Effects of Insecticides on Leafminers, *Liriomyza* spp., and Associated Parasitoids on Spring Cantaloupes

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Abstract

A study was conducted to determine the effects of repeated insecticide applications on leafminer and parasitoid populations on spring melons. After four applications, none of the insecticides induced large build-ups of leafminer larvae. A new material, AC 303630, was very effective in maintaining low numbers of pupae. However, the results of this preliminary test indicate that all insecticides tested had a negative impact on the parasitoid population. In general, in the absence of insectcides, parasitoids were capable of maintaining L. sativae populations at low levels in the experimental plots.

Introduction

Liriomyza leafminers have recently emerged as a key pest of melons crops, occurring sporadically throughout Arizona. Many entomologists believe that outbreaks of leafminers occur because of the use patterns of broad-spectrum insecticides, and their impact on natural enemies within the cropping system (Trumble 1990, Trumble & Toscano 1983, Oatman & Kennedy 1976). Studies in the 1940's reported that leafminers in the Salt River Valley of Arizona were held to low numbers by parasitism in the absence of DDT applications (Hills & Taylor 1951). In the Yuma Valley, populations of Liriomyza on melon crops are usually heavily parasitized (Palumbo, unpublished data). Many species of parasitoids have been recorded from these leafminers on cantaloupe and lettuce crops. However, no previous work has been conducted on cantaloupes to look at the effects of the newer chemistries of insecticides on leafminers and their parasitoids. Therefore, studies were initiated to investigate the impact of labeled, and unregistered insecticides on the population ecology of *Liriomyza* on spring cantaloupes.

Materials and Methods

A field study were conducted at the Univ. of Arizona, Yuma Valley Ag Center, Yuma in the spring of 1991. The investigation was made on an open-pollinated cantaloupe variety, 'traveler', direct-seeded on April 12, 1991. Beds were spaced 80" between rows, and plants were thinned at 12 inch intervals. Plants were grown using local, commercial practices. Field plots were arranged in a completely randomized block design with 4 replicates, and consisted of 6 rows, 50 ft long on 80 in centers with a 6.7 ft buffer on each plot side. Insecticide treatments were applied with a tractor-mounted boom sprayer (4 nozzles/row) operated at 40 psi, delivering 35 gal water\acre. Applications were first initiated when vines exceeded a length of 1.5 ft.

The following treatments were applied to each plot: Lannate L at 0.75 lb ai/acre; Capture 2EC at 0.03 lb ai/acre; AC 303630 (24SC) at 0.20 lb ai/acre, and Larvin at 0.75 lb ai/acre. An untreated control plot was included.

Applications were made 18, 25 June, and 3, 10 July. Samples were collected on 16, 26 June, 4, 10, and 18 July. Twenty fully-expanded leaves taken from the middle of each vine were collected from the inside 2 rows of each plot and taken immediately to the laboratory. The samples were placed in emergences containers constructed from cylindrical, ice cream cartons (1.5 liter) with a organdy covering to allow for ventilation. After 3 weeks, emerged insects were identified and recorded. Specimens of each species of Liriomyza were identified by Dr. Eric Fisher, Calif. Dept. of Food & Agric., Sacramento. Parasitoids were identified down to genus by Gordon Gordh, University of California, Riverside, and Floyd Werner and Carl Olsen, Dept. Of Entomology, Univ. Of Arizona.

Results and Discussion

Table 1. shows the periodic results of leafminer and parasitoid population densities relative to several insecticide applications. The pre-treatment sample conducted on June 16 indicated that although means were variable, there were no significant differences in emergent *Liriomyza* or parasitoid adults per leaf among the treatments. At this time in the growing season, the infestations were considered low-moderate. At 1-day after the second application (26 June), all insecticide treatments resulted in the reduction of emergent *Liriomyza* adults as compared with the pretreatment sample. Plots treated with Capture and AC 303630 appeared to have the greatest initial reduction.

