INFLUENCE OF SYSTEMIC INSECTICIDES ON THRIPS[1] DAMAGE AND YIELD OF FLORUNNER PEANUTS IN GEORGIA[2,3]

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Abstract: Aldicarb, carbofuran, disulfoton, and phorate applied in-furrow at planting provided control of immature thrips, *Frankliniella fusca* (Hinds) in 1980. Carbofuran failed to control thrips in 1981. In both years, plant growth for peanuts treated with aldicarb and disulfoton was more rapid than growth of untreated peanuts. Both adult and immature thrips were more abundant in flowers than in terminals after flowering was initiated. There were no significant differences, however, in peanut yield, quality characteristics, or crop value in either year. Therefore, the value of systemics for thrips control on Florunner peanuts in south Georgia is primarily cosmetic and cannot be justified on the basis of increased yield or quality, or a more rapid plant growth.

Key words: Thrips, *Frankliniella fusca,* systemic insecticides.

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Thrips injury to peanuts, *Arachis hypogaea* L., is one of the most frequently encountered insect problems. Three species, the tobacco thrips, *Frankliniella fusca* (Hinds), the flower thrips, *F. tritici* (Fitch), and *F. bispinosa* (Morgan), attack peanuts grown in the Southeast (Morgan et al. 1970). The tobacco thrips is the most common species on seedling peanuts where they feed in terminals, rasping the unfolded leaflets. This feeding produces scarred and malformed leaves and, under severe infestations, stunting of the plant.

Several studies have been conducted on thrips control throughout the peanut-producing areas of the United States. Smith and Sams (1977) summarized this work from 1945-1977 and showed that in only 2 of 14 published reports were there significant yield increases due to thrips control. Tappan and Gorbet (1979, 1981) evaluated spray applications of acephate and band and broadcast applications of aldicarb, carbofuran, and disulfoton for thrips control. These authors also reported significant thrips control without a corresponding significant increase in yield.

Thrips reduced peanut profits by over $26 million in Georgia from 1972-1981 (Suber and Todd 1980, Todd and Suber 1980, Suber et al. 1981, H. Womack, L. W. Morgan, D. B. Adams, and R. E. Lynch, unpublished 1981 losses). However, over 76% of this loss was due to cost of the control agent. Only in 3 of the 10 years were losses considered due to actual thrips damage.

A survey of peanut producers in Georgia from 1979-1981 showed that ca. 60% of the peanut acreage in Georgia received a systemic insecticide at planting for thrips control (Herbert Womack, University of Georgia Extension Peanut Entomologist, personal communication). Systemic insecticides for thrips control in peanuts are still advocated by some extension personnel on the basis that early plant growth is accelerated, allowing the peanut plant to cover the soil surface more rapidly and thus reduce weed competition.

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[3] Mention of a proprietary product does not constitute an endorsement by the USDA.

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This research was conducted to evaluate in-furrow application of recommended insecticides for thrips control and to measure their effects on thrips populations, early plant growth, yield, quality, and crop value.

MATERIALS AND METHODS

The studies were conducted on the Agronomy Farm, Coastal Plain Experiment Station, Tifton, GA, in 1980 and 1981. Systemic insecticides were applied in-furrow at planting with a Gandy® granule applicator. The granule applicator was calibrated to deliver (kilograms of AI/ha) 0.50 aldicarb or 0.84 each of either carbofuran, disulfoton, or phorate. Florunner peanuts were planted on 1 May 1980, and 28 April 1981. Plots were 6.1 m long and 1.8 m wide with two rows of peanuts 81.3 cm apart. The experiment was designed in a randomized complete block with five replications. Standard production practices were employed throughout the season each year with irrigation of ca. 2.5 cm on 25 July, 6, 14, and 25 August, and 8 September 1980, 15 and 28 July, and 15 August 1981.

