EFFECT OF *ROTYLENCHULUS RENIFORMIS* ON SNAP BEAN AND METHODS FOR CONTROL BY OXAMYL [EFECTO DEL *ROTYLENCHULUS RENIFORMIS* EN LA HABICUELA Y METODOS PARA SU CONTROL CON OXAMIL].

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ABSTRACT

Of several methods of applying oxamyl to snap beans, six weekly foliar sprays of 0.56 kg ai oxamyl/ha combined with a soil drench of 2.24 kg ai oxamyl/ha at planting was the most effective in reducing soil populations of *Rotylenchulus reniformis* and *Quinisulcius acutus.* Yield of snap beans was negatively correlated with soil populations of *R. reniformis* at harvest, but not with populations at planting time or at mid-season. Final populations of *R. reniformis* were not correlated with initial populations in 18 test plots, whereas highly significant ($P = 0.01$) correlations between final and initial populations existed for *Q. acutus* and *Helicotylenchus dihystera.* However, there was no correlation of yield with initial, mid-season, or final population levels of these two nematodes.

Key Words: Phaseolus vulgaris, Helicotylenchus dihystera, Quinisulcius acutus

INTRODUCTION

Snap bean *(Phaseolus vulgaris* L.) is host to several potentially damaging plant parasitic nematodes. Damage symptoms and yield loss caused by *Meloidogyne* spp. are well documented (5, 7, 8, 10, 11, 12). Also, yield responses have been obtained by controlling *Belonolaimus longicaudatus* Rau (15) on snap bean, *Meloidogyne incognita* (Kofoid and White) Chitwood, *Criconemoides ornatus* Raski, and *Trichodorus christiei* Allen on pole bean (8). Damage to snap bean by *Pratylenchus scribneri* Steiner also has been described (17). Bean is also reported to be a host for *Rotylenchulus reniformis* Linford and Oliveira (9), which is common in southern Florida. It is important to know what effect *R. reniformis* and other plant parasitic nematodes have on snap bean, but such effects are difficult to determine when *Meloidogyne* spp. are present. For this reason, the current study was undertaken in experimental sites where *Meloidogyne* spp. had not been detected in previous crops.

Control of nematodes on beans in southern Florida has been erratic, possibly due to high soil pH (7.6 - 7.8) and rapid leaching of nonfumigant nematicides during heavy rains. Soil fumigation is thought to be uneconomical. Foliar sprays of oxamyl may be an effective control method (2, 6, 14), and provide an alternative to fumigants or nonfumigant soil treatments. In addition, foliar application may be used in conjunction with other pesticides (1, 18). The present study examines the efficacy of several methods of applying oxamyl to snap beans.

MATERIALS AND METHODS

Four tests were conducted on four sites near Homestead, Florida. Soil type in all sites was a Rockdale fine sandy loam, with pH ranging from 7.6 to 7.8. Methods of crop management were kept as similar as possible in all tests. All sites were planted to 'Harvester' snap bean on 3 October, 1979. Prior to planting, trifluralin at 840 g ai/ha and fertilizer (7-14-14) at 448 kg/ha were applied to each site. Permethrin at 112 g ai/ha and mancozeb at 1.8 kg ai/ha were applied weekly for insect and disease control. The heavy spray program for insects was necessary to maintain minimal insect populations in the plots and avoid complications due to the insecticidal activity of oxamyl. Supplementary fertilizer (7-14-14) was added to all sites at the rate of 224 kg/ha and incorporated by cultivation on 26 October, 1979. Overhead irrigation was applied to all sites as needed.

