EFFICACY OF INSECTICIDES AGAINST *SPISSISTILUS FESTINUS* (SAY),[1] *EMPOASCA FABAE* (HARRIS),[2] AND *LYGUS LINEOLARIS* (PALISOT DE BEAUVOIS)[3] IN ALFALFA IN GEORGIA[4]

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ABSTRACT

Eleven insecticides were evaluated against the threecornered alfalfa hopper, *Spissistilus festinus* (Say), the potato leafhopper, *Empoasca fabae* (Harris), and the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), in alfalfa. Control of *S. festinus* was extended to 28 d post-treatment with a single application of cypermethrin applied to the alfalfa stubble. Control of *E. fabae* was achieved with the majority of the insecticides evaluated, but control of *L. lineolaris* was more difficult to obtain.

Key Words: Alfalfa, threecornered alfalfa hopper, potato leafhopper, tarnished plant bug, insecticides.

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INTRODUCTION

Alfalfa, *Medicago sativa* L., is an important forage crop throughout the United States. Traditionally, alfalfa production in Georgia has been concentrated in the Piedmont and Mountain regions, however with the development of better adapted varieties, production has been expanding to the Coastal Plain region as well.

The threecornered alfalfa hopper (TCAH), *Spissistilus festinus* (Say), the potato leafhopper (PLH), *Empoasca fabae* (Harris), and the tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), are all known to cause economic damage to alfalfa (Kouskolekas and Decker 1968; Wilson et al. 1979; Walstrom 1983; Wildermuth 1915). In Georgia the potential for damage on alfalfa by these three insect pests exists primarily on the third and subsequent cuttings. However, detailed information is lacking concerning the seasonal abundance, management strategies, and potential for economic damage for *E. fabae, S. festinus,* and *L. lineolaris* with respect to alfalfa in the southeastern United States. This study reports on the efficacy of selected insecticides against these three potential insect pests of alfalfa in Georgia.

MATERIALS AND METHODS

Efficacy of selected registered and non-registered insecticides were evaluated against the threecornered alfalfa hopper, the potato leafhopper, and the tarnished

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[2] Homoptera: Cicadellidae.
[3] Hemiptera: Miridae.
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plant bug during the 1983 and 1984 seasons. Two alfalfa fields (var. 'Florida 77') located at the Southwest Georgia Branch Station, Plains, GA, were used for the study. These fields had been planted in October of 1982 and 1983, respectively, and managed according to standard agricultural practices.

The use of the term "cutting" applies to the period of alfalfa regrowth prior to the time of harvest (i.e. the third cutting would be the period of regrowth prior to the third time the alfalfa was cut that season).

Insecticide screening tests were conducted in 1983 on the third, fourth, and fifth cuttings. Test in 1984 were conducted on the third and fifth alfalfa cuttings to assess the effects of type of and time of insecticide application during alfalfa regrowth within a cutting period. Insecticides were applied as follows: 1) within one week of cutting (stubble); 2) three weeks after the cutting (3-wk); or 3) spray applied at weekly intervals for the first three weeks of regrowth (maximum). Insecticides, rates, and times of application are provided in the tables for each of the screening tests conducted.

During both years insecticides were applied by means of a two-wheeled boom sprayer (1.7 m) equiped with a CO_2 spray system that was calibrated to deliver 92 liters of water/ha. Eleven insecticides were evaluated at various rates. Individual plot sizes measured 5 × 5 m and 9 × 9 m in 1983 and 1984, respectively. During both seasons a minimum of four replications were conducted for any given test.

Insect counts were made by means of a standard sweep net (38 cm diam.), with 20 sweeps taken per plot per sampling date. Samples were transported to the laboratory and held in a freezer until time of counting.

A randomized complete block design was used for all of the insecticide screening tests. Data were analyzed by the analysis of variance (Statistical Analysis System, Inc.). Duncan's multiple range test was used to determine differences between means (Duncan 1955). Significance was determined at $P < 0.05$ for all tests.

RESULTS AND DISCUSSION

Since detailed survey information does not yet exist for *S. festinus, E. fabae,* nor *L. lineolaris,* no conclusions can be made regarding the degree of abundance of these three pests during the two seasons of this study. Additional years of data are needed.

In general, adult TCAH were more abundant during 1984 than in 1983, however the reverse was true for adult PLH (Tables 1 and 2). Numbers of adult TPB were comparable in both years (Tables 1 and 5).

Results of the various insect screening tests are presented in Tables 1 - 6. Specifics, with respect to the degree of control achieved by using the different insecticides evaluated, can be obtained directly from the tables. Although a detailed account of each test seems unnecessary, a brief description with respect to control of each of the pests in question does seem warranted.