Ten unopened terminal buds were selected at random from each plot at 7-d intervals after plant emergence and placed in 118 ml capped plastic jars containing 50 ml of 70% ethanol. Ten flowers per plot also were selected at random each 7 d, beginning 35 d postemergence and placed in 70% ethanol. The terminals or flowers were agitated in alcohol for ca. 1 min, and the adult and immature thrips were counted with the use of a microscope. Flowers also were examined individually for thrips that were not removed from the staminal column by agitation. Each plot was rated visually 30 d postemergence for thrips damage on a 1-9 rating scale where 1 = no damage, and 9 = plant death due to severe stunting.

Five plants/plot were sampled at 7-d intervals for 7 wk to determine the effect of thrips damage and/or systemic insecticides on plant growth. Plants from each plot were removed from the soil, placed in a labeled plastic bag, brought into the laboratory, and refrigerated until analysis. Each plant was individually analyzed for leaf area by clipping the leaves and terminals and measuring the leaf-surface area with a LI-COR® Model LI-3000 leaf area meter.

Peanuts from each plot were dug at maturity with an inverter, thrashed with a KEM® Model KPT-30 plant thresher, and dried. Yields then were computed by weighing peanuts from each plot. Quality data were obtained as outlined by USDA inspection instructions for peanuts (Anonymous 1978) and value/ha was determined from the peanut loan schedule for runner peanuts in 1980 and 1981 (Anonymous 1980, 1981).

RESULTS AND DISCUSSION

The tobacco thrips, *F. fusca,* represented > 90% of the thrips in peanut terminals and flowers. (See Appendix Tables 3 and 4 for population trends.) These trends are similar to those reported by Tappan and Gorbet (1979, 1981); the initial infestation was composed primarily of adults and a natural population decline occurred within 17-31 d after planting. However, in south Georgia, the decline occurred slightly later, 21-28 d postemergence, than reported for Florida. In both years, immature forms represented 90.5% of the thrips in the terminals but varied between samples after initial infestation from 50 to 98.5%. Contradictory to the report of Tappan and Gorbet (1979), immature thrips also were the predominant stage in flowers, representing 64.2 and 63.7% of the total thrips in 1980 and 1981, respectively. This percentage also varied between samples and ranged from 32.4 to 94.7% immature thrips in the flowers.

The decline in thrips damage to newly emerged leaves has been hypothesized to result from movement of thrips from terminals to flowers as the peanut plant reaches anthesis (Leuck 1967) ca. 28-35 d postemergence. Tappan and Gorbet (1979) did not find mass movement by immature thrips. Data presented in Table 1, however, show that both adult and immature thrips were more abundant in flowers. This fact was especially evident for adults; the ratios of adults per terminal versus flower favored flowers, with only one exception where the ratio was equal. The ratios also show a 28:1 and 14:1 preference for flowers during the 2 years. Immature thrips initially established in terminals, but in both years tended to prefer flowers as the season progressed. However, the preference for flowers by immature forms was not as great as the preference by adults. Hammons and Leuck (1966) also noted that immature thrips were the predominant stage in flowers.

Table 1. Ratio of thrips in the terminals and flowers of untreated Florunner peanuts.

Days after plant emergence	Thrips ratio* (terminals:flowers)		
	Adults	Immatures	Total
		1980	
35	1.0: 2.9	1.0:1.2	1.0:1.7
42	1.0: 1.7	1.6:1.0	1.4:1.0
49	1.0: 1.0	1.3:1.0	1.3:1.0
56	1.0:28.5	1.0:1.6	1.0:4.4
63	1.0: 8.4	1.0:3.5	1.0:4.7
70	1.0: 2.5	1.0:1.6	1.0:1.8
		1981	
35	1.0: 2.0	1.3:1.0	1.0:1.0
42	1.0:14.0	1.5:1.0	1.0:1.1
49	1.0: 6.7	1.2:2.0	1.0:2.4

* Ratio of the number of thrips per 10 terminals to the number of thrips per 10 flowers.

