Peanut Science (1978) 5, 83-86

Effect of Pesticide Interactions on the Twospotted Spider Mite on Peanuts[1, 2]

W. V. Campbell[3]

ABSTRACT

Pesticides commonly applied to the foliage of peanuts in North Carolina were evaluated under field conditions for their effect on the twospotted spider mite *Tetranychus urticae* Koch. Most fungicides caused a higher mite increase than insecticides on NC 2 peanuts. When fungicides and insecticides were tank mixed or applied on alternate weeks, mite outbreaks occurred. These outbreaks were followed by severe injury to the foliage and finally defoliation and yield reductions.

Among the fungicides applied only Du-Ter and Copper Count failed to cause significant mite damage even when combined with an insecticide. Since mites failed to develop on untreated peanuts following six or more mite releases during the season, it was apparent that pesticides predispose peanuts to spider mite buildup and damage.

Key Words: Twospotted spider mite, *Tetranychus urticae* Koch, Peanuts, Ground nuts, *Arachis*, and Pesticide interactions.

The twospotted spider mite *Tetranychus urticae* Koch is a destructive pest of peanuts *Arachis hypogaea* L. in North Carolina. Spider mite outbreaks have ocurred frequently on peanuts since 1970. In 1971, research was initiated to provide information on miticide efficacy and to investigate initially in the laboratory and greenhouse the effect of pesticides and combinations of pesticides on *T. urticae* (Campbell *et al.*, 1974).

Carner and Canerday (1968) reported a fungus *Entomophthora fresenii* to be a pathogen of spider mites. *Entomophthora* sp. has been identified as an important pathogen of the twospotted spider mite on peanuts in North Carolina. The fungus appears most effective after a general *T. urticae* buildup followed by wet, hot, and humid weather.

It is a well recognized fact that spider mite outbreaks may occur following certain insecticide applications (De Bach, 1947; Davis, 1952; Klostermeyer, 1959; Saini and Cutkomp, 1966; Bartlett, 1968). Information is lacking on the effects of current fungicides, insecticides and the interactions of fungicides and insecticides on the twospotted spider mite. Therefore, fungicides, insecticides and combinations of these pesticides were evaluated for their potential contribution to pesticide-induced mite outbreaks on peanuts.

Materials and Methods

Since spider mite infestations are sporatic, localized and unpredictable, it is risky to depend upon naturally occurring mite populations for research; therefore, spider mites were reared in the laboratory and uniformly released in the field plots. *T. urticae* were field collected in the late summer each year from peanuts and transfered to 'Fordhook 242' lima beans, *Phaseolus lunatus* L., for rearing. New mite colonies were established each year to minimize laboratory inbreeding. Fordhook 242 lima bean seeds were planted in greenhouse flats using Promix B as a growing medium. Mites were maintained at a low population level during the winter on open shelves in a rearing room maintained at 26°C and 60% RH.

In mid June production was accelerated to rearing ca. 40 greenhouse flats of mites each week. Mite-infested leaves were transferred to new greenhouse flats for rearing when the first true leaf of Fordhook 242 appeared. After infesting the beans with mites it required about 5 days for the mite population to build up and uniformly infest the leaves. At this stage of mite damage the bean leaves have a white speckled appearance.

Two bean stems containing two unifoliate leaves and one trifoliate leaf were placed in the center of the two center rows of each peanut plot. The leaves contained a good population of mites and mite eggs. Plots were 4 rows wide by 9.1 m long and replicated three times. Experiments were arranged in a completely randomized block design. Mites were released in the plots 6 times and in some tests 7 times beginning in early July and ending in late August. Generally, 3 mite releases were made in July and 3 or 4 in August to NC 2 peanut variety.

Fungicides recommended for Cercospora leafspot control were applied at two-week intervals beginning the last week in June and terminating by early September for 5 or 6 applications. The following fungicides were evaluated: Benlate (benomyl) methyl-l-(butylcarbamoyl)-2-benzimidazole carbamate; Bravo (chlorothalonil) tetrachloro isophthalonitrile; Copper Count (ammonical copper); Copper Count NS (ammonical copper 8% + sulfur 5%); copper sulfur dust; Fungi-Sperse (liquid copper sulfur); Dithane M-45 (mancozeb) coordinated product of zinc ion and manganese ethylene bisdithiocarbamate; Du-Ter (fentin hydroxide); Kocide 101 (cupric hydroxide).