Threecornered Alfalfa Hopper Control. Adult TCAH abundance peaked during the fifth cutting in 1984, with a mean of 109.4 per 20 sweeps detected on 11 September (Table 6). Usage of either carbaryl, cypermethrin, fenvalerate, or methyl parathion resulted in reductions in TCAH abundance that were significant when compared to the untreated checks (Tables 1 - 6). Conversely chlorpyrifos,

Table 1. Efficacy of selected insecticides against adults of the threecornered alfalfa hopper (TCAH), the potato leafhopper (PLH), and the tarnished plant bug (TPB) on the third and fourth alfalfa cuttings. Plains, GA, 1983.

THIRD CUTTING				
	Rate	Mean no. per 20 sweeps: 6 July		
Insecticide*	(kg ai/ha)	TCAH	PLH	TPB
Carbaryl	1.10	3.4 a†	0.6	12.8
Cypermethrin	0.07	1.6 a	0.4	11.4
Untreated check	—	6.0 b	2.8	14.8
			N.S.	N.S.
		Mean no. per 20 sweeps: 12 July		
Carbaryl		5.4 a	5.2 a	21.6 ab
Cypermethrin		7.8 b	3.8 a	30.8 b
Untreated check		9.8 bc	13.6 b	17.8 a
FOURTH CUTTING				
		Mean no. per 20 sweeps: 10 August		
Insecticide‡	(kg ai/ha)	TCAH	PLH	TPB
Carbaryl	1.10	7.5 ab†	3.0 ab	6.8
Cypermethrin	0.07	5.8 ac	11.8 bc	8.5
Methyl parathion	0.55	11.0 b	7.3 bc	10.3
Untreated check	—	5.3 ac	16.8 c	7.0
				N.S.
		Mean no. per 20 sweeps: 16 August		
Carbaryl		3.8 abc	7.8 a	8.0
Cypermethrin		2.5 b	18.3 a	6.0
Methyl parathion		8.1 c	10.3 ab	6.5
Untreated check		7.8 c	23.5 c	7.8
				N.S.

* Insecticides were applied 30 June.

† Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

‡ Insecticides were applied 4 August.

dimethoate, and mevinphos, even at three applications per cutting, did not significantly reduce populations of TCAH (Tables 4 and 5).

When time of application was considered, both carbaryl and cypermethrin provided a significant degree of residual control (Tables 5 and 6). During the fifth alfalfa cutting in 1984, the cypermethrin-stubble treatment was significantly lower than the untreated check for TCAH abundance at 7, 14, 21, and 28 d post-treatment (Table 6). The carbaryl-stubble treatment also significantly reduced TCAH abundance below that of the untreated check at 21 and 28 d post-treatment (Table 6).

Table 2. Efficacy of selected insecticides used at various rates against adults of the threecornered alfalfa hopper (TCAH), the potato leafhopper (PLH), and the tarnished plant bug (TPB) on the fourth alfalfa cutting. Plains, GA, 1983.

Insecticide*	Rate (kg ai/ha)	Mean no. per 20 sweeps TCAH	PLH	TPB
Carbaryl 80S	4.40	2.8 ab†	8.8 ad	4.3 abc
Carbaryl 80S	2.20	5.0 bc	17.3 abc	4.3 abc
Carbaryl 80S	1.10	3.0 ab	18.5 abc	9.0 a
Cypermethrin 2.5EC	0.26	2.3 ab	8.8 abd	1.5 c
Cypermethrin 2.5EC	0.13	3.0 ab	4.8 d	3.5 bc
Cypermethrin 2.5EC	0.07	1.8 ab	18.8 abc	2.5 bc
Methyl parathion 4EC	2.20	4.5 bc	9.5 abd	3.3 abc
Methyl parathion 4EC	1.10	8.3 c	16.3 abc	2.8 bc
Methyl parathion 4EC	0.55	0.8 a	9.0 ad	8.5 ab
Trichlorfon 80SP	4.40	3.3 ab	21.3 bc	4.0 abc
Trichlorfon 80SP	2.20	2.3 ab	12.8 abd	4.3 abc
Trichlorfon 80SP	1.10	3.0 ab	20.3 abc	3.3 abc
Untreated check	—	4.8 bc	29.0 c	5.8 abc

* Insecticides were applied 10 August, with sweep sampling conducted 16 August.
† Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

Table 3. Efficacy of selected synthetic pyrethroid insecticides against adults of the threecornered alfalfa hopper (TCAH) and potato leafhopper (PLH) on the fifth alfalfa cutting. Plains, GA, 1983.

