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ARTHROPOD CONTROL ON CUCURBITS AND EGGPLANT[1]

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Abstract. **Insecticides were applied weekly to field-grown plants of cucumber** (Cucumis sativis **L.), honeydew melon** (C melo **L.), and eggplant** (Solanum melongena **L.) for arthropod control. Methamidophos (Monitor®), acephate (Orthene®), and methomyl (Lannate®) produced the best control of both the melonworm** (Diaphania hyalinata **(L.)), and pickleworm** (D. nitidalis **(Stoll)) on cucurbits. Methamidophos, oxamyl (Vydate®), acephate, cyhexatin (Plictran®), hexakis (Vendex®), and fenvalerate (Pydrin®) gave best control of both the twospotted and Glover's spider mites** (Tetranychus urticae **Koch and** T. gloveri **Banks, respectively) on eggplant. The green peach aphid** (Myzus persicae **(Sulzer)) was controlled with methamidophos, oxamyl, acephate, fenvalerate and permethrin (Ambush®). The number of eggplant fruit damaged by the cabbage looper** (Trichoplusia ni **(Hubner)) was reduced with methamidophos, acephate, cyhexatin, fenvalerate and permethrin. Only methamidophos and oxamyl reduced foliar leafminer** (Liriomyza sativae **Blanchard) damage.**

Cucumber (*Cucumis sativis* L.) and eggplant (*Solanum melongena* L.) are important vegetable crops of Florida, accounting for a total value of $45.6 and $7.3 million, respectively, for the 1979-80 crop (2). Although many arthropod pests may attack these crops, no data have been reported in Florida in the past 10 years. Adlerz (1) reported that methomyl (Lannate®, Nudrin®), sulprofos (Bolstar®), carbaryl (Sevin®), trichlorfon (Dylox®), fenvalerate (Pydrin®), endosulfan (Thiodan®), and leptophos (Phosvel®) gave good control of pickleworm larvae, (*Diaphania nitidalis* (Stoll) on cantaloupe (*C. melo* L.) and squash (*Cucurbita pepo* L.).

The purpose of the present investigation is to compare various insecticides for control of arthropods on cucumber, honeydew melon and eggplant.

Materials and Methods

Four cucurbit experiments were conducted in the Fall 1975, Fall 1976, Spring 1978, and Spring 1979 seasons, and 2 eggplant experiments were conducted in the Spring and Fall 1980 seasons at the Agricultural Research & Education Center in Bradenton.

In each cucurbit experiment, honeydew melon cv. 'Morgan' and cucumber cv. 'Poinsett' were planted on black polyethylene plastic mulched beds 0.8 m (2.5 ft) wide by 20 cm (8 inches) high of Myakka fine sand as subplots in a split plot design with 4 replications. Subplots in the fall experiments were 1.2 m (4 ft) double rows spaced 30 cm (1 ft) apart with 2 plants every 0.3 m (1 ft). Subplots in the spring experiments were 3 m (10 ft) single rows planted 30 cm (1 ft) from the bed middle with plants every 30 cm (1 ft).

In the fall cucurbit experiments, sprays were begun 2-3 weeks after planting and continued for 3-4 applications. Two samples of 10 runners each were taken 2 weeks apart for each subplot and examined for melonworm larvae, *Diaphania hyalinata* (L.). In the spring experiments, sprays were begun 2-5 weeks after planting and continued for 7-9 weeks. Plots were harvested 3-6 times and the number of fruit damaged by pickleworm larvae counted.

In each eggplant experiment, 'Florida Market' transplants were set 46 cm (18 inches) apart in single rows in the middle of plastic covered beds as for the cucurbit experiments. Plots consisted of 10 plants and treatments were replicated 4 times in randomized complete blocks designs. In the spring 1980 experiment the numbers of Glover's mites, *Tetranychus gloveri* Banks, and green peach aphids, *Myzus persicae* (Sulzer), were counted on the third leaf from the top of the largest lateral of 5 plants per plot. Twospotted spider mites were counted on the undersides of the third leaf from the top of the youngest lateral of 5 plants per plot. The numbers of feeding damage scars in these same leaves produced by cabbage looper larvae, *Trichoplusia ni* (Hubner), were also counted. The numbers of leafmines of the vegetable leafminer, *Liriomyza sativae* Blanchard, were counted on the second leaf from the bottom of 5 plants per plot. In the fall 1980 experiment the numbers of green peach aphids and leafmines on the bottommost leaf of 5 plants per plot were counted. Mite and aphid counts were completed by brushing the leaves in a leaf brushing machine and counting the number of individuals trapped on 1/10 of a detergent-coated glass plate. Counts were adjusted to a per leaf basis. Plots in both experiments were harvested at least 4 times and the number of fruit injured by lepidopterous larvae, principally the cabbage looper, were counted.