Some of the commonly used insecticides were applied separately at planting or tank mixed with a fungicide or applied on weeks alternating with the fungicide. The following insecticides were evaluated for mite suppression and mite interaction: Furadan (carbofuran) 2,3-dihydro-2, 2-dimethyl-7-benzofuranyl methylcarbamate; Lannate (methomyl) S-methyl N-[(methylcarbamoyl)oxy]-thioacetmidate; Sevimol or Sevin (carbaryl) l-naphthyl methylcarbamate; Thimet (phorate) O,O-diethyl S-[(ethylthio) methyl] phosphorodithioate; Vydate (oxamyl) Methyl NN-dimethyl-N [(methylcarbamoyl)oxy] -l-thiooxamimidate.

Fungicide and insecticide sprays were applied at 25 gallons per acre at a pressure of 26 psi with a 4-row boom sprayer mounted on twin bicycle wheels. The systemic insecticides Thimet and Furadan were applied at 11.2 kg/ha. as granules in the seed furrow at planting with a tractor-mounted granular applicator. Thimet and Furadan were applied to give seasonal control of tobacco thrips *Frankliniella fusca* (Hinds) and the potato leafhopper *Empoasca fabae* (Harris). Sevin was applied all season as a tank mix with specific fungicides for seasonal control of all foliage pests. Sevin was applied also in separate plots in 1974 as one application in June for thrips control or three applications in July and early August for leafhopper control or two applications in August for worm (Lepidoptera) control.

Several types of ratings were made to determine the effect of pesticides on twospotted spider mite buildup and damage. The number of mites on 10 apical leaflets were counted in the field using a binocular microscope. All active stages of the mite were counted on the 10 leaflets. Leaves in the top third of the plant were collected from 10 plants from the center rows on either side of the mite release areas. Mite counts were not taken until after mite releases were completed for the season.

Mite damage was determined by a visual estimate of the degree of mite induced leaf chlorosis. Mite damage estimate ratings over the full range of 0 to 100% were made for the mite release area, for the center 2 rows, and for the entire 4-row plot. Ratings were made in late August and continued at intervals until harvest in October. Since the efficacy of insecticides against thrips and leafhoppers is well established (Campbell, 1969), only mite data are reported in this investigation.

[1]Paper Number 5575 of the Journal Series of the North Carolina Agricultural Experiment Station, Raleigh, North Carolina 27650.

[2]The use of trade names in this publication does not imply endorsement of the products named or criticisms of similar ones not mentioned.

[3]Professor of Entomology, North Carolina State University, Raleigh, 27650.

Table 1. Effect of fungicide-insecticide interaction on the twospotted spider mite on peanuts. Halifax County, N. C. 1973.

Treatment[1]	Rate/ha[2]	Avg. no. mites/10 leaflets Sept. 18	Avg. % mite damage in center 2-rows Aug. 28	Sept. 14	Oct. 2
Copper Sulfur Dust	28 kg	192.0 cd	1.8 d	10.3 d-g	25.0 d-f[3]
Fungi-Sperse + Sevin 80 W	18.8 ℓ + 1.4 kg	475.0 abc	15.8 ab	43.3 a	63.3 a
Dithane M-45 80 W	1.7 kg	11.7 d	7.1 a-d	16.3 d-g	20.0 d-g
Benlate + Oil (70 sec.)	0.6 kg + 4.7 ℓ	111.7 d	0.2 d	0.3 g	15.0 e-g
Thimet 10G	11.2 kg	0.3 d	0.4 d	0.1 g	1.3 g
Du-Ter + Sulfur 47.5 + 15 W	0.4 kg	3.7 d	1.7 d	0.1 g	2.3 fg
Benlate + Lannate 90 SP	0.3 kg + 0.3 kg	708.7 a	2.1 d	40.0 ab	53.3 ab
Sevin 80 W	1.4 kg	8.3 d	10.8 a-d	10.3 d-g	18.3 d-g
Fungi-Sperse + Sevimol 4F	18.8 ℓ + 2.3 ℓ	299.3 bcd	9.8 a-d	35.0 a-c	47.7 a-c
Du-Ter 47.5 WP	0.6 kg	1.3 d	2.5 d	2.8 fg	5.0 fg
Du-Ter + Sevimol	0.4 kg + 2.3 ℓ	0 d	7.2 a-d	12.3 d-g	14.3 e-g
Copper Sulfur Sevin Dust	28.0 kg	82.0 d	16.3 a	26.7 b-d	38.3 b-d
Benlate + Sevimol	0.6 kg + 2.3 ℓ	540.0 ab	1.5 d	18.3 d-f	53.3 ab
Fungi-Sperse	18.8 ℓ	68.3 d	11.3 a-d	21.7 c-e	31.7 de
Benlate 50 WP	0.4 kg	252.7 bcd	0.1 d	5.7 e-g	17.3 d-g
Benlate + Vydate L 24%	0.3 kg + 0.3 kg	298.7 bcd	0.8 d	4.7 e-g	25.0 d-f
Bravo 75 SP	1.7 kg	12.7 d	6.0 a-d	3.7 fg	10.0 e-g
Benlate 50 WP	0.6 kg	70.3 d	0.2 d	0.4 g	15.0 e-g
Copper Count 8%	4.7 ℓ	2.0 d	3.3 cd	3.3 fg	10.0 e-g
Furadan 10G	11.2 kg	0.3 d	1.3 d	0.4 g	1.3 g
Du-Ter 47.5 WP	0.4 kg	0 d	1.0 d	0.2 g	2.0 fg
Du-Ter + Sevin	0.4 kg + 1.4 kg	3.7 d	14.5 a-c	12.0 d-g	13.3 e-g
Benlate + Sevin	0.6 kg + 1.4 kg	676.0 a	4.8 b-d	26.0 b-d	63.3 a
Untreated	---	6.0 d	6.3 a-d	4.3 e-g	4.0 fg