Insecticide*	Rate (kg ai/ha)	Mean no. per 20 sweeps: 28 Sept. TCAH	PLH	Mean no. per 20 sweeps: 30 Sept. TCAH	PLH
Cypermethrin 2.5EC	0.07	1.5 a†	0.0	1.0 a	0.0 a
Cypermethrin 2.5EC	0.05	2.0 a	0.5	1.8 a	0.5 a
Cypermethrin 3E	0.09	0.8 a	0.3	0.0 a	0.0 a
Cypermethrin 3E	0.07	2.5 a	0.8	0.5 a	0.0 a
Cypermethrin 3E	0.05	2.3 a	0.8	1.5 a	0.5 a
Fenvalerate 2.4EC	0.09	2.8 a	0.5	1.5 a	0.0 a
Fenvalerate 2.4EC	0.07	1.3 a	0.0	1.0 a	0.0 a
Untreated check	—	17.0 b	4.5	18.5 b	12.0 b
			N.S.		

* Insecticides were applied 26 September.
† Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

Potato Leafhopper Control. Adult populations of PLH peaked at a mean of 29 per 20 sweeps on 16 August 1983 (Table 2). Applications of either carbaryl, cypermethrin, fenvalerate, methyl parathion, or trichlorfon significantly reduced adults of PLH below that of the untreated checks in 1983 (Tables 1 - 3). Carbaryl or cypermethrin applications significantly reduced adult PLH abundance at 12 d post-treatment during the third and fifth cuttings in 1983 (Table 1). Carbaryl also significantly reduced the number of adults of PLH at 6 d post-treatment during the fifth cutting of this test.

Table 4. Efficacy of selected insecticides against adults of the threecornered alfalfa hopper (TCAH) and the tarnished plant bug (TPB) on the third alfalfa cutting. Plains, GA, 1984.

Insecticide*	Rate (kg ai/ha)	Mean no. per 20 sweeps: 28 June TCAH	TPB	Mean no. per 20 sweeps: 3 July TCAH	TPB
Chlorpyrifos 4E	1.100	1.0 abc†	0.5 c	1.0 abc	3.8 ab
Cypermethrin 2.5E	0.070	1.0 abc	0.0 c	1.0 abc	1.5 bc
Cypermethrin 3E	0.050	0.0 c	0.0 c	0.0 c	2.5 abc
Dimethoate 4E	0.550	0.3 bc	0.5 c	0.3 bc	4.0 ab
FMC-54800 2EC	0.070	0.0 c	0.0 c	0.0 c	0.8 c
FMC-54800 2EC	0.050	1.8 ab	0.3 c	1.8 ab	2.3 abc
MK-936 0.15EC	0.020	1.3 abc	1.5 b	1.3 abc	2.8 abc
ICI-PP321 1.0EC	0.015	0.5 abc	0.0 c	0.5 abc	4.0 ab
ICI-PP321 1.0EC	0.010	0.5 abc	0.8 c	0.5 abc	2.0 abc
Untreated check		2.0 a	3.3 a	2.0 a	4.5 a

* Insecticides were applied 26 June.

† Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

As was true for TCAH, the level of control of adult PLH in 1983 was not significantly affected by the rate of formulation of the synthetic pyrethroids tested (Table 3).

Tarnished Plant Bug Control. Peak populations of TPB of 30.8 and 40.2 per 20 sweeps were observed for 1983 and 1984, respectively (Tables 1 and 5). Numbers of adult TPB in the insecticide test plots were significantly reduced below the numbers found in the untreated checks only during the third cutting in 1984 (Tables 4 and 5). All the insecticides evaluated during the third cutting in 1984 significantly reduced TPB numbers 2 d post-treatment, however TPB numbers were low during this period. However, at 7 d post-treatment (3 July) only the cypermethrin and FMC-54800 treated plots had significantly fewer TPB adults as compared to the untreated check (Table 4).

Comparisons between timing and number of insecticide applications on the third cutting in 1984 for the sampling date of 3 July indicated that the cypermethrin and dimethoate treatments of maximum and 3-wks both resulted in levels of adult TPB that were significantly lower than detected in the untreated check (Table 5).

Adult TPB were the most difficult of the three pests to control, especially when they were present in numbers greater than 0.5 per sweep.

CONCLUSIONS

Currently available insecticides can provide control of *S. festinus* and *E. fabae* in alfalfa. It is hoped that the information provided in this study will assist not only in decisions regarding control strategies, but also as a tool for regulating populations for economic threshold and economic injury level studies.