Both adult and immature thrips initially infest the terminal buds where they feed in a relatively protected environment. As terminals develop and leaflets unfold, the site becomes unsuitable for thrips feeding. During early growth of the plant, thrips can probably complete development from egg to adult, ca. 13 d (Bass and Ledbetter 1970), within one or at most two terminals before the leaflets expand. However, as the growth rate of the plant increases from slow vegetative growth during the first 30 d after emergence to a more rapid, exponential growth phase (Duncan et al. 1978), terminal leaflets develop and unfold more rapidly. Thus, immature thrips are unable to complete development in a single terminal before the leaflets unfold and must migrate to another terminal or, in many instances, to a flower. Peanut flowers are suitable feeding sites for only short periods of time since the flower emerges, wilts, and desiccates in only 1 or 2 d under normal field conditions (Gregory et al. 1951). Both adult and immature thrips must migrate to another feeding site, become trapped in the staminal column, or die in the desiccating flower. Indeed, dead or moribund thrips, both adults and immatures, were observed in the staminal column of desiccated flowers.

This entrapment and repeated migration, especially of soft-bodied immatures, exposes them to starvation, predation, and environmental stresses such as desiccation, and probably accounts for the decline in thrips damage as the peanut plant initiates flowering and enters the exponential growth phase.

The efficacy of systemic insecticides for thrips control in 1980 is presented in Appendix Table 3. Control of adults in the terminals was limited to 2 wk after plant emergence for aldicarb, disulfoton, and phorate, and only 1 wk for carbofuran. Immature control in the terminals persisted for 28 d with carbofuran and disulfoton and 35-42 d with aldicarb and phorate. A slight resurgence in thrips occurred 42-49 d after plant emergence and none of the systemics provided control after 42 d.

Visual plant damage ratings 30 d after plant emergence were analagous to terminal counts of thrips. Damage ratings were 2.2 for aldicarb and phorate, 2.4 for carbofuran and disulfoton, and 5.6 for the untreated check. All systemics afforded significantly lower damage ratings than the untreated check.

Systemic insecticides provided little control of adults in the flowers. At 35 d posttreatment, only aldicarb provided control significantly better than the untreated check. Control of immature thrips on the flowers also paralleled control in the terminals in that significant differences were noted only through 42 d.

Data on leaf area per plant as influenced by systemics and thrips damage are presented in Appendix Table 3. Plants treated with aldicarb, carbofuran, and disulfoton had a significantly greater leaf area than plants treated with phorate at 35 d. This difference was primarily a result of phorate-induced leaf-burn that resulted in loss of the lower leaves. Regression analysis of days on leaf area showed that the quadratic trend was significant ($P = 0.05$) and that the regression lines for aldicarb and disulfoton differed significantly ($P = 0.05$) from the untreated check. However, the trends for aldicarb, carbofuran, and disulfoton were not significantly different, and the trends for carbofuran, disulfoton, and phorate were not significantly different. Thus, plants in plots treated with aldicarb and disulfoton grew more rapidly than plants in untreated plots.

Thrips populations in 1981 were much greater than in 1980 and reached 28/terminal in the untreated check (see Appendix Table 4). With the exception of carbofuran, the results paralleled the 1980 test; aldicarb, disulfoton, and phorate provided control of adults in the terminals for 2 wk, and control of immatures in the terminals and flowers for 5 wk after plant emergence. Carbofuran, however, failed to provide thrips control. Peanuts treated at planting with carbofuran had significantly more adults/terminal at 7 d than any of the other treatments, including the untreated check. The population trend for immature thrips in both the terminals and flowers of peanuts treated with carborfuran tended to parallel that for the untreated peanuts, but was delayed by 1 wk. Tappan and Gorbet (1981) also noted that the highest thrips populations, with the exception of the untreated check, occurred in carbofuran-treated peanuts. However, in their results, thrips populations in the carbofuran treatment did not significantly exceed populations in the untreated check as in the present results.

