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EFFECTS OF SELECTED DEFOLIANTS ALONE AND IN COMBINATION WITH INSECTICIDES ON SILVERLEAF WHITEFLY AND PARASITOIDS IN COTTON

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Abstract

Effects of Def and Dropp alone and in combination with two insecticides, Karate (a pyrethroid) and Guthion (an organophosphate) on silverleaf whitefly, *Bemisia argentifolii* Bellows & Perring were determined in 2001. The defoliants, Def and Dropp, and their combinations with Guthion and Karate significantly affected the infection and survival of both silverleaf whiteflies and their parasitoids, *Encarsia* spp. and *Eretmocerus* spp, although the effects varied greatly among the treatments. Karate had no significant effects on silverleaf whitefly and its parasitoids. Combining defoliants and insecticides increased the effectiveness on whiteflies and parasitoids on cotton.

Introduction

Cotton is generally considered as a source of silverleaf whitefly of nearby vegetables in south Texas (Legaspi et al. 1997, Liu unpublished data). However, cotton could serve as sources of the whitefly's natural enemies as well. Both Def (S,S,S-tributylphosphorotrithioate) and Dropp (thidiazuron) have been used as defoliants for cotton. During the cotton defoliation season, whiteflies take off from the defoliated leaves where they were feeding and emerging, and migrate to nearby field crops or weeds. Enormous numbers of whiteflies have been found on all "green" wide-leaf plants, including summer-fall vegetables and many species of weeds, after cotton defoliation. At that time, whiteflies can also be seen on vehicles, farming machinery, people, and in the open air. It is not unusual to find that the leaves of some small plants are totally covered by whitefly adults. In addition, some older nymphs on defoliated cotton leaves are able to continue their development to adults that will migrate to new hosts. Similarly, parasitoids and predators of whiteflies and other insects have to migrate or disperse to nearby environment for new hosts or prey. Some endoparasitoids (i.e. *Eretmocerus* spp. and *Encarsia* spp.) of whitefly in the hosts on defoliated leaves gradually mature and emerge, then disperse to new environment for hosts, and others die before emergence.

Liu et al. (2001) found that application of Def for defoliation of cotton in the field had little effects on the eggs, second and older instar nymphs of silverleaf whitefly. However, application of Def significant reduced the survival rate (30%) of first instar nymphs compared with untreated control (70%). Def, in combination with two insecticides, Karate and Guthion also decreased the survival rates of first, second and third instar nymphs. Almost all chemical treatments did not significantly affect the survival rate of fourth instar nymphs and pupae compared with untreated control. Although numbers of *B. argentifolii* adults caught on yellow sticky cards varied greatly among treatments on different dates, the differences were generally not significant. However, numbers of parasitoids, *Eretmocerus* spp. and *Encarsia* spp., caught on yellow sticky cards were significantly fewer in the plots treated with Def, Def + Guthion and Def + Karate and in untreated control than those in the plots treated with Karate and Guthion alone.

Although defoliants are used in every season in south Texas, the role of these defoliants on *B. argentifolii* and their natural enemies have not been fully understood. The objective of this study was to determine the effects of defoliants, Def and Dropp alone or in combination with Karate and Guthion on survival of *B. argentifolii* and their parasitoids after the defoliants and insecticides were applied.

Materials and Methods

Cotton Field and Experimental Design

Detailed information on the cotton field and experimental design has been described in Greenberg et al. (2002). Each experimental plot was 6 rows of cotton and 45 m long. Each treatment had three replications. Defoliant and insecticides were applied on 24 July 2001.

Chemicals
Two defoliants, Def 6 (S,S,S-tributylphosphorotrithioate, Bayer, Kansas City, MO); Dropp (50% thidiazuron, Aventis [AgrEvo], Wilmington, DE), and two insecticides, a pyrethroid, Karate 2.08CS (lambda-cyhalothrin, Zeneca, Wilmington, DE), and an organophosphate, Guthion 2L (azinphosmethyl, Bayer, Kansas City, MO), were used in this study.

Treatments
There were eight treatments with different combinations of defoliants and insecticides at different rates: 1. Def (2 pts/ac)+Dropp (0.2lb/ac) + Guthion (0.25 lb/ac); 2. Def (1 pt/ac) + Dropp (0.1 lb/ac); 3. Dropp (0.2 lb/ac) + Guthion (0.5 lb/ac); 4. Def (2 pt/ac) + Guthion (0.25 lb/ac); 5. Def (2 pt/ac) + Karate (0.03 lb AI/ac); 6. Guthion (0.5 lb AI/ac); 7. Karate (0.03 lb AI/ac), and 8. untreated control.

