same letter are not significantly different (F protected LSD  $P < 0.05$ ).

<sup>a</sup>Rates for each insecticide in each treatment regime are provided in Table 1.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except Agri-Mek, which included 1.0 gal/acre of NR-415 spray oil.

Applications containing Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v.

<sup>c</sup>Average maximum daily temperature F, from time of most recent application.

Table 3. Commercial Test, 1998. Percentage of fruit infested with immature citrus thrips on lemons following applications 4, 5 and 6.

Applications and mean percentage fruit infested with immature citrus thrips (CT)									
Treatment Regime <sup>ab</sup>	19 May	22 May	28 May	29 May	01 Jun	04 Jun	05 Jun	08 Jun	12 Jun
	Application # 4	3 DAT CT (85.3 F) <sup>c</sup>	9 DAT CT (89.0 F)	Application # 5	3 DAT CT (96.7 F)	6 DAT CT (93.5 F)	Application # 6	3 DAT CT (90.0 F)	7 DAT CT (91.0 F)
1.	Untreated	54.18 a	39.98 a	Untreated	43.33	49.18 a	Untreated	51.68 a	52.50 a
2.	none	1.65 c	14.18 bc	Baythroid	2.48	6.68 bcd	none	19.18 b	10.83 c
3.	Agri-Mek	1.65 c	2.50 d	none	6.65	9.20 b	none	13.35 bc	25.00 b
4.	none	2.5 bc	10.83 bcd	Vydate	3.33	8.35 bc	none	18.33	25.00 b
5.	none	8.35 bc	11.65 bcd	Carzol	0.00	2.50 cd	none	10.83 bc	10.85 c
6.	none	3.35 bc	5.83 cd	none	9.18	10.00 b	Dimethoate	15.00 bc	23.35 b
7.	none	20.00 b	17.50	Success	2.50	0.83 d	none	5.00 c	5.83 c

Means in a column followed by the same letter are not significantly different (F protected LSD  $P < 0.05$ ).

<sup>a</sup>Rates for each insecticide in each treatment regime are provided in Table 1.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except Agri-Mek, which included 1.0 gal/acre of NR-415 spray oil. Applications containing Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v.

<sup>c</sup>Average maximum daily temperature F, from time of most recent application.

Table 4. Commercial Test, 1998. Fruit scarring damage ratings and cost effectiveness indexes.

Treatment Regime <sup>ab</sup>	Fruit scarring evaluations				Cost Effectiveness Index <sup>d</sup>
	21 Aug	Percentage damaged fruit <sup>e</sup>			
		21 Aug	21 Aug	21 Aug	
Damage rating 1-5 <sup>d</sup>	none	slight	sign.		
1.	2.00 a	34.17 c	42.09 a	23.75 a	NA
2.	1.33 c	72.92 ab	22.50 b	4.58 b	127.72 d
3.	1.29 c	75.84 a	20.42 b	3.75 b	193.00 b
4.	1.33 c	72.92 ab	22.50 b	4.58 b	186.75 bc
5.	1.40 bc	65.83 ab	27.50 b	6.67 b	239.22 a
6.	1.51 b	61.67 b	28.33 b	10.00 b	177.99 bc
7.	1.33 c	71.67 ab	24.17 b	4.17 b	168.36 c

Means in a column followed by the same letter are not significantly different (F protected LSD  $P < 0.05$ ).

<sup>d</sup>Damage rating (1-5) 1=no scarring, 2=slight scarring but not a complete circle around stem, 3=significant scarring, complete circle around stem, 4=significant scarring, complete circle around stem and some on shoulder, and 5=severe scarring, sides of fruit with scars.

<sup>e</sup>Percentage damaged fruit. none=percentage with no scarring, slight=percentage of fruit with damage ratings of 2, and sign.=significant scarring or percentage of fruit with damage ratings of 3 or higher.

<sup>d</sup>Cost effectiveness index = total cost of the treatment regime (\$/acre, Table 1) X the damage rating.

Table 5. Application timings and rates of insecticide applied in the experimental test, 1998.

Treatment Regime <sup>ab</sup>	Insecticide	Rate	Application Date					Total Applications	
			10 Apr	08 May	15 May	19 May	29 May		05 Jun
1.	Untreated							0	
2.	AZEXP1-L	0.075 lbs-ai/A	X	X		X	X	X	5
3.	AZEXP1-H	0.1 lbs-ai/A	X		X	X	X	X	5
4.	AZEXP2-L	0.1 lbs-ai/A	X		X				2
5.	AZEXP2-H	0.2 lbs-ai/A	X		X				2
6.	M96	25 lbs/100 gal	X						2
	+ Carzol	+ 1.5 lbs/A							
	Success	9.0 oz/A				X			
7.	M96	25 lbs/100 gal	X		X				2
	+ Dimethoate	+ 2.0 lbs-ai/A							
	Success	9.0 oz/A							
8.	Dimethoate	2.0 lbs-ai/A	X						3
	Baythroid	6.4 oz/A			X				
	Carzol	1.5 lbs/A						X	

X indicates when an application of the insecticide within each treatment regime was made, a blank spot indicates no insecticide was applied.

<sup>a</sup>All treatments were applied as needed based on a threshold of 10 or more immature citrus thrips per 100 fruit.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except treatments mixed with M96. Applications with M96 contained methanol (solvent) at 4 gal per 25 lbs of M96. Applications containing Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v.

Table 6. Experimental Test, 1998. Percentage of fruit infested with immature citrus thrips on lemons following applications 1, 2 and 3.

