

CHEMICAL CONTROL OF *MELOIDOGYNE INCOGNITA*,
ROTYLENCHULUS RENIFORMIS AND *ANTHONOMUS EUGENII* IN
CAPSICUM ANNUUM AND *C. FRUTESCENS*Nelia Acosta, Nydia Vicente, Edwin Abreu,
and Silverio Medina-GaudRespectively, Nematologist, Research Assistant, Assistant Entomologist,
and Entomologist; Crop Protection Department, University of Puerto
Rico, College of Agricultural Sciences, Mayagüez, Puerto Rico 00708.

Accepted:

10.IX.1987

Aceptado:

ABSTRACT

Acosta, N., N. Vicente, E. Abreu, and S. Medina-Gaud. 1987. Chemical control of *Meloidogyne incognita*, *Rotylenchulus reniformis*, and *Anthonomus eugenii* in *Capsicum annuum* and *C. frutescens*. *Nematropica* 17:163-169.

Field experiments were conducted in Isabela, Puerto Rico to determine the efficacy of oxamyl and phenamiphos for control of nematodes (*Rotylenchulus reniformis* and *Meloidogyne incognita*) and the pepper weevil (*Anthonomus eugenii*) in *Capsicum annuum* and *C. frutescens*. Significantly higher yields (number and weight of fruits) and 81% and 85% nematode control in *C. annuum* and *C. frutescens*, respectively were obtained from plots treated with 1.12 kg/ha (a.i.) of oxamyl. Plots of *Capsicum* spp. treated with the higher rate of oxamyl showed a significantly lower percentage of fruit damaged by the weevil as compared to other treatments. *Capsicum annuum* proved to be more susceptible to the weevil than *C. frutescens*, whereas *C. frutescens* was more susceptible to *Phytophthora*. Most of the damage to the plant and reduction in quality of *C. frutescens* fruits were caused by *Phytophthora* spp. and *Myzus persicae*. The higher rate of phenamiphos (2.2 kg/ha) produced a significantly lower root gall index in *C. annuum* roots as compared to the other treatments.

Additional key words: root-knot nematode, reniform nematode, pepper weevil, foliar application, cooking pepper.

RESUMEN

Acosta, N., N. Vicente, E. Abreu y S. Medina-Gaud. 1987. Control químico de *Meloidogyne incognita*, *Rotylenchulus reniformis* y *Anthonomus eugenii* en *Capsicum annuum* y *C. frutescens*. *Nematropica* 17:163-169.

Se establecieron dos experimentos de campo en Isabela, Puerto Rico para determinar la eficacia de oxamil y fenamifos en el control de nematodos (*Rotylenchulus reniformis* y *Meloidogyne incognita*) y del picudo del pimiento (*Anthonomus eugenii*) en *Capsicum annuum* y en *C. frutescens*. Rendimientos (número y peso de fruta) significativamente mayores y 81% y 85% de control de nematodos en *C. annuum* y *C. frutescens*, respectivamente se obtuvieron de parcelas tratadas con 1.12 kg/ha (i.a.) de oxamil. Parcelas de *Capsicum* spp. tratadas con la dosis más alta de oxamil mostraron un porcentaje de frutas dañadas por el picudo significativamente menor que en las demás parcelas. *Capsicum annuum* resultó más susceptible al picudo que *C. frutescens*, mientras que este último fue más susceptible a *Phytophthora* spp. La mayor parte del daño a la planta de *C. frutescens* y reducción en la

calidad del fruto fueron causados por *Phytophthora* spp. y *Myzus persicae*. La dosis más alta de fenamifos (2.2 kg/ha) produjo un índice de nodulación significativamente menor en raíces de *C. annuum* al compararlo con los demás tratamientos.

Palabras claves adicionales: nematodo nodulador, nematodo reniforme, picudo del pimiento, aplicación foliar, pimiento de cocinar.