[1] Applied 6 times at 2 week intervals beginning the last week in June. "+" means tank mixture.

[2] Amount formulation per acre.

[3] Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Results and Discussion

Mite population and damage in 1973 was low until September. Mite damage on August 28 ranged from ca. 10% to 16% in plots treated with Sevin or combinations containing Sevin (Table 1). By mid September the mite population reached high numbers. The highest numbers of mites on September 18 were collected from peanuts treated with Fungi-Sperse + Sevin, Benlate + Lannate, Benlate + Sevimol, Benlate + Vydate and Benlate + Sevin. Mite damage increased from a high of 16.3% on August 28 to 43.3% on September 14 to 63.3% on October 2.

Mite outbreaks occurred in all plots treated with fungicide-insecticide combinations except Du-Ter. This is evident by the number of mites, their spread from the original release area, and the high cumulative mite damage. Plots treated wiht Thimet, Furadan, Du-Ter and untreated peanuts had less than 5% mite damage at harvest time on October 2. While Sevin used in combination with some fungicides caused mite outbreaks, Sevin when used alone resulted in only 18% seasonal mite damage. The fungicide Fungi-Sperse when used alone resulted in 31.7% mite damage on October 2.

On August 28, peanuts treated with Benlate + Sevin exhibited lower mite damage than peanuts treated with Du-Ter + Sevin; however mite damage increased rapidly in the Benlate + Sevin plots in September while mite damage failed to increase in the Du-Ter + Sevin plots.

Excessive rain during August and September kept the mite population low in 1974. Adverse pesticide interactions did occur however and mites increased on peanuts treated with Bravo + Sevin, Dithane + Sevimol and Fungi-Sperse + Sevimol (Table 2). Peanuts treated with Dithane or Bravo had more mite damage than peanuts treated only with Sevin. Mite damage remained low in plots treated with Du-Ter, Copper Count, and Benlate. Again, mites failed to build up and mite damage remained low on peanuts that were not treated with pesticides or peanuts that were treated with Furadan or Thimet without a fungicide.

Mite damage occured earlier in 1975 than in 1973 or 1974. By August 20 high mite populations were recorded on peanuts treated with Fungi-Sperse + Sevin, Fungi-Sperse and Sevin, Benlate (early) and Du-Ter (late), Benlate (early) and Bravo (late), Benlate + Sevin, Dithane and Sevin, Fungi-Sperse, Bravo + Sevin, Dithane + Sevin, Dithane, and Benlate (Table 3).

Mite damage did not develop in the absence of pesticides. Mite damage remained very low throughout the season on peanuts treated with Du-Ter, Copper Count, Du-Ter and Sevin, Du-Ter (early) and Bravo (late), Bravo (early) and Du-Ter (late), Copper Count + Sevin, and Du-Ter + Sevin. Mites failed to build up in these plots even when adjacent 4-row plots were brown from severe mite damage.