After the third application, Lannate plots had significantly more *Liriomyza* than any other treatment (July 4; Table 1). It appeared that Lannate did not provide any measurable control of leafminers, while resulting in a reduction in parasitoid numbers. This is consistent with findings of Trumble and Toscano (1983) in celery. However, the density level was lower than the initial population level at the beginning of the treatment applications. None of the other insecticide treatments were significantly lower than the untreated check, which contained significantly greater numbers of parasitoids. No parasitoids were observed in the AC 303630 plots on this date. On July 10, the number of leafminer and parasitoid adults emerged from leaves in Lannate plots were not significantly different than the untreated plots. We are uncertain why the sudden switch in population densities occurred in Lannate treated plots. However, leaves treated with the AC 303630 yielded significantly fewer leafminer adults that the other sprays and the untreated. In addition, AC 303630 treated leaves contained no parasitoid adults. Whether this occurred because of direct mortality of the natural enemies or fewer hosts for the parasitoids is unknown. Although Capture and Larvin plots contained similar number of leafminers as the untreated, they contained significantly fewer parasitized pupae.

On the final sample date, no significant differences in the number of emergent *Liriomyza* adults per leaf were detected among treatments. In addition, the population density of each treatment was well below the initial population at the beginning of the study. Parasitoid populations were reduced in all of the treatments with the exception of Lannate and the untreated check. Melons on the crown set were about 2 weeks from harvest at this time. However, insecticide applications were terminated due to a heavy infestation of sweet potato whitefly, *Bemisia tabaci*. The populations were high in all plots and may have confounded the results of the last sample because of vine wilting and honeydew accumulation.

Table 2. shows the seasonal average number of emergent *Liriomyza* and parasitoid adults per leaf. When averaged across all samples, Lannate plots contained significantly greater numbers of *Liriomyza* adults per leaf than any other treatment in the study. AC 303630 contained a significantly lower number of leafminers, and Capture and Larvin were not significantly different from the check, but were lower than Lannate. In addition, these plots contained significantly lower number of parasitoids when compared with Lannate and the check. All treatments, with the exception of AC 303630 had a higher leafminer/parasitoid ratio than the untreated check.

The differences in the leafminer numbers observed among treatments in this study were primarily a result of insecticidal efficacy on *L. sativae* (Table 2). This leafminer species was predominant during the study, accounting for greater than 80 % of all adults recorded. There were no detectable differences among treatments in the number of *L. trifolii* adults. This may have occurred because of their low numbers, as populations in the Yuma area occur at lower levels than in other growing regions of the state (Palumbo 1992, Palumbo 1991). In addition, resident populations of *L. trifolii* may be more susceptible to insecticides because they were just recently introduced in 1987.

The results of this study demonstrated that after four repeated applications, none of the insecticides flared leafminer populations. Although seasonal leafminer numbers were greater in Lannate plots, the numbers observed at the end of the study were lower than when the study began. This does not concur with results of others in crops such as celery and tomatoes. There may be several reasons why this did not occur during our study. First, only 4 applications were made. However, it is unlikely that a greater number of sequential applications of Lannate would be used in a melon IPM program. In addition, inter-specific competition with whiteflys, and honeydew on the upper leaf surfaces late in the study may have influenced leafminer feeding and ovipositional behavior. However, we cannot quantitatively account for that occurrence. It may be concluded though that Lannate is not very toxic against leafminer. Our data does suggest though, that it is relatively toxic to parasitoids, as indicated by the ratio of emergent Liriomyza/parasitoid (Table 2). However, all of the compounds used in this study appeared to have a negative impact on parasitoid populations when used repeatedly.

Liriomyza populations were maintained at low levels throughout the study, regardless of whether they were treated with insecticide or not. Populations of *Liriomyza* in the untreated plots remained fairly constant throughout the study largely due to parasitism. The untreated control contained significantly greater numbers of parasitoids relative to the number of emerging adults leafminers. Table 3 provides the percentage of total parasitoid species which were emerged from samples in each treatment. The only real obvious differences were in the number of Diglyphus spp., a larval parasitoid. The check contained a significantly higher percentage than any other treatment. The chemical differences among each insecticide may partially explain differences in species composition of the parasitoid complex.

In conclusion, preliminary data collected in this study suggest that all of the insecticides tested had a negative impact on parasitoids of *Liriomyza*. However, the full impact of insecticidal control on the population ecology of *Liriomyza* and it's parasitoids can not be determined from this study, primarily because of the unexpected occurrence of *B. tabaci*. We are now planning to replicate this study in 1992, and hope to prevent whiteflys from becoming a confounding factor. The newer chemistries of AC 303630 and Capture show promise as effective insecticides against *L. sativae*. Although results from this preliminary study indicate that they may be hard on natural enemies, they appeared to compensate for this by their efficacy on *L. sativae*. Their effect on *L. trifolii* could not be assessed from this study. The concern of whether Lannate or the other compounds flare leafminers in cantaloupes could not be completely resolved in this study.

Literature Cited

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Table 1. Influence of insecticides on the emergence of *Liriomyza* and associated parasitoids from cantaloupes at Yuma, AZ, 1991.

Date	Treatment	Mean no. *Liriomyza* adults per leaf[a]	Mean no. parasitoid adults per leaf[a]	Ratio of emergent *Liriomyza*/parasitoid
16 June	Lannate	5.2 a	0.70 a	7.4 a
	Larvin	4.2 a	0.73 a	5.8 a
	Capture	3.8 a	0.70 a	5.4 a
	AC 303630	5.5 a	0.43 a	12.8 a
	Untreated	3.0 a	0.68 a	4.4 a
26 June	Lannate	3.8 a	0.27 b	14.1 a
	Larvin	1.7 ab	0.17 b	10.0 a
	Capture	0.8 b	0.05 b	16.0 a
	AC 303630	0.3 b	0.03 b	10.0 a
	Untreated	1.7 ab	0.82 a	1.7 b
4 July	Lannate	4.5 a	0.41 b	11.3 a
	Larvin	1.8 b	0.20 b	9.0 a
	Capture	1.2 b	0.10 b	12.0 a
	AC 303630	1.6 b	0.00 b	--
	Untreated	1.9 b	1.22 a	1.6 b
10 July	Lannate	2.5 a	1.05 a	2.3 b
	Larvin	2.1 a	0.30 b	7.0 ab
	Capture	2.3 a	0.20 b	11.5 a
	AC 303630	0.1 b	0.00 b	--
	Untreated	2.3 a	1.25 a	1.6 b
18 July	Lannate	3.3 a	2.36 a	1.4 a
	Larvin	2.6 a	0.40 b	6.5 ab
	Capture	2.5 a	0.50 b	5.5 ab
	AC 303630	1.3 a	0.10 b	12.0 b
	Untreated	2.7 a	2.62 a	1.0 a

Means in columns followed by the same letter are not significantly different at the ($P < 0.05$ level, LSD).

a Populations were assessed by placing infested leaves in emergence containers for a 3 week period and then counting the number of emerged adults. Sample consisted of 2 fully expanded leaves/plant; 10 plants/replicate.

Table 2. Seasonal mean numbers of *Liriomyza* and associated parasitoids from cantaloupes as influence by several insecticide regimes at Yuma, AZ, Spring 1991.

Treatment	Mean no. of *Liriomyza* per leaf[a]			Mean parasitoids adults per leaf	Ratio of emergent *Liriomyza*/parasitoid
	sativae	*trifolii*	Total		
Lannate	3.18 a	0.66 a	3.86 a	0.98 a	7.3 a
Larvin	1.94 b	0.52 a	2.46 b	0.36 b	7.7 a
Capture	1.64 bc	0.48 a	2.12 bc	0.31 b	10.1 a
AC 303630	1.06 c	0.24 a	1.34 c	0.18 b	6.9 ab
Untreated	2.02 b	0.32 a	2.26 bc	1.31 a	2.1 b

Means in columns followed by the same letter are not significantly different at the (P <0.05 level, LSD).

a Populations were assessed by placing infested leaves in emergence containers for a 3 week period and then counting the number of emerged adults. Sample consisted of 2 fully expanded leaves/plant; 10 plants/replicate; 5 weekly samples.

Table 3. Species composition of leafminer parasitoids emerging from cantaloupes treated with selected insecticides[a]

Treatment	Percent of total parasites emerged[b]			
	Diglyphus spp.	*Chrysocharis* spp.	*Halticoptera* spp.	Braconidae[c]
Lannate	9.6 b	44.0 a	14.1 b	32.6 a
Larvin	0.9 b	67.7 a	12.6 b	18.8 ab
Capture	5.7 b	47.5 a	40.7 ab	6.1 b
AC 303630	6.2 b	25.3 a	32.9 a	25.6 a
Control	21.6 a	41.0 a	25.2 ab	12.3 ab

a Populations were assessed by placing infested leaves in emergence containers for a 3 week period and then counting the number of emerged adults. Sample consisted of 2 fully expanded leaves/plant; 10 plants/replicate; 5 weekly samples.

b Arcsine transformation prior to analysis; means in columns followed by same letter followed by the same letter are not significantly different at the (P <0.05 level, LSD).

c At the present time, these specimens have only been identified to Family; we believe two genera are present.