INTRODUCTION

The production value of fresh vegetables in Puerto Rico has doubled in the last decade. In 1976-77 the gross income from vegetables and legumes was \$12.8 million, whereas in 1983-84 it was \$26.6 million (5). Presently, the production of pepper, *Capsicum annuum* L., is 146,000 cwt, which accounts for 72% of the local consumption of the fruit.

In order to satisfy increasing demand for peppers, pests and diseases must be controlled. Nematodes and the pepper weevil, *Anthonomus eugenii* Cano, are among the most detrimental pests of pepper in Puerto Rico. Varela, Ayala, and Toro (6) demonstrated that population levels of 2,500 eggs and juveniles of the root-knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood, per plant caused chlorosis and stunting of cooking pepper cultivars 'Blanco del País' and 'Cubanelle' in the Island. Abreu and Cruz (1), who reported the presence of the pepper weevil in the Island in 1982, demonstrated that it can cause a 50% loss of cooking peppers in the Isabela area.

Attempts have been made to identify and register with the U.S. Environmental Protection Agency the use permit of an effective product to control both organisms. Oxamyl has proven effective in controlling nematodes and the pepper weevil in Isabela. Cruz et al. (3) obtained a normal stand, high yield, and good nematode and mite control with foliar applications of oxamyl on the pepper cultivar 'Blanco del País', which was heavily infected with the reniform nematode, *Rotylenchulus reniformis* Linford and Oliveira. Gordon-Mendoza (4) obtained only 16% weevil damage on peppers from plots treated with oxamyl, whereas 89% damage was recorded from nontreated plots. Abreu and Cruz (1) also controlled the weevil effectively with applications of oxamyl.

In order to obtain more information on the efficacy of nematicides for the control of nematodes and the pepper weevil and to supply the required information to register the use of oxamyl on cooking peppers cv. 'Blanco del País' and 'Cubanelle', and on *Capsicum frutescens* L., two field experiments were established in Isabela.

MATERIALS AND METHODS

Experiments were carried out on a Coto clay soil, pH 6.5 and 1.8% organic matter, at the Isabela Agricultural Experiment Station during

1985 to 1986 to determine the effect of the insecticide-nematicides oxamyl (Vydate® L) and phenamiphos (Nemacur® 15G) on populations of the nematodes *M. incognita* (root-knot) and *R. reniformis* (reniform) and on the pepper weevil.

In the first test, two rates of oxamyl (0.56 and 1.12 kg/ha [a.i.]) and two of phenamiphos (1.10 and 2.20 kg/ha [a.i.]) were evaluated for the control of nematodes and the pepper weevil and their effect on yield of pepper (*C. annuum*) var. 'Cubanelle'. Nontreated control plots were included for comparison. Plots consisted of three beds, each 30 cm wide x 600 cm long. Bed spacing and plant spacing were 90 cm and 30 cm, respectively, and so 20 transplants per bed were planted in holes placed 30 cm apart along the center of each bed. Phenamiphos granules were applied on the bed with glass jars by hand and incorporated 5-8 cm deep into the soil with a hoe immediately before transplanting 5-week-old nematode-free seedlings from a commercial nursery.

Oxamyl was applied to the foliage with a 5-gal knapsack sprayer, one fan nozzle per row, every week for 7 weeks.

Plants were overhead irrigated immediately after planting and as needed throughout the season. Control of weeds and fertilizer (10-10-8 at 1120 kg/ha) application were those recommended by this station. Soil samples (250 cm³ per plot) for nematode assays (root-knot and reniform larvae) were taken 15 cm deep prior to and 5 weeks after nematicide application and at harvest (5 weeks later). The modified Christie and Perry method (2) was used to extract nematodes from the soil. The percent reduction in nematode soil populations (PRNSP) was calculated for each plot comparing the initial population of nematodes with the final population. PRNSP is a measure of the effect of a treatment reducing nematode population levels within time lapse in the same plot, where $PRNSP = [(P_i - P_f)/P_i] \times 100$. The variable P_i represents the initial root-knot and reniform larvae in the soil of a plot per treatment; P_f the final population (10 weeks after treatment) from the soil after treatment in the same plot.