Site 1, Effect of Application Methods. The site for this test had been planted to 'Harvester' snap bean in the autumn of 1978 and in the spring of 1979, and to 'Clemson Spineless' okra *(Hibiscus esculentus* L.) in the summer of 1979. The experimental design at site 1 was a randomized complete block with five replications. Treatments were applied to single rows 3.66 m long spaced 0.9 m apart. The five treatments consisted of: oxamyl foliar spray, oxamyl soil drench, oxamyl foliar spray plus carbofuran granules, oxamyl foliar spray plus oxamyl soil drench, and untreated control. Oxamyl at the rate of 0.56 kg ai/ha in 935 liters of water/ha was sprayed on the foliage at a pressure of 21 kg/cm^3 using one nozzel of a boom sprayer per row. This oxamyl foliar spray was applied six times at weekly intervals beginning 11 October, 1979. The oxamyl soil drench was applied at the rate of 2.24 kg ai/ha in 935 liters of water/ha in a 25 cm band over the row just after planting. Carbofuran was applied at 2.24 kg ai/ha to the soil surface in a 30.5 cm band after planting and watered in with 935 liters of water/ha.

Sites 2-4, Effect of Nematode Populations. Major differences in cropping history existed among these three sites. Site 2 had the same history as site 1, but sites 3 and 4 had been planted to 'Berken' mungbean *(Phaseolus aureus* L.) during the summer of 1979. During the 1978-79 growing season, site 3 had been fallow, while site 4 had been planted to sweet potato *(Ipomea batatas* (L.) Lam.). Plots at each site consisted of paired rows, each 3.66 m long and 0.9 m apart. One row of each pair was treated with the oxamyl foliar spray plus the oxamyl soil drench using the rates and spray schedule described for site 1. The second row was an untreated control. Each plot was replicated six times at each of the three sites.

Soil samples were collected with a hand trowel to a depth of 10-12 cm from six locations in each row at all sites on 3 October, 1979, 31 October, 1979, and 19 November, 1979. Each soil sample was passed through a 4 mm sieve to remove rock, and a 100 cm^3 subsample was then processed by decanting and sieving followed by suspension of the residues in modified Baermann funnels (4). In addition, one root system was removed from each row and incubated in water for recovery of endoparasitic nematodes. A 1.83 m portion of each row at all sites was harvested on 20 November, 1979. Data from site 1 were subjected to analysis of variance and Duncan's New Multiple Range Test, and data from sites 2-4 were analyzed by the t-test for paired observations.

RESULTS AND DISCUSSION

Rotylenchulus reniformis Linford and Oliveira, *Quinisulcius acutus* (Allen) Siddiqi, and *Helicotylenchus dihystera* (Cobb) Sher were present in soil samples from all sites. *Pratylenchus* spp. were present in very low numbers. Root incubations yielded only low numbers of young *R. reniformis* females. Initial populations (P_i) of nematodes at the various sites are shown in Table 1. Initial populations varied widely in the individual plots of sites 2-4.

Site 1, Effect of Application Methods. All treatments significantly reduced *R. reniformis* populations on 31 October, but only the combination of the oxamyl foliar

Table 1. Mean numbers of nematodes in the soil at planting (3 October 1979).

Site	Nematodes/100 cm³ soil		
	Rotylenchulus reniformis	*Quinisulcius acutus*	*Helicotylenchus dihystera*
1	130	68	12
2	151	62	16
3	97	4	8
4	260	8	13

Table 2. Mean numbers of nematodes in the soil and bean yield, site 1[1].

Treatment	Nematodes/100 cm³						Yield (kg/ha)
	Rotylenchulus reniformis		*Quinisulcius acutus*		*Helicotylenchus dihystera*		
	31 Oct.	19 Nov.	31 Oct.	19 Nov.	31 Oct.	19 Nov.	
Oxamyl foliar spray + carbofuran granules	5a	210ab	2a	66ab	12a	17ab	5144a
Oxamyl foliar spray	32a	367b	15ab	86ab	12a	18ab	5191a
Oxamyl foliar spray + oxamyl soil drench	13a	88a	8a	18a	7a	2a	5215a
Oxamyl soil drench	12a	207ab	16ab	176b	35a	21b	5422a
Control	93b	372b	38b	140b	15a	14ab	5144a

[1]Data followed by the same letter in each column are not significantly (P = 0.05) different, according to Duncan's New Multiple Range Test.

spray plus the oxamyl soil drench significantly reduced populations of this nematode on 19 November (Table 2). The combination of the oxamyl foliar spray plus the oxamyl soil drench significantly reduced *Q. acutus* on both dates compared to the untreated control, while the oxamyl foliar spray plus carbofuran reduced *Q. acutus* populations on 31 October. *H. dihystera* occurred in relatively low numbers and was not affected by any treatment. Yields were not significantly different.

