

Residual Activity of Insecticides to Citrus Thrips on Lemon Foliage¹

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Abstract

The residual activity of insecticides to second instar citrus thrips was measured on lemon foliage in 1998. In April, Dimethoate and Agri-Mek provided only knockdown control of thrips, dropping to <70% mortality by 3 days after treatment (DAT). Baythroid performed slightly better, providing 95% mortality 3 DAT, but by 7 DAT was giving about 74% mortality. Alert, Carzol, Success and AZEXP-2 provided the longest residual activity, lasting 7 days, but began to slip at 14 DAT. AZEXP-1 induced only 74% 0 DAT. Although, residual activity in general was greater in June than April, however this increase in residual activity did not necessarily increase the length of commercially acceptable residual. Agri-Mek and Dimethoate still only provided knockdown activity, and Baythroid was still giving 3 days of good activity. AZEXP-1 performed much better following the June application relative to the April application, providing 3 days of adequate activity. Although we are not certain the reason for this result, it maybe due to the adsorption properties of this chemical relative to leaf physiology. Alert performed similarly in June and April, and Carzol, Success and AZEXP-2 each lasted about 1 week longer.

Introduction

An understanding of the level and length of control offered by insecticides is important for growers and pest control advisors (PCA's) to understand to best utilize these resources. A common question concerning citrus thrips *Scirtothrips citri* (Moulton), control in citrus is, "Under the current environmental conditions, how long can I expect an insecticide to provide thrips control"? Growers and PCA's often note that there is a great amount of variability in the residual activity of insecticides. In Arizona, Carzol has been reported to deliver residual control as long as 4 weeks, or as short as 1 week. In California, Baythroid is thought to offer at least 4 weeks of residual activity, but in Arizona it appears to offer as little as 1 week. There are several factors, which may greatly influence the residual activity of insecticides in citrus. New flush and fruit growth, leaf expansion, and temperature and light intensity are important factors that may affect the residual activity of many insecticides. If growers and PCA's could determine the best timing for insecticides, they could not only achieve better thrips control, but may also be able to reduce the number of applications. In Yuma, insecticide residual activity seems to drop as temperatures increase. Short residual insecticides are often just as effective as long residual insecticides if applied just before the onset of cool temperatures. On the other hand, one application of a long residual insecticide may provide the same length of control as 2 to 3 applications of a short residual material when temperatures are high. Thus, proper selection and timing of insecticides an extremely important consideration. The purpose of this research was to determine the length of residual activity of various insecticides to citrus thrips on lemon foliage.

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Materials and Methods

Five-year-old lemon trees grown at the Yuma Mesa Agricultural Center were used in this study. The tests were randomized complete block designs consisting of four replicates. Each plot (30 ft by 150 ft) consisted of five trees in a row spaced 30 ft apart. Prior to the insecticide application, six pieces of fully expand flush growth were chosen in each plot, and tagged using vinyl tape. Insecticides were applied using a Solo Backpack Airblast Sprayer calibrated to deliver 90 gal/acre. Insecticides included Alert at 0.30 lbs-ai/acre, Agri-Mek at 12.5 oz/acre, Baythroid at 6.4 oz/acre, Carzol at 1.5 lbs/acre, Dimethoate 4E at 2.0 lbs-ai/acre, Success at 9.0 oz/acre, AZEXP-1 at 0.1 lbs-ai/acre and AZEXP-2 at 0.2 lbs-ai/acre. All products except Agri-Mek contained Kinetic non-ionic spreader at 0.1% v/v. Agri-Mek included NR-415 citrus spray oil at 1.0 gal/acre. Insecticides were applied on 28 April and 2 June. Additional applications were scheduled for March and May, but low thrips numbers at the collection site prevented us from completing these evaluations. Different sets of trees were selected for treatment for each application.

Following application, 4 fully expanded but non-hardened leaves, selected from previously tagged flush, were removed from each plot at 0, 3, 7, 14, 21 and 28 days after treatment (DAT). These leaves were transported to the laboratory where they were placed individually into Munger cells. Leaves were oriented so that the bottom surface was exposed. Ten second instar citrus thrips were placed into each cell on the bottom of each leaf. The thrips were obtained from a young nearby commercial lemon grove that had not been treated with insecticides. Thrips were collected by aspirating them into soda straws. They were then anesthetized using carbon dioxide before transferring them into the Munger cells. Mortality in each Munger cell was assessed 48 hrs after infestation by counting the number of live and dead thrips under a dissecting microscope. Thrips that could not freely move about were considered dead.

Temperature data was obtained from the AZMET weather database system, from the weather station located at the University of Arizona Yuma Mesa Station, ca. 100-yds from the test site. Daily high and low temperature data are presented in °F for each 24-hr period following the insecticide application.

The percentage mortality within each Munger cell was corrected for mortality in the untreated check using Abbott's formula. Differences among treatments were separated using ANOVA and an F protected LSD, $P < 0.05$.