Visual ratings 30 d after plant emergence confirmed that carbofuran failed to control thrips. Peanuts treated with aldicarb, disulfoton, or phorate exhibited moderate thrips damage with a rating of 2.8, significantly less damaged than peanuts treated with carbofuran (6.4), or untreated (6.8). The failure of carbofuran to control thrips also was documented in a field of a Tift County, Georgia, farmer where both carbofuran and aldicarb were used. At ca. 40 d after peanut emergence, the peanuts treated with aldicarb at planting were given a damage rating of 2.3

while those treated with carbofuran were rated 6.8. Failure of carbofuran to adequately control thrips may be related to microbial degradation (Ahmad et al. 1979, Felsot et al. 1981, 1982, Williams et al. 1976), or possibly resistance.

Significant differences also were noted in leaf area/plant under the intense thrips pressure of 1981 (see Appendix Table 4). By 21 d, plants in the aldicarb, disulfoton, and phorate plots had significantly greater leaf areas than plants in the carbofuran or untreated plots. This trend continued through 49 d with the exception that at 28 d, carbofuran was not significantly different from disulfoton- or phorate-treated plants, or from phorate-treated plants at 49 d. Regression analysis of days on leaf area showed that the quadratic trend was significant ($P = 0.05$) and that the regression line for aldicarb differed significantly ($P = 0.05$) from those for all other treatments. The leaf area trend for disulfoton also differed significantly ($P = 0.05$) from that for carbofuran and the untreated check, but did not differ from the trend for phorate. Thus, as in 1980, plants in plots treated with aldicarb and disulfoton grew more rapidly than plants in untreated plots.

In both years, no significant yield, quality, or crop value differences were noted between peanuts receiving a systemic at planting and the untreated check (Table 2). Tappan and Gorbet (1979, 1981) also found no significant yield differences when aldicarb, carbofuran, or disulfoton was broadcast or banded for thrips control. In-furrow application of systemics represents the most inexpensive means of applying systemics and providing thrips control. However, even with in-furrow application, unprofitable rather than profitable net returns could predominate since there were no significant peanut yield or quality increases associated with the use of systemics.

Table 2. Influence of systemic insecticides on yield and value of Florunner peanuts*.

Treatment	Rate (kg AI/ha)	Yield (kg/ha) 1980	Yield (kg/ha) 1981	Value/ha ($)† 1980	Value/ha ($)† 1981	Avg. value/ hectare ($)†
Aldicarb	0.50	2822 a	6033 a	1326.88 a	3136.65 a	2231.77
Carbofuran	0.84	2895 a	5700 a	1328.27 a	2928.31 a	2128.29
Disulfoton	0.84	3252 a	5602 a	1508.85 a	2868.71 a	2188.78
Phorate	0.84	2984 a	6091 a	1392.96 a	3131.42 a	2262.19
Untreated	—	3065 a	5513 a	1421.34 a	2828.59 a	2124.97

* Means within a column followed by the same letter are not significantly different at the 5% level using Duncan's multiple range test.

† To convert to value/acre, divide by 2.47.

In summary, these results support the conclusions of Tappan and Gorbet (1979, 1981); thrips control does not significantly increase peanut yield, even under heavy thrips infestations. Severe thrips damage occurs early in plant development and is insufficient at more critical physiological stages to significantly reduce yield. Plant growth rates were more rapid in plots treated with aldicarb or disulfoton. However, there were no visual differences noted in weed competition, and the increased growth rate did not significantly increase peanut yield, quality, or crop value. Therefore, the value of systemics for thrips control is primarily cosmetic and is not justified on the basis of increased plant growth rate.

Table 3. Influence of systemic insecticides on thrips populations and leaf area of Florunner peanuts in 1980. Tifton, GA*.