Sprays for all experiments were applied to run-ofl with a 9.5 liter (2.5 gal) hand-held stainless steel sprayer with a single adjustable cone nozzle at 2.8 kg/cm^2 (40 psi). Amount of spray applied increased as plants grew and ranged from about 374-935 liters/ha (40-100 gal/acre) for cucurbits and 657-1122 liters/ha (70-120 gal/acre) for eggplant.

Results and Discussion

In both fall cucurbit experiments, foliage of honeydew melon and cucumber sprayed with either methomyl or acephate (Orthene®) had significantly fewer melonworm larvae at all sampling dates than foliage sprayed with water (Tables 1 and 2). Control with chlordimeform (Fundal®), *Bacillus thuringiensis* (HD-1 strain) var. *kurstaki* Berliner (Dipel®), trichlorfon and lindane (the registered chemical check) appeared intermediate, particularly in the first sample for the 3 latter compounds in the fall 1976 experiment when larval densities were high. Chlordimeform produced a slight cupping of foliage.

In the 2 spring cucurbit experiments no melonworm larvae were present. However, pickleworm larvae were present in damaging numbers on cucumbers, particularly in the spring of 1978 (Table 3). No data are presented for honeydew melons as few pickleworm larvae were present. In both experiments, significantly fewer cucumber fruit were damaged by pickleworm larvae on plants sprayed with methamidophos (Monitor®), acephate, methomyl or lindane compared to plants sprayed with water. In the spring 1978 experiment, about a 50% reduction in damaged fruit was observed on plants sprayed with carbaryl or endosulfan, al-

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Table 1. Control of melonworm larvae on cucurbits at AREC-Bradenton, fall 1975.[z]

Insecticide and formulation	Lb. AI/ 100 gal.	Avg no. larvae/10 runners: Morgan melon Oct. 24	Morgan melon Nov. 4	Poinsett cucumber Oct. 14	Poinsett cucumber Nov. 4
Methomyl 90SP	0.5	0.0 a[y]	0.0 a	0.0 a	0.0 a
Acephate 75SP	1.0	0.0 a	0.0 a	0.2 a	0.0 a
Lindane 25WP	1.0	0.2 a	0.0 a	0.0 a	0.2 a
Bacillus thuringiensis WP[x]	1.0	0.0 a	1.5 a	1.2 a	1.2 a
Chlordimeform 4EC	0.125	0.2 a	2.2 a	1.0 a	2.2 a
Check (water)	—	3.5 b	5.0 b	1.0 a	9.2 b

[z]Plots were planted Oct. 1 and sprayed Oct. 17. 24 and 31.
[y]Means within columns of the same date followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.
[x]Pounds of product.

Table 2. Control of melonworm larvae on cucurbits at AREC-Bradenton, fall 1976.[z]

Insecticide and formulation	Lb. AI/ 100 gal	Avg no. larvae/10 runners: Morgan melon Sept. 30	Morgan melon Oct. 14	Poinsett cucumber Sept. 30	Poinsett cucumber Oct. 14
Acephate 75SP	0.5	0.2 a[y]	0.0 a	0.5 a	0.2 a
Methomyl 1.8L	0.5	1.2 a	0.0 a	1.0 a	1.5 a
Trichlorfon 80SP	0.5	5.7 ab	0.2 a	6.7 b	0.2 a
Bacillus thuringiensis WP	1.0[x]	9.7 bc	4.5 b	7.2 bc	3.5 a
Lindane 25WP	1.0	15.7 cd	1.5 a	11.2 c	2.2 a
Check (water)	—	21.5 d	11.5 c	16.2 d	10.5 b

[z]Plots were planted Aug. 27 and sprayed Sept. 17, 24, Oct. 1 and 8.
[y]Means within columns of the same date followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.
[x]Pounds of product.

though the reduction with the latter insecticide was not significant when compared to the water check.

There were significantly fewer Glover's and twospotted spider mites on eggplant foliage sprayed with pesticides, except the azinphosmethyl (Guthion®) and dicofol (Kelthane®) chemical check, compared to foliage sprayed with water (Table 4). Applying methamidophos, oxamyl (Vydate®) at the high rate, acephate or fenvalerate at the high rate significantly reduced the number of green peach aphids relative to the water check. Foliage sprayed with methamidophos or oxamyl had significantly fewer leafmines than foliage sprayed with water. Methamidophos (high rate), acephate and fenvalerate reduced foliage leaf damage due to cabbage looper feeding relative to the water check. These same treatments plus cyhexatin (Plictran®) and the azinphosmethyl and dicofol standard reduced the number of fruit injured. Cyhexatin, a miticide, has been shown to have antifeedant or toxic properties against many lepidopterous larvae including the tomato pinworm in the laboratory and *Spodoptera eridania* Cramer and *T. ni* in the field (3). Acephate and oxamyl at the high rates tested produced a marginal chlorosis, followed by necrosis, of lower foliage.