Results and Discussion

In this study, commercially acceptable mortality is 80%. Following the application made on 28 April there were distinct differences in the residual activity of the insecticides tested (Table 1, Figure 1). All the products tested caused >90% mortality at 0 DAT except AZEXP-1 which provided poor activity (73.66%). Dimethoate and Agri-Mek provided only knockdown control of thrips, dropping to <70% mortality 3 DAT. Baythroid performed slightly better, providing 95% mortality 3 DAT, but by 7 DAT was giving about 74% mortality. Alert, Carzol, Success and AZEXP-2 provided the longest residual activity, lasting 7 days, but began to slip at 14 DAT.

In general, treatments applied later in the season on 2 June provided longer residual activity than the early season application (Table 2, Figure2). This is in contrast to the hypothesis that insecticides are shorter lived late in the season when temperatures increase. Following the June application, temperatures were similar to the April application the first 7 DAT, but were roughly 10 F higher later in the trial (Figures 1 and 2). Since temperatures were similar to higher following the June application, the reason the insecticides provided longer residual activity may be due to a differences in physiological nature of the leaf tissue. Following the June application, the tagged flush growth hardened more quickly than those following the April application.

Although, residual activity in general was greater in June, this increase in residual activity did not necessarily increase the length of commercially acceptable residual activity. Agri-Mek and Dimethoate still only provided knockdown activity, and Baythroid was still giving 3 days of good activity. AZEXP-1 performed much better following the June application relative to the April application, providing 3 days of adequate activity. Although we are not certain the reason for this result, it maybe due to the adsorption properties of this chemical relative to leaf physiology. Alert performed similarly following the June application, and Carzol, Success and AZEXP-2 each lasted about 1 week longer.

Overall, Carzol, Success and AZEXP-2 should all be characterized as long residual materials, providing 7 to 14 days of control. Baythroid is moderate in its residual nature, lasting about 3 days, while Dimethoate and Agri-Mek should be considered knockdown materials, offer very little residual control. Because of the variability in the residual activity of AZEXP-1 between the two application dates, this product will require further study to fully characterize. Growers and PCA should keep in mind that these data represent true residual activity and not the length of control as influenced by the speed of thrips re-infestation. It is entirely possible that a grove treated with a short residual material may not require re-treatment for several weeks or more if for whatever reason, the next generation of thrips fails to infest the trees. This relationship with speed of re-infestation also helps explain why growers and PCA's often note that treatments last longer early in the season than later in the season. Essentially, the thrips populations develop more slowly under the cooler spring temperatures.

Table 1. Residual activity of insecticides to second instar citrus thrips nymphs on lemon foliage, 28 April 1998¹.

Treatment ³	Rate	% corrected mortality X days after treatment ²					
		0 DAT	3 DAT	7 DAT	14 DAT	21 DAT	28 DAT
Dimethoate	2.0 lbs-ai/A	92.26 a	66.25	41.93	16.49 cde	6.87 c	0.00 d
Agri-Mek	12.5 oz/A	95.54 a	36.39	53.67	31.65 cd	16.84 c	17.51 cd
Baythroid	6.4 oz/A	96.53 a	95.04	73.74	28.17 cd	23.49 bc	34.51 bc
Carzol	1.5 lbs/A	100 a	98.99	93.55	40.71 bc	52.77 a	29.83 bc
Alert	0.3 lbs-ai/A	98.52 a	96.40	92.88	57.57 ab	24.09 bc	40.30 abc
Success	9.0 oz/A	100 a	100	93.23	70.04 a	46.56 ab	58.90 a
AZEXP-1	0.1 lbs-ai/A	73.66 b	11.14	13.02	9.52 de	16.74 c	21.93 bcd
AZEXP-2	0.2 lbs-ai/A	95.37 a	94.29	94.49	60.41 ab	24.88 bc	42.92 ab
Untreated		0.00 c	0.00	0.00	0.00 e	0.00 c	0.00 d

¹Means in a column followed by the same letter are not significantly different based on a F protected LSD $P < 0.05$.

²Percentage mortality within each treatment was corrected for control mortality using Abbott's formula.

³All treatments included Kinetic at 0.1% v/v except Agri-Mek which contained NR-415 spray oil at 1.0 gal/A.

Table 2. Residual activity of insecticides to second instar citrus thrips nymphs on lemon foliage, 2 June 1998¹.