Treatment†	Days post plant emergence	Thrips/10 terminals			Thrips/10 flowers			Leaf area/plant (cm^2)
		Adults	Immatures	Total	Adults	Immatures	Total	
Aldicarb	7	0.2 a	0.0 a	0.2 a	—	—	—	33.4 a
Carbofuran		1.0 a	0.0 a	1.0 a	—	—	—	30.4 a
Disulfoton		1.0 a	0.0 a	1.0 a	—	—	—	27.1 a
Phorate		0.4 a	0.0 a	0.4 a	—	—	—	25.7 a
Untreated		2.2 b	0.0 a	2.2 b	—	—	—	32.8 a
Aldicarb	14	2.8 a	0.8 a	3.6 a	—	—	—	89.9 a
Carbofuran		7.2 c	1.6 a	8.8 b	—	—	—	85.5 a
Disulfoton		5.4 b	0.8 a	6.2 ab	—	—	—	81.3 a
Phorate		3.4 a	0.0 a	3.4 a	—	—	—	72.7 a
Untreated		8.4 c	8.4 b	16.8 c	—	—	—	91.5 a
Aldicarb	21	2.4 a	12.8 a	15.2 a	—	—	—	135.1 a
Carbofuran		2.6 a	23.2 a	25.8 a	—	—	—	132.3 a
Disulfoton		2.0 a	16.0 a	18.0 a	—	—	—	130.6 a
Phorate		1.8 a	3.2 a	5.0 a	—	—	—	133.6 a
Untreated		1.2 a	103.4 b	104.6 b	—	—	—	122.7 a
Aldicarb	28	2.6 a	11.2 b	13.8 ab	—	—	—	305.1 a
Carbofuran		1.8 a	14.0 b	15.8 b	—	—	—	307.1 a
Disulfoton		1.8 a	15.4 b	17.2 b	—	—	—	238.3 a
Phorate		1.6 a	6.2 a	7.8 a	—	—	—	260.0 a
Untreated		2.8 a	35.4 c	38.2 c	—	—	—	212.8 a

Aldicarb	35	2.8 a	9.4 ab	12.2 a	8.2 a	5.8 a	13.8 a	480.3 a
Carbofuran		3.8 a	14.6 b	18.4 b	12.2 ab	12.8 b	25.0 b	472.4 a
Disulfoton		4.2 a	13.6 b	17.8 ab	21.6 c	9.2 ab	30.8 c	425.1 a
Phorate		4.6 a	5.4 a	10.0 a	13.6 ab	4.4 a	18.8 a	301.2 b
Untreated		5.6 a	14.2 b	19.8 b	16.2 bc	17.6 c	33.8 c	411.7 ab
Aldicarb	42	7.2 a	46.6 a	53.8 a	6.4 a	8.2 a	14.6 a	1094.0 a
Carbofuran		3.2 a	61.8 ab	65.0 ab	7.0 a	30.2 b	37.2 b	832.6 a
Disulfoton		7.8 a	70.2 b	78.0 b	10.4 a	29.4 b	39.8 bc	1097.8 a
Phorate		4.6 a	47.6 a	52.4 a	9.2 a	20.4 b	29.6 b	720.7 a
Untreated		4.2 a	66.2 b	70.4 ab	7.2 a	42.0 c	49.2 c	822.0 a
Aldicarb	49	3.6 a	32.6 a	36.2 a	3.8 a	23.2 a	27.0 a	1472.6 a
Carbofuran		3.0 a	48.2 a	51.2 a	2.0 a	40.6 a	42.6 a	1311.9 a
Disulfoton		4.4 a	40.2 a	44.6 a	2.8 a	41.4 a	44.2 a	1222.6 a
Phorate		1.8 a	40.6 a	42.4 a	3.8 a	32.6 a	36.4 a	1185.9 a
Untreated		2.0 a	46.4 a	48.4 a	2.0 a	36.0 a	38.0 a	939.3 a

* Means within a column for each sampling date followed by the same letter are not significantly different at the 5% level using Duncan's new multiple range test.
† All systemics were applied in-furrow at planting. Aldicarb was applied at 0.50 kg AI/ha and carbofuran, disulfoton, and phorate each were applied at 0.84 kg AI/ha.

Table 4. Influence of systemic insecticides on thrips populations and leaf area of Florunner peanuts in 1981. Tifton, GA*.