Table 2. Effect of fungicide-insecticide interaction on the twospotted spider mite. Lewiston, N. C. 1974.

Treatment[1/]	Rate/ha	Avg. % mite damage Sept. 9[2/]
Benlate + Oil (70 sec)	0.6 kg + 4.7 ℓ	6.7 e-h[3/]
Benlate 50 WP	0.6 kg	6.7 e-h
Benlate + Sevin	0.6 kg + 1.4 kg	10.7 d-h
Benlate (2) and Du-Ter (4)	0.6 kg + 0.4 kg	9.0 d-h
Benlate (3) and Du-Ter (3)	0.6 kg + 0.4 kg	11.7 d-f
Benlate + Sevin (3 early)	0.6 kg + 1.4 kg	3.3 f-h
Benlate + Sevin (2 late)	0.6 kg + 1.4 kg	4.3 f-h
Benlate + Sevin (3 late)	0.6 kg + 1.4 kg	9.0 d-h
Du-Ter-Sulfur 47.5-15W	0.4 kg	3.0 e-h
Du-Ter 47.5 WP	0.4 kg	5.0 e-h
Du-Ter + Sevin	0.4 kg + 1.4 kg	11.0 d-g
Du-Ter + Sevin (3 early)	0.4 kg + 1.4 kg	7.7 d-h
Du-Ter + Sevin (3 late)	0.4 kg + 1.4 kg	8.7 d-h
Bravo 75 WP	1.7 kg	16.7 d
Bravo + Sevin	1.7 kg + 1.4 kg	48.3 c
Copper Count 8%	4.7 ℓ	7.3 e-h
Copper Count + Sevin	4.7 ℓ + 1.4 kg	15.7 de
Sevin (1-Thrips) 80 W	1.4 kg	4.3 f-h
Sevin (3-Leafhoppers)	1.4 kg	6.7 e-h
Sevin (2-worms)	1.4 kg	5.7 f-h
Sevin (1 + 3 + 2)	1.4 kg	11.7 d-f
Fungi-Sperse	18.8 ℓ	10.7 d-h
Fungi-Sperse + sevimol (4F)	18.8 ℓ + 2.3 ℓ	71.7 a
Dithane 80 W	1.7 kg	17.0 d
Dithane + Sevimol	1.7 kg + 2.3 ℓ	58.0 b
Thimet 10G	11.2 kg	2.0 gh
Furadan 10G	11.2 kg	1.7 h
Untreated	---	3.3 f-h

1/ Applied June 21, July 4, July 19, Aug. 5, Aug. 16, and Aug. 29
3 early = 3 earliest dates; 3 late = 3 latest dates; "+" = Tank mixed
Numbers in parenthesis following Sevin, Benlate or Du-Ter refer to the number of applications and sequence of applications.

2/ Mite release site.

3/ Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Between September 5 and September 26 mite damage did not increase markedly except on peanuts treated with Benlate and alternate treatments of Benlate and Sevin. The late season buildup of mites on peanuts treated with Benlate was observed also in the 1973 tests.

Yields were significantly affected by the twospotted spider mite (Table 4). the lowest yields were obtained from plots treated with pesticides that caused mite outbreaks such as Dithane and Sevin, Fungi-Sperse and Sevin and Benlate and Bravo. The highest yields were recorded for plots treated with Du-Ter, Du-Ter + sevin, and the combination Du-Ter (early) and Benlate (late). All Du-Ter plots had low seasonal mite damage. Since *Cercospora* leafspot on untreated peanuts averaged only 10% leaf damage, yield differences were due primarily to twospotted spider mite damage. Pod rot caused by soil-borne organisms and some insect damage further confounded the yield data.

It is clear from these data that pesticides predispose peanuts to the twospotted spider mite. Fungicides caused a higher mite increase and mite damage than insecticides and the combination fungicide + insecticide resulted in mite outbreaks. All fungicide or fungicide-insecticide combinations caused mite increases and significant mite damage except Du-Ter and Copper Count.

Table 3. Effect of fungicide-insecticide interaction on the twospotted spider mite on peanuts. Halifax County, N. C. 1975.