Treatment Regime <sup>ab</sup>	Applications and mean percentage fruit infested with immature citrus thrips (CT)									
	10 Apr Application # 1	13 Apr 3 DAT CT (74.3 F) <sup>c</sup>	16 Apr 6 DAT CT (72.7 F)	21 Apr 11 DAT CT (79.6 F)	28 Apr 18 DAT CT (82.1 F)	06 May 26 DAT CT (83.5 F)	08 May Application # 2	11 May 3 DAT CT (84.3 F)	15 May Application # 3	18 May 3 DAT CT (94.3 F)
	1.	Untreated	10.83 a	15.00 a	8.34 a	10.84 a	22.50 a	Untreated	22.50 a	Untreated
2.	AZEXP1-L	1.67 bc	4.17 b	3.34 b	1.67 b	15.83 b	AZEXP1-L	7.50 a	none	24.18 b
3.	AZEXP1-H	0.83 c	0.00 c	0.83 b	2.50 b	3.33 cd	none	16.65 a	AZEXP1-H	11.68 c
4.	AZEXP2-L	3.33 bc	0.83 bc	0.83 c	0.00 b	3.33 cd	none	14.20 a	AZEXP2-L	5.85 cd
5.	AZEXP2-H	4.17 bc	3.33 bc	0.83 b	0.00 b	0.83 d	none	13.33 a	AZEXP2-H	1.65 d
6.	M96 + Carzol	2.50 bc	1.67 bc	0.83 b	0.00 b	3.35 cd	none	7.50 a	none	11.68 c
7.	M96 + Dimethoate	0.83 c	1.67 bc	2.50 b	1.67 b	3.33 cd	none	10.03 a	Success	0.83 d
8.	Dimethoate	5.00 b	0.83 bc	1.67 b	2.50 b	8.33 c	none	15.83 a	Baythroid	7.50 cd

Means in a column followed by the same letter are not significantly different (F protected LSD  $P < 0.05$ ).

<sup>a</sup>Rates for each insecticide in each treatment regime are provided in Table 5.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except treatments mixed with M96. Applications with M96 contained methanol (solvent) at 4 gal per 25 lbs of M96. Applications containing Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v.

<sup>c</sup>Average maximum daily temperature F, from time of most recent application.

Table 7. Experimental Test, 1998. Percentage of fruit infested with immature citrus thrips on lemons following applications 4, 5 and 6, and fruit scarring evaluations.

Trt. Reg <sup>a</sup> b	Applications and mean percentage fruit infested with immature citrus thrips (CT)									Fruit scarring evaluations			
	19 May	22 May	28 May	29 May	01 Jun	04 Jun	05 Jun	08 Jun	12 Jun	Percentage damaged fruit <sup>c</sup>			
	Application # 4	3 DAT CT (85.3 F) <sup>c</sup>	9 DAT CT (89.0 F)	Application # 5	3 DAT CT (96.7 F)	6 DAT CT (93.5 F)	Application # 6	3 DAT CT (90.0 F)	7 DAT CT (91.0 F)	21 Aug	21 Aug		
										Damage rating 1- 5 <sup>d</sup>	none	slight	sign.
1.	Untreated	39.15 a	42.50 a	Untreated	46.65 a	39.18 a	Untreated	40.00 a	42.53 a	1.75 a	46.25 d	37.92 a	15.00 a
2.	AZEXP1-L	6.68 b	18.35 b	AZEXP1-L	17.5 b	23.35 b	AZEXP1-L	27.53 b	30.00 b	1.24 bc	79.17 b	18.34 b	2.50 b
3.	AZEXP1-H	5.00 b	18.33 b	AZEXP1-H	15.85 b	24.15 b	AZEXP1-H	12.50 c	25.83 bc	1.27 b	77.09 b	19.58 b	3.33 b
4.	none	3.33 b	0.83 c	none	7.50 cd	2.50 d	none	7.50 cd	17.53 cd	1.15 cd	87.08 c	11.25 c	1.67 b
5.	none	0.83 b	2.50 c	none	2.50 cd	4.18 cd	none	6.68 cde	17.50 cd	1.11 d	89.58 c	10.00 c	0.42 b
6.	Success	1.65 b	0.83 c	none	2.50 cd	0.83 d	none	0.83 e	5.00 e	1.13 d	87.92 c	11.25 c	0.84 b
7.	none	1.68 b	0.83 c	none	0.83 d	3.35 cd	none	4.15 de	6.68 e	1.10 d	90.00 c	10.00 c	0.00 b
8.	none	5.00 b	5.00 c	none	8.33 c	10.00 c	Carzol	4.18 de	9.18 de	1.20 bcd	81.25 b	17.50 b	1.25 b

Means in a column followed by the same letter are not significantly different (F protected LSD  $P < 0.05$ ).

<sup>a</sup>Rates for each insecticide in each treatment regime are provided in Table 5.

<sup>b</sup>All treatments were applied with Kinetic non-ionic surfactant at 0.1% v/v, except treatments mixed with M96. Applications with M96 contained methanol (solvent) at 4 gal per 25 lbs of M96. Applications containing Carzol or Dimethoate included Neutralizer buffer at 0.125% v/v.

<sup>c</sup>Average maximum daily temperature F, from time of most recent application.

<sup>d</sup>Damage rating (1-5) 1=no scarring, 2=slight scarring but not a complete circle around stem, 3=significant scarring, complete circle around stem, 4=significant scarring, complete circle around stem and some on shoulder, and 5=severe scarring, sides of fruit with scars.

<sup>e</sup>Percentage damaged fruit. none=percentage with no scarring, slight=percentage of fruit with damage ratings of 2, and sign.=significant scarring or percentage of fruit with damage ratings of 3 or higher.