Treatment ³	Rate	% corrected mortality X days after treatment ²					
		0 DAT	3 DAT	7 DAT	14 DAT	21 DAT	28 DAT
Dimethoate	2.0 lbs-ai/A	99.29 a	70.56 c	26.86 f	7.47 e	17.01 d	2.08 d
Agri-Mek	12.5 oz/A	95.54 b	59.30 d	42.22 e	32.64 d	10.51 de	13.04 cd
Baythroid	6.4 oz/A	100 a	94.86 a	76.85 cd	60.96 c	39.30 c	28.29 bc
Carzol	1.5 lbs/A	100 a	100 a	97.98 a	91.30 a	78.97 a	60.09 a
Alert	0.3 lbs-ai/A	100 a	100 a	95.62 ab	77.05 b	58.21 b	45.85 ab
Success	9.0 oz/A	100 a	99.49 a	95.59 ab	85.41 ab	73.76 ab	56.31 a
AZEXP-1	0.1 lbs-ai/A	98.87 ab	82.65 b	67.90 d	55.34 c	25.53 cd	7.19 d
AZEXP-2	0.2 lbs-ai/A	100 a	94.67 a	83.68 bc	84.18 ab	66.45 ab	50.72 a
Untreated		0.00 c	0.00 e	0.00 g	0.00 e	0.00 e	0.00 d

¹Means in a column followed by the same letter are not significantly different based on a F protected LSD $P < 0.05$.

²Percentage mortality within each treatment was corrected for control mortality using Abbott's formula.

³All treatments included Kinetic at 0.1% v/v except Agri-Mek which contained NR-415 spray oil at 1.0 gal/A.

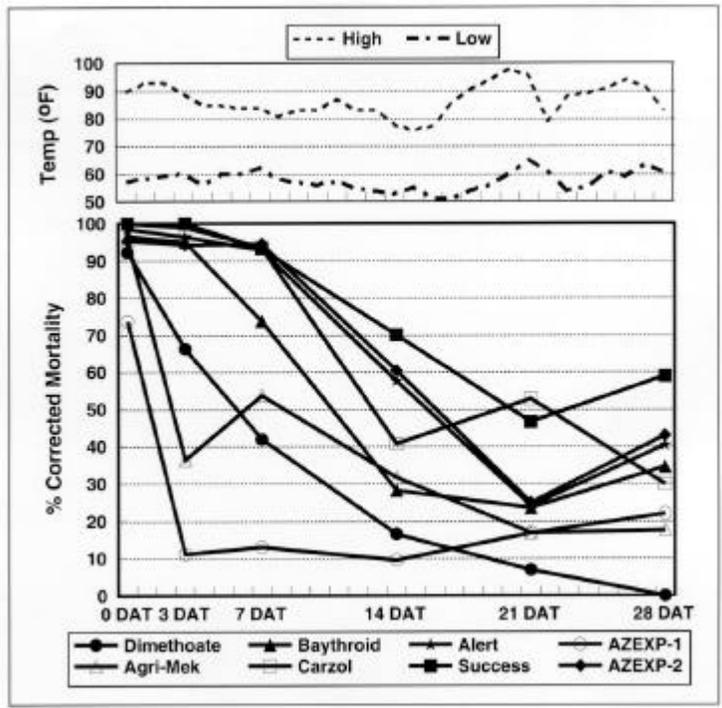


Figure 1. Residual mortality of second instar citrus thrips on lemon foliage treated on 28 April, ¼ inch diameter fruit.

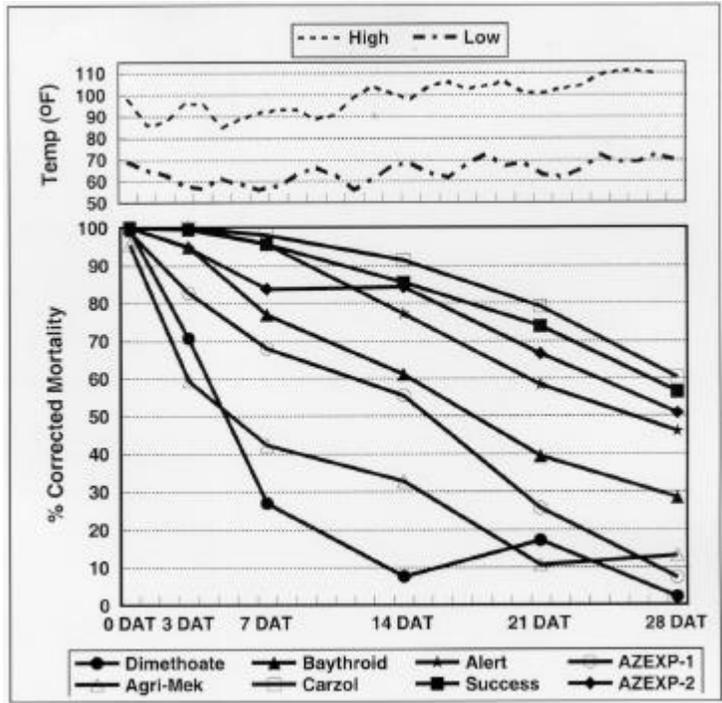


Figure 2. Residual mortality of second instar citrus thrips on lemon foliage treated on 2 June, 1.0 inch diameter fruit.