Treatment[1/]	Rate/ha	Avg. no. mites/10 leaflets Aug. 20	Avg. % mite damage in 4-row plot. Sept. 5	Sept. 26
Untreated	---	3.0 f	0 h	0 h[2/]
Bravo (3 early) and Benlate (2 late)	1.7 kg and 0.6 kg	336.7 ef	33.3 d-h	48.3 c-e
Du-Ter + Sevin 47.5 + 80 W	0.4 kg + 1.4 kg	39.7 f	4.0 h	10.0 f-h
Copper Count (N) + Sevin	4.7 ℓ + 1.4 kg	22.3 f	1.3 h	9.0 f-h
Benlate and Sevin (alt. wk.)	0.6 kg and 1.4 kg	702.3 b-d	46.7 b-g	70.0 a-c
Dithane and Sevin (alt. wk.)	1.7 kg and 1.4 kg	973.0 a-c	75.0 a-c	73.3 a-c
Bravo 75 WP	1.7 kg	238.7 f	21.7 gh	30.0 e-g
Du-Ter (3 early) and Bravo (2 late)	0.4 kg and 1.7 kg	31.0 f	3.7 h	8.7 f-h
Du-Ter and Sevin (alt. wk.)	0.4 kg and 1.4 kg	22.0 f	4.0 h	5.7 f-h
Fungi-Sperse + Sevin	18.8 ℓ + 1.4 kg	1301.0 a	90.0 a	86.0 ab
Dithane + Sevin	1.7 kg + 1.4 kg	707.0 b-d	51.7 a-g	65.0 b-d
Bravo and Sevin (alt. wk.)	1.7 kg and 1.4 kg	599.0 de	26.7 f-h	38.3 de
Bravo (3 early) and Du-Ter (2 late)	1.7 kg and 0.4 kg	42.7 f	1.7 h	4.7 gh
Fungi-Sperse	18.8 ℓ	974.7 a-c	66.7 a-e	76.0 a-c
Benlate (3 early) and Bravo (2 late)	0.6 kg and 1.7 kg	1105.3 a	63.3 a-f	70.0 a-c
Copper Count (N) 8%	4.7 ℓ	5.0 f	0.7 h	1.0 h
Du-Ter (3 early) and Benlate (2 late)	0.4 kg and 0.6 kg	48.7 f	3.3 h	10.0 f-h
Fungi-Sperse and Sevin (alt. wk.)	18.8 ℓ and 1.4 kg	1193.0 a	72.3 a-c	94.0 a
Dithane 80 W	1.7 kg	689.3 b-d	35.0 d-h	53.3 c-d
Benlate (3 early) and Du-Ter (2 late)	0.6 kg and 0.4 kg	1231.3 a	36.7 c-h	33.3 ef
Benlate + Sevin	0.6 kg + 1.4 kg	1033.3 ab	78.3 ab	75.0 a-c
Bravo + Sevin	1.7 kg + 1.4 kg	732.3 b-d	66.7 a-e	56.7 c-d
Du-Ter 47.5 WP	0.4 kg	9.3 f	0 h	0.3 h
Benlate 50 WP	0.6 kg	652.7 c-e	21.7 gh	50.0 c-e

1/ All treatments with "+" Sevin means tank mixed. Alt. wk = alternate weekly applications of fungicides and insecticides totaling 10 applications. All other plots treated 5 times at 2 week intervals. 3 early = 3 earliest dates of application; 2 late = 2 latest dates of application.

2/ Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Table 4. Yield of peanuts as influenced by spider mites and pesticide interaction. Halifax County, N. C. 1975.