Treatment†	Days post plant emergence	Thrips/10 terminals Adults	Thrips/10 terminals Immatures	Thrips/10 terminals Total	Thrips/10 flowers Adults	Thrips/10 flowers Immatures	Thrips/10 flowers Total	Leaf area/plant (cm^2)
Aldicarb	7	2.6 a	0.0 a	2.6 a	-	-	-	29.1 a
Carbofuran		24.0 d	0.6 a	24.6 d	-	-	-	27.6 a
Disulfoton		9.2 bc	0.0 a	9.2 bc	-	-	-	27.0 a
Phorate		7.6 ab	0.0 a	7.6 ab	-	-	-	24.1 a
Untreated		14.8 c	0.4 a	15.2 c	-	-	-	26.2 a
Aldicarb	14	7.6 a	2.6 a	10.2 a	-	-	-	39.8 a
Carbofuran		20.2 b	48.2 b	68.4 b	-	-	-	29.9 a
Disulfoton		12.4 a	10.2 a	22.6 a	-	-	-	50.6 a
Phorate		11.8 a	1.8 a	13.6 a		-	-	41.2 a
Untreated		19.6 b	151.8 c	171.4 c	-	-	-	31.5 a
Aldicarb	21	9.4 a	14.8 a	24.2 a	-	-	-	137.1 a
Carbofuran		20.8 a	157.2 b	178.0 b	-	-	-	99.1 b
Disulfoton		14.4 a	29.6 a	44.0 a	-	-	-	140.6 a
Phorate		10.8 a	16.4 a	27.2 a	-	-	-	130.9 a
Untreated		12.6 a	267.4 c	280.0 c	-	-	-	76.5 b
Aldicarb	28	5.4 a	18.0 a	23.4 a	-	-	-	364.6 a
Carbofuran		5.4 a	199.4 d	204.8 d	-	-	-	231.6 bc
Disulfoton		2.6 a	69.8 bc	72.4 bc	-	-	-	345.4 ab
Phorate		5.0 a	33.6 ab	38.6 ab	-	-	-	354.9 ab
Untreated		6.8 a	99.4 c	106.2 c	-	-	-	189.8 c
Aldicarb	35	11.6 a	7.8 a	19.4 a	7.8 a	3.8 a	11.6 a	810.9 a
Carbofuran		7.0 a	20.2 a	27.2 a	14.8 c	18.0 b	32.8 b	289.2 b
Disulfoton		9.0 a	15.6 a	24.6 a	8.6 ab	9.0 a	17.6 a	789.8 a
Phorate		8.2 a	7.8 a	16.0 a	8.0 a	4.8 a	12.8 a	812.2 a
Untreated		6.8 a	34.2 b	41.0 b	13.6 bc	25.8 c	39.4 b	335.3 b

Aldicarb	42	2.2 a	27.2 a	28.8 a	19.2 a	19.2 a	38.4 a	1961.8 a
Carbofuran		3.0 a	43.0 a	46.0 a	19.6 a	31.8 b	51.4 a	994.5 c
Disulfoton		2.2 a	33.0 a	35.2 a	15.6 a	19.4 a	35.0 a	1505.3 b
Phorate		1.6 a	24.8 a	26.0 a	16.4 a	22.0 a	38.4 a	1389.2 b
Untreated		1.2 a	34.4 a	35.6 a	16.8 a	23.6 ab	40.4 a	955.3 c
Aldicarb	49	0.6 a	6.8 a	7.4 a	3.8 a	10.4 a	14.2 a	3654.9 a
Carbofuran		1.6 a	8.8 a	10.4 a	3.2 a	10.2 a	13.4 a	2137.8 b
Disulfoton		0.4 a	10.6 a	11.0 a	3.8 a	7.8 a	11.6 a	3050.2 a
Phorate		0.4 a	6.2 a	6.6 a	3.6 a	8.0 a	11.6 a	2757.7 ab
Untreated		0.6 a	5.6 a	6.2 a	4.0 a	11.0 a	15.0 a	2203.1 b

* Means within a column for each sampling date followed by the same letter are not significantly different at the 5% level using Duncan's new multiple range test.

† All systemics were applied in-furrow at planting. Aldicarb was applied at the 0.50 kg AI/ha, and carbofuran, disulfoton, and phorate each were applied at 0.84 kg AI/ha.

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