Table 5. Efficacy of selected insecticides against adults of the threecornered alfalfa hopper (TCAH) and the tarnished plant bug (TPB) as affected by time of application during regrowth on the third alfalfa cutting. Plains, GA, 1984.

Insecticide*	Applied†	Mean no. per 20 sweeps TCAH	TPB
19 June			
Cypermethrin	stubble	7.6	30.2 ab‡
Dimethoate	stubble	8.6	36.6 ab
Mevinphos	stubble	6.0	38.4 a
Untreated check	—	9.0	28.6 b
		N.S.	
26 June			
Cypermethrin	stubble	1.2 a	35.2
Dimethoate	stubble	1.6 ab	40.2
Mevinphos	stubble	2.6 ab	33.6
Cypermethrin	maximum	1.6 ab	26.0
Dimethoate	maximum	3.2 ab	31.2
Mevinphos	maximum	2.8 ab	30.8
Untreated check	—	4.4 b	38.0
			N.S.
3 July			
Cypermethrin	stubble	1.4	13.2 a
Dimethoate	stubble	1.0	13.8 a
Mevinphos	stubble	1.8	14.6 a
Cypermethrin	maximum	0.4	6.0 b
Dimethoate	maximum	1.0	2.8 b
Mevinphos	maximum	0.6	8.0 ab
Cypermethrin	3-wks	0.4	5.8 b
Dimethoate	3-wks	0.4	4.4 b
Mevinphos	3-wks	1.2	13.2 a
Untreated check	—	1.4	13.2 a
		N.S.	

* Insecticide rates (kg ai/ha): cypermethrin at 0.07, dimethoate and mevinphos at 0.55.
† Insecticides were applied as follows: stubble on 12 June, 3-wk on 26 June, and maximum on 12, 19, and 26 June.
‡ Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

The true economic impact of *S. festinus, E. fabae,* or *L. lineolaris* in the southeastern United States is still to be determined. Research is currently underway to determine economic thresholds and economic injury levels for the three species discussed in this paper (Isenhour and Fales, unpublished data).

Table 6. Efficacy of selected insecticides against adults of the threecornered alfalfa hopper (TCAH) and the tarnished plant bug (TPB) as affected by time of application during regrowth on the fifth alfalfa cutting. Plains, GA, 1984.

Insecticide*	Applied†	Mean no. per 20 sweeps TCAH	TPB
28 August			
Carbaryl	stubble	5.0 ab‡	3.5
Chlorpyrifos	stubble	5.0 ab	2.3
Cypermethrin	stubble	3.3 b	3.0
Untreated check	—	8.8 a	3.3
			N.S.
4 September			
Carbaryl	stubble	27.0 ab	3.0
Chlorpyrifos	stubble	45.3 a	3.8
Cypermethrin	stubble	10.0 c	3.8
Carbaryl	maximum	17.3 bc	3.8
Chlorpyrifos	maximum	49.3 a	5.5
Cypermethrin	maximum	10.0 c	2.0
Untreated check	—	56.4 a	4.5
			N.S.
11 September			
Carbaryl	stubble	53.0 a	2.0 abc
Chlorpyrifos	stubble	70.8 abc	3.0 abc
Cypermethrin	stubble	26.0 d	4.8 abc
Carbaryl	maximum	7.3 e	2.8 abc
Chlorpyrifos	maximum	111.8 bc	5.3 a
Cypermethrin	maximum	2.5 e	1.0 c
Carbaryl	3-wk	20.8 d	4.3 abc
Chlorpyrifos	3-wk	93.5 c	4.3 ab
Cypermethrin	3-wk	9.8 d	1.0 c
Untreated check	—	109.4 bc	2.9 abc
18 September			
Carbaryl	stubble	23.4 ab	3.8
Chlorpyrifos	stubble	35.0 ac	6.0
Cypermethrin	stubble	19.3 be	4.3
Carbaryl	maximum	10.3 ef	5.5
Chlorpyrifos	maximum	51.0 cd	8.8
Cypermethrin	maximum	5.3 f	5.8
Carbaryl	3-wk	9.5 f	5.0
Chlorpyrifos	3-wk	57.5 d	5.5
Cypermethrin	3-wk	8.5 f	4.8
Untreated check	—	43.2 cd	5.1
			N.S.

* Insecticide rates (kg ai/ha): carbaryl at 1.10, chlorpyrifos at 1.10, and cypermethrin at 0.07.

† Insecticides were applied as follows: stubble on 21 August, 3-wks on 4 September, and maximum on 21 and 28 August, and 4 September.

‡ Means in a column followed by a common letter do not differ significantly at the 0.05 level. Duncan's (1955) multiple range test.

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