Treatment[1/]	Rate/ha	Kg peanuts/36.4 m Oct. 15
Untreated	---	5.6 a-c[2/]
Bravo (3 early) and Benlate (2 late)	1.7 kg + 0.6 kg	5.0 a-c
Du-Ter + Sevin 47.5 + 80 W	0.4 kg + 1.4 kg	6.3 a
Copper Count (N) + Sevin	4.7 ℓ + 1.4 kg	5.8 a-c
Benlate and Sevin (alt. wk.)	0.6 kg and 1.4 kg	4.7 a-c
Dithane and Sevin (alt. wk.)	1.7 kg and 1.4 kg	3.9 c
Bravo 75 WP	1.7 kg	5.2 a-c
Du-Ter (3 early) and Bravo (2 late)	0.4 kg and 1.7 kg	5.2 a-c
Du-Ter and Sevin (alt. wk.)	0.4 kg and 1.4 kg	5.7 a-c
Fungi-Sperse + Sevin	18.8 ℓ + 1.4 kg	4.5 a-c
Dithane + Sevin	1.7 kg + 1.4 kg	5.7 a-c
Bravo and Sevin (alt. wk.)	1.7 kg and 1.4 kg	5.6 a-c
Bravo (3 early) and Du-Ter (2 late)	1.7 kg and 0.4 kg	5.7 a-c
Fungi-Sperse	18.8 ℓ	5.0 a-c
Benlate (3 early) and Bravo (2 late)	0.6 kg and 1.7 kg	4.0 bc
Copper Count (N) 8%	4.7 ℓ	5.3 a-c
Du-Ter (3 early) and Benlate (2 late)	0.4 kg and 0.6 kg	6.2 ab
Fungi-Sperse and Sevin (alt. wk.)	18.8 ℓ and 1.4 kg	3.8 c
Dithane 80 W	1.7 kg	5.1 a-c
Benlate (3 early) and Du-Ter (2 late)	0.6 kg and 0.4 kg	5.1 a-c
Benlate + Sevin	0.6 kg + 1.4 kg	4.9 a-c
Bravo + Sevin	1.7 kg + 1.4 kg	5.2 a-c
Du-Ter 47.5 WP	0.4 kg	6.4 a
Benlate 50 WP	0.6 kg	4.6 a-c

[1/]All treatments with "+" Sevin means tank mixed.
All plots treated 5 times at 2 week intervals except treatments followed by alt. week = 5 fungicide alternated weekly with 5 insecticides to total 10 applications.

[2/]Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Benlate did not cause a mite buildup until late in the season since it has low level ovicidal activity on the twospotted spider mite (Campbell et al., 1974). However, the early season beneficial ovicidal action of Benlate was offset by the season long adverse effect.

The destruction of *Entomophthora* sp. fungi by fungicides applied for leafspot control may be one of the contributing factors associated with mite outbreaks. This is supported by observations of high incidence of *Entomophthora* in peanut plots. For example, Sevin in the absence of a fungicide caused a buildup of spider mites in mid-season but *Entomophthora* killed the mites following a rainy period. Mites failed to become established again in the Sevin-treated plots. Under the same environmental conditions mites continued to survive and build up in plots treated with some fungicide and insecticide combinations such as Fungi-Sperse + Sevin.

Other factors that may contribute to mite outbreaks include destruction of predaceous insects and predaceous mites, stimulation of mites by certain pesticides that may cause increased activity or oviporision and some pesticides may change the physiology of the plant and indirectly increase the fecundity or survival of the twospotted spider mite.

Spider mite outbreaks on peanuts may be minimized by selecting Du-Ter or Copper count as the leafspot fungicide in the mite problem areas and by eliminating foliage applications of insecticides by the use of a systemic insecticide at planting.

Acknowledgment

The author acknowledges the valuable assistance of R. W. Batts, Research Technician, Department of Entomology.

Literature Cited

1. Bartlett, B. R. 1968. Outbreaks of twospotted spider mites and cotton aphids following pesticide treatment. I. Pest stimulation vs. natural enemy destruction as the cause of outbreaks. J. Econ. Entomol. 61:297-303.
2. Campbell, W. V. 1969. Influence of seasonal insect control on the incidence of stunt virus in peanuts. Jour. Amer. Peanut Res. Ed. Assoc. 1(1):41-45.
3. Campbell, W. V., R. W. Batts, R. L. Robertson, and D. A. Emery. 1974. Suppression of the twospotted spider mite on peanuts. Peanut Science 1(1):30-34.
4. Carner, G. R. and T. D. Canerday. 1968. Field and laboratory investigations with *Entomophthora fresenii*, a pathogen of *Tetranychus* spp. J. Econ. Entomol. 61:956-961.
5. Davis, D. W. 1952. Some effects of DDT on spider mites. J. Econ. Entomol. 45:1011-1019.
6. DeBack, P. 1947. Predators, DDT, and citrus red mite populations. J. Econ. Entomol. 40:598-599.
7. Klostermeyer, E. C. 1959. Insecticide-induced population changes in four mite species on alfalfa. J. Econ. Entomol. 52: 991-994.
8. Saini, R. S. and L. K. Cutkomp. 1966. The effects of DDT and sublethal doses of Dicofol on reproduction of the twospotted spider mite. J. Econ. Entomol. 59:249-253.

Accepted August 16, 1978