The experiment consisted of five treatments replicated four times and arranged in a partially-balanced incomplete block design.

At harvest, data on number and weight of marketable fruits per plot (yield), and on number and weight of fruits damaged by the pepper weevil, *Heliothis* spp., and *Phytophthora* spp. were recorded. All damaged fruits were cut open and examined for presence of *Heliothis* and the pepper weevil. The weevil larvae cause a sudden and premature drop of infested fruits since it feeds on the seeds, whereas the adult in its way out makes small openings in the fruits (1). *Heliothis* larvae feed on the fruit, damaging it entirely. The green peach aphid (*M. persicae* Sulzer) feeds on the leaf sap causing wilting and the weakening of the entire plant. It is characterized by an oily appearance of the wilted leaves.

Table 1. Effect of nematode control on yield of *C. annuum* per plot. Isabela, 1985.

Treatment	Dosage kg/ha (a.i.)	Marketable fruit/plot ^y		Root gall index (0-5)	Percent nematode control ^z
		Number	Weight (kg)		
Phenamiphos	1.10	80 a	4.4 a	4.4 a	85 a
Phenamiphos	2.20	82 a	3.8 a	3.0 b	62 a
Oxamyl	0.56	206 b	9.8 b	4.0 a	74 a
Oxamyl	1.12	351 c	16.1 c	4.0 a	81 a
Check	—	70 a	3.7 a	4.8 a	-84 b

^yValues in the same column followed by the same letters do not differ statistically ($P=0.05$), according to Duncan's multiple range test; each value is the mean of four replications with 60 plants/plot.

^zPercent reduction in nematode soil populations = $([\text{initial population (Pi)} - \text{final population (Pf)}]/\text{Pi}) \times 100$.

Following harvest, 10 plants from the central bed per plot were pulled out and roots examined for nematode damage. Damage by *M. incognita* was rated by the root gall index (0-5); where 0=0, 1=1-2, 2=3-10, 3=11-30, 4=31-100, 5 = more than 100 galls per root system. All data were analyzed using ANOVA and differences were compared using Duncan's multiple range test.

In the second test, the procedures, agricultural practices, dosages and the data recorded for *C. frutescens* were similar to those in the first test.

RESULTS AND DISCUSSION

The results on the effect of the control of nematodes and the pepper weevil in *C. annuum* and *C. frutescens* are presented in Tables 1, 2, and 3. Significantly higher yields of *Capsicum* spp. (number and weight of fruits) were obtained from plots treated with both rates of oxamyl (0.56 and 1.12 kg/ha [a.i.]) as compared to the other treatments.

Both nematicides were effective reducing nematode populations in the soil. The higher rate of phenamiphos (2.2 kg/ha [a.i.]) produced a significantly lower root gall index in *C. annuum* roots. Plots treated with 1.12 kg/ha (a.i.) of oxamyl showed a significantly lower percentage of *Capsicum* spp. fruits damaged by the weevil, whereas a higher percentage of fruits damaged by *Heliothis* was recorded from the same plots (Table 3). This suggests an interspecific competition between both species of insects, with a tendency for populations of *Heliothis* to increase when the

Table 2. Effect of nematode control on yield of *C. frutescens* per plot. Isabela, 1985.

Treatment	Dosage kg/ha (a.i.)	Marketable fruit/plot ^y		Root gall index (0-5)	Percent nematode control ^z
		Number	Weight (kg)		
Phenamiphos	1.10	351 a	1.3 a	4.4 a	75.5 a
Phenamiphos	2.20	428 a	1.7 a	4.4 a	91.0 a
Oxamyl	0.56	862 b	4.4 b	4.0 a	77.5 a
Oxamyl	1.12	1224 c	6.3 b	4.0 a	85.5 a
Check	—	332 a	2.7 a	4.6 a	-20.0 b

^yValues in the same column followed by the same letters do not differ statistically ($P=0.05$), according to Duncan's multiple range test; each value is the mean of four replications with 60 plants/plot.