Permethrin (Ambush®) applied at the 0.8 and 0.2 lb AI/100 gal resulted in significantly fewer green peach aphids and leafmines relative to the water check in the spring 1979 eggplant experiment (Table 5). All insecticide treatments, including the methomyl and ethion standard, significantly reduced the number of fruit damaged by

Table 3. Control of pickleworm larvae on 'Poinsett' cucumber at AREC-Bradenton.[z]

Insecticide and formulation	Lb. AI/ 100 gal	No. pickleworm damaged fruit[y]: Spring 1978	Spring 1979
Methamidophos 4EC	1.0	2.0 a[x]	0.0 a
Methamidophos 4EC	0.5	6.3 a	0.2 a
Acephate 75SP	1.0	—	0.0 a
Acephate 75SP	0.75	2.3 a	—
Acephate 75SP	0.50	—	0.0 a
Methomyl 90SP	0.90	—	0.0 a
Methomyl 90SP	0.45	2.7 a	0.0 a
Lindane 25WP	0.25	4.0 a	0.0 a
Carbaryl 80WP	1.0	7.3 a	—
Endosulfan 2EC	1.0	8.0 ab	—
Check (water)	—	14.7 b	2.7 b

[z]Spring 1978 plots were planted April 4 and sprayed April 19, 26, March 3, 10, 17, 24, 31, June 7 and 14. Spring 1979 plots were planted March 6 and sprayed April 10, 17, 24, May 1, 8, 15 and 23.
[y]Data are totals/20 plants harvested May 15, 24, 31, June 7, 13 and 20 for the Spring 1978 experiment and May 4, 11, and 18 for the Spring 1979 experiment.
[x]Means within a column followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.

Table 4. Control of arthropods on 'Florida Market' eggplant at AREC-Bradenton, Spring 1979.[z]

Insecticide and formulation	Lb. AI/ 100 gal.	No. Glover's mites/ 5 leaves (May 8)	No. twospotted spider mites/ leaf (June 12)	No. green peach aphids/ 5 leaves (May 8)	No. leaf-mines/5 leaves (June 12)	Lepidopterous larval damage: No. feeding holes/5 leaves (June 12)	No. damaged fruit[y]
Methamidophos 4EC	1.0	0.0 a[x]	0.5 a	0.2 a	0.5 a	1.2 ab	0.2 a
Methamidophos 4EC	0.5	0.0 a	1.0 a	0.0 a	1.5 ab	6.0 bcde	0.0 a
Oxamyl 2L	2.0	0.0 a	1.5 a	1.0 ab	1.4 ab	5.7 bcde	9.2 b
Oxamyl 2L	1.0	0.2 a	0.5 a	1.7 abc	1.7 abc	8.7 cde	8.2 b
Acephate 75SP	2.0	0.0 a	1.0 a	0.0 a	6.0 bcd	3.5 abcd	0.2 a
Acephate 75SP	1.0	14.7 a	33.5 a	0.0 a	7.0 bcd	2.0 abc	0.2 a
Cyhexatin 50WP	0.8	1.0 a	0.0 a	10.5 abcd	9.5 cd	2.7 abcd	0.0 a
Cyhexatin 50WP	0.4	5.7 a	5.0 a	11.7 abcd	14.7 d	4.0 abcde	2.5 a
Hexakis 50WP	2.0	10.0 a	2.5 a	39.5 d	14.5 d	11.7 e	9.2 b
Hexakis 50WP	1.0	0.0 a	0.0 a	19.2 bcd	7.2 bcd	10.7 e	8.5 b
Fenvalerate 2.4EC	0.2	1.0 a	2.5 a	0.0 a	13.2 d	2.0 ab	0.0 a
Fenvalerate 2.4EC	0.1	5.2 a	3.0 a	16.7 abcd	13.5 d	0.2 a	0.0 a
Azinphosmethyl 2L + dicofol 35WP	0.5 / 0.25	3.0 a	187.5 b	15.0 abcd	12.7 d	9.2 cde	2.5 a
Water	—	149.0 b	196.0 b	19.2 cd	15.2 d	11.2 e	10.5 b

[z]Plots were transplanted March 21 and sprayed April 18, 25, May 2, 9, 16, 23, 30, June 6, 13, and 20.
[y]Data are totals/10 plants harvested June 6, 13, 20. 22, 24, and 26.
[x]Means within columns followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.

Table 5. Control of insects on 'Florida Market' eggplant at AREC-Bradenton, spring 1980.[z]

Insecticide and formulation	Lb. AI/ 100 gal.	No. green peach aphids/5 leaves (Nov. 5)	No. leafmines/ 5 leaves (Nov. 5)	No. fruit damaged by lepidopterous larvae[y]
Permethrin 2EC	0.8	0.0 a[x]	0.5 a	0.0 a
Permethrin 2EC	0.2	9.2 a	1.2 a	0.0 a
Permethrin 2EC	0.1	34.5 ab	7.2 b	0.0 a
Methomyl 1.8L	0.9			
+ ethion 4EC	0.225	26.5 ab	11.5 b	0.6 b
Check (water)	—	97.2 b	10.7 b	1.7 c

[z]Plots were transplanted Sept. 8 and sprayed Sept. 16, 22, 29, Oct. 6, 13, 20, 27, Nov. 3, 10, 19, 14, and Dec. 1.
[y]Data are totals/10 plants harvested Nov. 7, 14, 21, and Dec. 1.
[x]Means within columns followed by the same letter are not significantly different at the P = 0.05 level, Duncan's multiple range test.

cabbage looper larvae. Permethrin was phytotoxic, particularly at the 0.8 lb AI rate, reducing plant height. Foliar symptoms included leaf distortion and mottling similar to a yellows-type virus infection.

Pesticides were identified which gave control of arthropods equal to or better than chemical standards, i.e. lindane on cucurbits and either azinphosmethyl and dicofol or methomyl and ethion on eggplant. Methomyl and acephate gave consistent control of melonworm larvae on cucurbits. These compounds plus methamidophos also consistently controlled pickleform larvae on cucumber. *B. thuringiensis* generally gave significant but intermediate control of melonworm larvae.

The insecticides methamidophos, oxamyl, acephate and fenvalerate gave as good control of both the Glover's and twospotted spider mites on eggplant as the miticides cyhexatin and hexakis (Vendex®). The chemical standards azinphosmethyl and dicofol controlled the Glover's mite but not the twospotted spider mite, indicating the need for proper identification before attempting chemical control. Methamidophos and permethrin controlled the green peach aphid, vegetable leafminer and cabbage looper. Oxamyl controlled the aphid and leafminer but not the looper, while acephate and fenvalerate controlled the aphid and looper but not the leafminer. Results indicate that there are compounds that may be used for arthropod control on eggplant when different combinations of pests are present.

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A VIRUS AS THE CAUSAL AGENT OF SPRING YELLOWS OF LETTUCE AND ESCAROLE[1]

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Abstract. **A virus was isolated from lettuce and escarole plants showing typical symptoms of spring yellows. The virus, called the spring yellows virus (SYV), was demonstrated to be the causal agent of spring yellows by aphid transmission studies done in the laboratory. Shepherd's purse,** Capsella bursa-pastoris, **was the best assay host for detecting SYV, and SYV was found occurring naturally in other south Florida vegetables (broccoli, kohlrabi, cauliflower, turnip, and mustard). The green peach aphid,** Myzus persicae, **was an efficient vector for SYV, while** Hyadaphis pseudobrassicae **and** Aphis coreopsidis **were not vectors in these experiments. Transmission properties of SYV by** M. persicae **were typical for persistent-circulative aphid transmitted viruses. SYV reacted positively in double antibody sandwich ELISA tests with antiserum to the RYIR isolate of beet western yellows virus, which is the causal agent of "June Yellows" of lettuce in California.**

The spring yellows disorder of lettuce and escarole has occurred annually in south Florida for approximately 15 years. Substantial economic losses can be attributed to spring yellows each year. This disorder is characterized by the progressive overall yellowing that occurs in escarole and lettuce plants during the growing season; however, it is most common in spring crops, hence the name spring yellows. Individual affected plants show a progressive interveinal chlorosis and thickening of leaves that begins on the older leaves (Fig. 1A). In sensitive varieties, entire plants may become yellow and thereby give a whitish-yellow cast to entire fields. Considerable work as to the cause of this disorder had met with no success (V. L. Guzman, unpublished). As a result, the selection for varieties tolerant to this disorder has been somewhat slow.

Because of the similarities in symptomatology of spring yellows to the virus induced yellowing diseases of lettuce found in other areas of the world, e.g., June yellows in California (3), and premature yellowing in the Netherlands (1), it was postulated that a similar virus might be the causal agent of the spring yellows disorder in south Florida. This report summarizes efforts to determine if a virus is the causal agent of spring yellows.

Materials and Methods

During the 1980-81 growing season, field collected lettuce (*Lactuca sativa* L.) and escarole (*Cichorium endivia* L.) plants showing typical symptoms were used as aphid acquisition source plants for virus transmission studies in the laboratory.

Colonies of non-viruliferous green peach aphids (*Myzus persicae* Sulzer) and turnip aphids (*Hyadaphis pseudobrassicae* Davis) were reared on radish (*Raphanus sativa* L., cv. White Icicle), and *Aphis coreopsidis* Thomas, was reared

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