Laboratory Examination - Whitefly Adult and Parasitoid Adult Emergence
To test the effect of applied chemicals on adult emergence for *B. argentifolii*, the third, and fifth and seventh leaf from the terminal was collected after chemical applications. The leaves were placed in paper bags and held in the laboratory for 3-4 weeks. Numbers of whitefly and parasitoid adults emerged from each bag were examined.

Data Analysis
Numbers of *B. argentifolii* adults and parasitoid adults emerged on treated leaves, were analyzed using analysis of variance, and means were separated using the least significant different test (SAS Institute 1996).

Results and Discussion

As shown in Table 1, numbers of whiteflies were significantly reduced on the leaves sampled on 26 July treated with defoliants and their combination with Karate and Guthion except for the cotton leaves treated Karate and Def + Dropp at 0.5X rate on which number of whiteflies was nor significantly different from those on untreated leaves.

Defoliants and their combinations with insecticides also significantly reduced the number of silverleaf whitefly parasitized (Table 2). Again, untreated leaves had the most parasitized whiteflies, followed by Karate-treated leaves, and then other treated leaves. Cotton leaves that treated with Def + Dropp + Guthion al 0.5X rate and Def + Guthion at 1.0X rate had the least number of parasitized whiteflies.

Few whiteflies and parasitoids were found on the cotton leaves sampled on 16 August when leaves were almost defoliated. Therefore, there were no significant differences in numbers of whiteflies and parasitoids on sampled leaves (Tables 3 and 4).

Table 5 shows numbers of *B. argentifolii* adults emerged from treated leaves after treatment. Cotton leaves treated with defoliants alone or in combination with Karate and Guthion reduced number of whitefly adults emerged in the samples on 26 July, although numbers of adults emerged in the treatments of Guthion and Karate alone and Def + Guthion at 1.0X rate were not significantly different from that in untreated control. There were no significant differences for both whitefly adult and parasitoids emerged for the samples in 16 August.

In conclusion, defoliants, Def and Dropp, and their combinations with Guthion and Karate significantly affected the infection and survival of both silverleaf whiteflies and their parasitoids, *Encarsia* spp. and *Eretmocerus* spp, although the effects varied greatly among the treatments. Karate had no significant effects on silverleaf whitefly and its parasitoids. Combining defoliants and insecticides increased the effectiveness on whiteflies and parasitoids on cotton.

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Table 1. Numbers of large nymphs and pupae of silverleaf whitefly on defoliant and insecticides treated cotton leaves sampled on 26 July.

	Number of whiteflies per leaf			
Treatments*	**3rd instar**	**4th instar**	**Pupae**	**Total**
Untreated control	5.1a	5.1a	0.7a	10.9a
Def + Dropp + Guthion, all 0.5X	0.7b	1.5b	0.3b	2.4c
Def + Dropp, all 0.5X	1.6b	4.3ab	0.3b	6.2abc
Def + Guthion, all 1.0X	0.9b	2.8b	0.3b	4.1bc
Def 1.0X + Guthion 0.5X	0.7b	3.3b	0.6b	4.5bc
Def 1.0X + Karate 0.5X	0.6b	2.1b	0.1b	2.7c
Guthion 1.0X	1.4b	1.8b	0.4b	3.6bc
Karate 1.0X	2.3b	4.3ab	1.5ab	8.1ab
F (df = 7, 112)	3.67	2.16	2.68	3.19
P	0.0013	0.0432	0.0132	0.0041

* Def 1.0X = 2 pt/ac; Dropp 1.0X = 0.5 lb/ac; Karate 1.0X = 0.03 lb AI/ac; Guthion 1.0X = 0.5 lb AI/ac.
** Means followed by the same letter do not differ significantly at P = 0.05 (LSD, SAS Institute 2000).

Table 2. Numbers of parasitized nymphs and pupae of silverleaf whitefly on defoliant and insecticides treated cotton leaves sampled on 26 July.

	Number of parasitoids per leaf			
Treatments*	**Parasitized nymphs**	**Parasitized pupae**	**Parasitoid emerged cases**	**Total**
Untreated control	3.0a	1.3a	1.9a	6.1a
Def + Dropp + Guthion, all 0.5X	0.5b	0.3bc	0.3b	1.0c
Def + Dropp, all 0.5X	0.5b	0.5bc	0.3b	1.3bc
Def + Guthion, all 1.0X	0.3b	0.2c	0.2b	0.7c
Def 1.0X + Guthion 0.5X	1.0b	0.2c	0.3b	1.5bc
Def 1.0X + Karate 0.5X	0.6b	0.1c	0.5b	1.2bc
Guthion 1.0X	1.3b	0.4bc	0.5b	2.3bc
Karate 1.0X	1.4b	0.9ab	0.8b	3.1b
F (df = 7, 112)	5.84	3.35	4.06	8.07
P	0.0001	0.0028	0.0005	0.0001

* Def 1.0X = 2 pt/ac; Dropp 1.0X = 0.5 lb/ac; Karate 1.0X = 0.03 lb AI/ac; Guthion 1.0X = 0.5 lb AI/ac.
** Means followed by the same letter do not differ significantly at P = 0.05 (LSD, SAS Institute 2000).

Table 3. Numbers of large nymphs and pupae of silverleaf whitefly on defoliant and insecticides treated cotton leaves sampled on 16 August.

	Number of whiteflies per leaf			
Treatments*	**3rd instar**	**4th instar**	**Pupae**	**Total**
Untreated control	0.0b	0.0	0.1	0.1ab
Def + Dropp + Guthion, all 0.5X	0.3a	0.1	0.0	0.3a
Def + Dropp, all 0.5X	0.1b	0.0	0.0	0.0b
Def + Guthion, all 1.0X	0.0b	0.0	0.0	0.1b
Def 1.0X + Guthion 0.5X	0.0b	0.0	0.0	0.0b
Def 1.0X + Karate 0.5X	0.2a	0.1	0.0	0.3a
Guthion 1.0X	0.0b	0.0	0.0	0.0b
Karate 1.0X	0.0b	0.0	0.0	0.0b
F (df = 7, 112)	2.85	1.55	1.00	3.87
P	0.0090	0.1578	0.4352	0.0008

* Def 1.0X = 2 pt/ac; Dropp 1.0X = 0.5 lb/ac; Karate 1.0X = 0.03 lb AI/ac; Guthion 1.0X = 0.5 lb AI/ac.
** Means followed by the same letter do not differ significantly at P = 0.05 (LSD, SAS Institute 2000).

Table 4. Numbers of parasitized nymphs and pupae of silverleaf whitefly on defoliant and insecticides treated cotton leaves sampled on 16 August.

	Number of parasitoids per leaf			
Treatments*	**Parasitized nymphs**	**Parasitized pupae**	**Parasitoid emerged cases**	**Total**
Untreated control	0.0	0.1	0.0	0.1
Def + Dropp + Guthion, all 0.5X	0.0	0.1	0.1	0.2
Def + Dropp, all 0.5X	0.0	0.0	0.1	0.1
Def + Guthion, all 1.0X	0.0	0.1	0.2	0.3
Def 1.0X + Guthion 0.5X	0.0	0.0	0.2	0.2
Def 1.0X + Karate 0.5X	0.2	0.2	0.1	0.3
Guthion 1.0X	0.0	0.0	0.0	0.0
Karate 1.0X	0.0	0.1	0.1	0.3
F (df = 7, 112)	.	1.22	0.88	1.31
P	.	0.2955	0.5255	0.2540

* Def 1.0X = 2 pt/ac; Dropp 1.0X = 0.5 lb/ac; Karate 1.0X = 0.03 lb AI/ac; Guthion 1.0X = 0.5 lb AI/ac.
** Means followed by the same letter do not differ significantly at P = 0.05 (LSD, SAS Institute 2000).

Table 5. Numbers of whitefly adults and parasitoid adults emerged from 20 cotton leaves after application of defoliants and insecticides sampled on 26 July and 16 August 2001.

	26 July		16 August	
Treatments*	**Whiteflies emerged**	**Parasitoids emerged**	**Whiteflies emerged**	**Parasitoids emerged**
Untreated control	8.0a	10.0	0.3	1.3
Def + Dropp + Guthion, all 0.5X	0.3b	1.3	0.0	0.0
Def + Dropp, all 0.5X	0.7b	5.3	0.0	0.0
Def + Guthion, all 1.0X	3.3a	1.7	0.0	0.0
Def 1.0X + Guthion 0.5X	1.3b	1.3	0.0	0.0
Def 1.0X + Karate 0.5X	1.0b	6.0	0.3	0.0
Guthion 1.0X	3.0ab	3.3	0.0	0.0
Karate 1.0X	4.0ab	7.0	0.0	0.0
F (df = 7, 16)	2.18	1.06	0.86	1.00
P	0.0930	0.4306	0.5585	0.4663

* Def 1.0X = 2 pt/ac; Dropp 1.0X = 0.5 lb/ac; Karate 1.0X = 0.03 lb AI/ac; Guthion 1.0X = 0.5 lb AI/ac.
** Means followed by the same letter do not differ significantly at P = 0.05 (LSD, SAS Institute 2000).