^zPercent reduction in nematode soil populations = $([\text{initial population (Pi)} - \text{final population (Pf)}]/\text{Pi}) \times 100$.

weevil populations decrease. The high degree of susceptibility of pepper 'Cubanelle' to the pepper weevil in the Isabela area was demonstrated once again in this test, where the weevil accounted for approximately 72% of the damaged fruits (check plots in Table 3). Our results are consistent with those by Gordon-Mendoza (4) who obtained 89% weevil damaged fruits in nontreated plots.

Most of the damage in *C. frutescens* plants and reduction in quality of the fruits was attributed to *Phytophthora* spp. which accounted for 94% of damaged fruits. A significantly higher percentage of *C. annuum* fruits damaged by *Phytophthora* was obtained from plots treated with 1.12 kg/ha of oxamyl.

More *C. frutescens* plants than *C. annuum* were affected by the green peach aphid, nevertheless the effect of this insect on yield could not be quantified, since its presence was characterized only qualitatively by the oily appearance of fully mature plants showing some wilting.

LITERATURE CITED

1. ABREU, E., and C. CRUZ. 1985. Occurrence of pepper weevil, *Anthonomus eugenii* (Coleoptera:Curculinodae). J. Agric. Univ. P. Rico. 69:223-224.
2. CHRISTIE, J. R., and V. G. PERRY. 1951. Removing nematodes from soil. Proc. Helminhol. Soc. Wash. 18:106-108.
3. CRUZ, C., N. ACOSTA, J. NEGRON, and A. ARMSTRONG. 1984. Evaluation of various pesticides for the control of aphids, mites and nematodes in peppers. J. Agric. Univ. P. Rico. 68:457-465.

Table 3. Percent damage on *C. annuum* and *C. frutescens* caused by *Anthonomus eugenii*, *Heliothis* spp., and *Phytophthora* spp. per plot. Isabela 1985.

Treatment	Dosage kg/ha (a.i.)	<i>Capsicum annuum</i> ^z				<i>Capsicum frutescens</i> ^z			
		<i>A. eugenii</i>	<i>Heliothis</i>	<i>Phytophthora</i>	<i>A. eugenii</i>	<i>Heliothis</i>	<i>A. eugenii</i>	<i>Heliothis</i>	<i>Phytophthora</i>
Phenamiphos	1.10	73.0 a	0.9 a	25.1 a	4.8 a	0.6 a	4.8 a	0.6 a	94.5 a
Phenamiphos	2.20	72.0 a	1.5 a	26.0 a	5.2 a	1.5 a	5.2 a	1.5 a	93.7 a
Oxamyl	0.56	58.0 a	0.9 a	41.0 a	5.2 a	1.3 a	5.2 a	1.3 a	93.6 a
Oxamyl	1.12	34.9 b	3.7 b	61.9 b	1.2 b	3.4 b	1.2 b	3.4 b	91.4 a
Check	—	72.4 a	1.3 a	26.8 a	5.3 a	0.7 a	5.3 a	0.7 a	93.9 a

^zValues in the same column followed by the same letters do not differ statistically ($P=0.05$), according to Duncan's multiple range test; each value is the mean of four replications with 60 plants/plot.

4. GORDON-MENDOZA, R. 1984. Control químico y biología del picudo del pimiento, *Anthonomus eugenii* Cano (Coleoptera:Curculionidae) en Puerto Rico. M.S. Thesis, University of Puerto Rico at Mayagüez. 54 pp.
5. MEDRANO-VAQUERO, H. 1985. Empresa de hortalizas. Pp. 72-94 in *Las Empresas Agrícolas de Puerto Rico: situación y perspectiva*. Agric. Extension Service Press, College of Agricultural Sciences, Mayagüez. 143 pp.
6. VARELA, F., A. AYALA, and J. TORO. 1985. Host-parasite relationship of *Meloidogyne incognita* on the pepper cultivars Blanco del País and Cubanelle in Puerto Rico. *Nematropica*. 15:135-143.

Received for publication:

12.V.1987

Recibido para publicar: