

Insect and Nematode Control in Cucumber (*Cucumis sativus*) in Puerto Rico¹

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ABSTRACT

Field experiments for the chemical control of the pickleworm (*Diaphania nitidalis*), the melonworm (*D. hyalinata*), the leafminer (*Liriomyza sativae*), and nematodes (*Meloidogyne incognita* and *Rotylenchulus reniformis*) on cucumber cultivar Ashley were established in two locations in Puerto Rico in 1979 and 1980. In the second test, a lower number of mined leaves was observed on methamidophos-treated plots as well as a significant lower index of leafminer damage. All chemicals controlled the pickleworm effectively. Highest yields were obtained from plots treated with the highest dosage of acephate and with the intermediate dose of methamidophos. Applications of carbofuran, acephate, methomyl and permethrin reduced the melonworm damage in the third test. Highest yields were obtained from carbofuran-treated plots. All nematicides controlled nematodes in the soil.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important vegetable crops grown in Puerto Rico. Sixty-six percent of the production obtained during the winter is exported to the United States. In 1982-83, Puerto Rico produced 693,910 kg of cucumbers (2).

Various organisms affect cucumber production, among which insects and nematodes are particularly detrimental. The most serious insect pests are the melonworm (*Diaphania hyalinata*) and the pickleworm (*D. nitidalis*). Their life cycles and habits are very similar, except that the melonworm feeds much more extensively on the foliage than does the pickleworm. The melonworm attacks cucumber and pumpkin as well as other cucurbits, but rarely enters the vine or leaf petioles, it is rare in watermelons. The pickleworm attacks mostly the fruit of cucumbers, cantaloupes, and squashes; it rarely attacks watermelons, and pumpkin not at all (8). Some crops are frequently destroyed by these worms.

Other insects associated with cucumber are the leafminer (*Liriomyza sativae*) and the aphid (*Aphis gossypii*). The leafminer is present most of the time, but it is more important early in the season when the plants are small and tender. Aphids appear sporadically and only cause severe damage occasionally. But sucking the sap from the leaves, they weaken the plants and reduce both the quantity and quality of the fruit.

Various insecticides have proved effective against some of these insects.

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Adlerz (1) controlled pickleworm (*D. nitidalis*) in zucchini with applications of methomyl and fenvalerate. Schuster (10) controlled the melonworm (*D. hyalinata*) and the pickleworm in cucumbers with applications of methomyl, methamidophos and acephate. He also reduced foliar leafminer (*Liriomyza sativae*) damage with foliar applications of methamidophos and oxamyl.

Various nematodes such as *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Helicotylenchus*, *Tylenchorhynchus* and *Trichodurus* are closely associated with production of cucurbits in Puerto Rico (9). In 1970, 30% loss on cucumbers was associated with these nematode species.³ Román et al. (9) found an increase in yields of pumpkin and watermelon of 52 and 33%, respectively with applications of 16.8 kg/ha of fenamiphos 15G. Some chemicals have proved effective for the control of nematodes in cucurbits in the United States (4, 5, 6, 7, 10). Johnson and Harmon (4) obtained nematode control with fensulfothion and fenamiphos. Johnson et al. (5) reported the effect of various pesticides on nematodes, weeds and yields of vegetable crops. Nematodes were reduced by soil treatments with an organic phosphate or carbamate nematicide-herbicide-fungicide combination. DD-MENCS, methyl bromide-chloropicrin, ethoprop, carbofuran, and sodium azide+ ethoprop or carbofuran. Wright and Rowland (11) reported effective control of *M. incognita* adult females with applications of oxamyl to cucumber roots soon after infection, when mostly 2nd stage juveniles were present in the soil. Littrell (7) reported an increase in yield of 75% in cucumbers and lower *M. incognita* populations and root-gall indices with applications of oxamyl L. Johnson et al. (6) found higher cucumber yield and lower *M. incognita* populations and root-gall indices with fenamiphos-sprinkler irrigations.

MATERIALS AND METHODS

Field experiments were established at Isabela on a Coto clay (pH 7.5 and 3.6% organic matter) and at Santa Isabel on a San Antón silt-loam (pH 7.7 and 2.9% organic matter) with cucumber cultivar Ashley. The target insects were the pickleworm (*Diaphania nitidalis*), the melonworm (*D. hyalinata*) and the leafminer (*Lyriomyza sativae*). The first experiment was established at Isabela in April 1979. Three dosages of the insecticides, acephate 75S (0.56, 1.12 and 2.24 kg a.i./ha), methamidophos 4E (0.56, 0.84 and 1.12 kg a.i./ha), 0.37 of dimethoate and 0.56 kg a.i./ha of oxamyl, a nematicide-insecticide, were included. Experimental plots with an area of 55.77 m² were established in April 1979, and consisted of four rows, each 1.83 m wide and 6.1 m long. Plant spacing was 1.83 m. All chemicals were applied in 100 gal of water per acre (2.47 ha) to the

³ Dr. Jessé Román, Personal Communication.

foliage with a 5-gal knapsack sprayer, one fan nozzle per row, every week throughout the 4-week season, starting 15 days after planting in April. Plants were sprinkled immediately after planting and as needed throughout the season. The experiment consisted of nine treatments replicated four times and arranged in a randomized complete-block design. Untreated plots served as controls. Yield data was recorded for a 30-day period beginning 30 days after planting.

A similar experiment to control *D. hyalinata* and *L. sativae* was established at Santa Isabel in May 1979. Treatments, methodology and plot size were as in the first test except that in this test, plots consisted of two rows, each 1.83 m wide and 15.24 m long, and oxamyl L was not included. Data on yield per plot, and visual damage index (1-5), where 1 represents normal plants and 5 represents the most infested by either leafminer and pickleworm, were recorded 60 days after planting. Data on the percentage of mined leaves were recorded on the basis of 100 leaf samples, the mined leaves of which were counted.

A third experiment to control the melonworm and nematodes was established at Isabela in March 1980. Two dosages (2.24 and 4.48 kg a.i./ha) of the granular nematicide-insecticides carbofuran 10G, aldicarb 10G, fenulfiothion 15G at 7.5 and 15 kg a.i./ha, and ethoprop 10G, at 3.36 kg a.i./ha were applied to the soil at planting. Plots treated with the lowest and highest doses of carbofuran received 3.36 and 6.72 kg/ha (a.i.) respectively 4 weeks after the first application. Oxamyl L at 0.56, 1.12 and 2.24 l/ha was applied to the foliage, 3½ weeks after planting and weekly up to three applications. Granular nematicides applied by hand from application jars to 30 cm wide bands were incorporated 5-8 cm deep with a hoe just before planting. Soil samples for nematode analysis (250 cm³ per plot) were taken 15 cm deep before nematicide or insecticide application and 5 weeks after application. Nematodes were extracted from the soil following the modified Christie and Perry method (3). The insecticides acephate (1.12 and 2.24 kg/ha), methamidophos (0.56 and 1.12 l/ha), methomyl (0.45 l/ha) and permethrin (0.2 and 0.4 l/ha) were also included, as well as untreated controls. Treatments, replicated four times, were included in an incomplete-block design.

Cultural practices, control of weeds, and fertilizer application were those recommended by the Agricultural Experiment Station.

RESULTS AND DISCUSSION

No significant differences in fruit weight among treatments were obtained in the first test (table 1). Number of fruits from the control plots was significantly higher than those from plots treated with 0.56 kg/ha of acephate 75S.

In the second test there were no differences among treatments on the

percentage of mined leaves (table 2). A significant lower index of leaf-miner damage was recorded from plots treated with methamidophos (table 2). All chemicals controlled pickleworm effectively. Highest yields were obtained from plots treated with the highest dosage of acephate and with the intermediate of methamidophos. Schuster (10) reduced foliar leafminer (*L. sativae*) with applications of methamidophos and oxamyl on cucumbers. He also controlled the pickleworm (*D. nitidalis*) with applications of methamidophos, acephate and methomyl. No data on nematode populations were recorded in the first two experiments.

Results from the third test in table 3 indicate that a lower melonworm damage was obtained with applications of 4.48 kg/ha of carbofuran, acephate (1.12 and 4.24 kg/ha), methomyl and permethrin (0.4 kg/ha).

TABLE 1.—*Effects of insecticides and a nematocide-insecticide on the control of insects in cucumber cv. Ashley at Isabela, Puerto Rico, 1979*

Treatment	Dosage	Fruit yield/plot ¹	
	kg (a.i.)/ha	Number	Weight kg
Acephate 75S	0.56	701.50 a	351.95 ²
Acephate 75S	1.12	868.25 a	477.05
Acephate 75S	2.24	792.00 ab	426.50
Dimethoate	0.56	765.75 ab	406.53
Methamidophos 4E	0.56	835.50 ab	434.38
Methamidophos 4E	0.84	893.00 ab	465.60
Methamidophos 4E	1.12	880.00 ab	474.13
Oxamyl L	0.56	793.50 ab	476.37
Control	—	1008.25 b	553.10

¹ Values in columns with different letters differ statistically at 5%.

² N.S.

Highest yields (fruit number and weight) were obtained with applications of carbofuran. Although a 32% increase in fruit weight was obtained with the higher dosage of carbofuran, this was not statistically different from the check. This might be due to a high degree of variation among replications within the same treatment. Some treated plots produced less than the untreated plots, which could be attributed to a possible phytotoxic effect by some of the pesticides. Higher yields in carbofuran-treated plots could be the result of its nematocidal effect. This chemical reduced more than 50% of the nematode populations. All nematocides reduced populations in the soil. Johnson and Harmon (4) controlled nematodes in cucurbits with applications of fensulfothion. Wright and Rowland (11) controlled *M. incognita* adult females with oxamyl L applications and Littrell (7) increased cucumber yields by 75% with oxamyl, whereas

TABLE 2.—*Effects of insecticides on the control of leafminer and pickleworm on cucumber cv. Ashley at Santa Isabel, Puerto Rico. 1979*

Treatment	Dosage kg/(a.i.) ha	Mined leaves ¹		Pickleworm Damage index (1-5) ²	Fruit yield/plot	
		%			Number	Weight
		Leafminer				
Acephate 75S	0.56	52.00	2.35 ac	1.48 a	64.75 a	44.08 ac
Acephate 75S	1.12	47.75	2.38 ac	1.43 a	113.00 bc	68.60 bc
Acephate 75S	2.24	51.00	2.75 a	1.55 a	122.50 bc	74.13 b
Dimethoate	0.56	47.75	2.25 ac	1.80 a	71.25 a	43.88 ac
Methamidophos 4E	0.56	45.25	1.68 bd	1.38 a	95.25 ac	50.08 ac
Methamidophos 4E	0.84	46.50	1.28 b	1.28 a	118.00 bc	80.90 b
Methamidophos 4E	1.12	41.75	1.55 b	1.43 a	80.00 a	49.00 ac
Control	—	51.75	2.18 cd	3.13 b	76.50 a	45.40 ac

¹ Values without letters do not differ statistically at the 5% probability level.

² Damage index (1-5), 1 = normal plants and 5 = most infested; numbers in columns with different letters differ statistically at 5% level, according to Duncan's multiple range test.

TABLE 3.—*Evaluation of insecticides and nematocidal-insecticides for the insect and nematode control in cucumber cultivar Ashley, Isabela. 1980*

Treatment	Dosage kg (a.i./ha)	Melonworm ¹ damage index	Fruit yield/plot		Nematode control ²
			Number	Weight	
			kg		%
Oxamyl L	0.56	1.9 ac	380.8 abc	491.7 abcd	12.33
Oxamyl L	1.12	2.0 ac	342.6 bcef	448.1 bcd	72.72
Oxamyl L	2.24	1.2 bc	273.2 c	350.1 df	15.00
Carbofuran 10G	2.24 + 3.36	1.4 c	508.1 ag	623.5 ab	66.66
Carbofuran 10G	4.48 + 6.72	1.1 b	476.1 ad	635.1 a	58.82
Aldicarb 10G	2.24	2.0 ac	415.8 ae	496.3 abcd	65.22
Aldicarb 10G	4.48	1.9 ac	423.3 ae	549.1 abe	60.00
Fensulfothion 15G	7.50	2.0 ac	410.9 ae	516.6 abcf	29.41
Fensulfothion 15G	15.00	1.5 c	434.6 af	540.1 abg	36.36
Acephate 75S	1.12	1.0 b	291.3 bce	372.9 cdeg	-31.25
Acephate 75S	4.24	1.0 b	370.8 bcdef	485.7 abcd	-36.36
Methamidophos 4S	0.56	1.5 c	363.1 bcdef	457.8 bcd	-50.00
Methamidophos 4S	1.12	1.4 c	366.1 bcdef	488.0 bcd	-63.15
Methomyl L	0.45	1.1 b	394.3 abcdg	604.1 abcd	-185.71
Ethoprop 10G	3.36	1.5 c	478.7 ad	415.8 ab	5.88
Permethrin L	0.20	1.2 bc	324.5 bcef	346.9 cdeg	-30.00
Permethrin L	0.40	1.0 b	277.3 bc	482.9 abcd	-212.50
Check	—	1.8 c	390.9 abc	482.9 abcd	-44.44

¹ Damage index (1-5), 1 = normal plants and 5 = most infested and damaged; numbers in columns with different letters differ statistically at 5% level, according to Duncan's multiple range test.

² Values without letters do not differ statistically at the 5% probability level.

Johnson et al. (6) obtained similar results with fenamidophos sprinkler irrigations.

RESUMEN

Se establecieron experimentos de campo en dos localidades en Puerto Rico en 1979 y 1980 para investigar el control químico del gusano del pepinillo (*Diaphania nitidalis*), el gusano de melón (*D. hyalinata*), el minador (*Liriomyza sativae*), el áfido (*Aphis gossypii*) y los nematodos *Meloidogyne incognita* y *Rotylenchulus reniformis* en pepinillo, cultivar Ashley. En el segundo experimento se observó una baja incidencia de hojas con galerías en las parcelas tratadas con metamidophos y un índice de daño del minador significativamente bajo. Todos los productos químicos controlaron el gusano del pepinillo. Las producciones más altas se obtuvieron en parcelas tratadas con las dosis más bajas de acephate y con la dosis intermedia de metamidophos. Las aplicaciones de carbofuran, acephate, metomil y permetrin redujeron el daño del gusano del melón en el tercer experimento. La producción más alta se obtuvo en parcelas tratadas con carbofuran. Todos los nematicidas controlaron los nematodos.

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