Sites 2-4, Effect of Nematode Populations. The oxamyl foliar spray plus oxamyl soil drench significantly reduced *R. reniformis* populations in the treated plots on 31 October at sites 3 and 4 and on 19 November at sites 2 and 4 (Table 3). *Q. acutus* and *H. dihystera* were present in relatively low numbers and were rarely affected by treatment. Mean yields were slightly greater in the treated rows, but differences were not significant. However, these sites contained a wide range of *R. reniformis* populations, introducing great variability into the statistical comparisons of means. On the other hand, this wide range of populations facilitates the examination of yield as a function of population level when data from these three sites are pooled (Fig. 1). A highly significant (P = 0.01) negative correlation existed between yield per ha (Y) and final population (P_f) of *R. renformis* in the test plots. Although various opinions (13, 16, 19) exist regarding the shape of similar functions, the correlations between Y and log

Table 3. Mean numbers of nematodes in the soil and bean yield, sites 2-4[1].

Treatment	Nematodes/100 cm^3 *Rotylenchulus reniformis* 31 Oct.	*Rotylenchulus reniformis* 19 Nov.	*Quinisulcius acutus* 31 Oct.	*Quinisulcius acutus* 19 Nov.	*Helicotylenchus dihystera* 31 Oct.	*Helicotylenchus dihystera* 19 Nov.	Yield (kg/ha)
Site 2							
Oxamyl foliar spray + oxamyl soil drench	14	94*	8	36	7*	2	5511
Control	88	468	32	134	16	19	5230
Site 3							
Oxamyl foliar spray + oxamyl soil drench	33*	248	0	16	5	6	5585
Control	201	482	2	27	8	5	5220
Site 4							
Oxamyl foliar spray + oxamyl soil drench	48*	87**	1	10	15	3	5876
Control	227	285	3	20	31	14	5492

[1]Asterisks (*, **) denote significant differences from appropriate control at P = 0.05 and P = 0.01, respectively, according to t-test for paired observations.

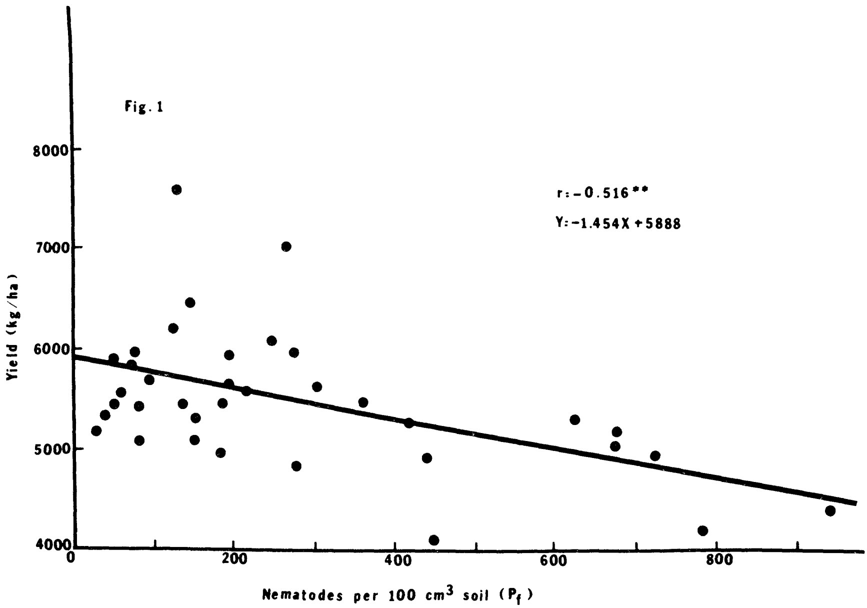

Fig. 1. Relationship of yield to final population (Pf) of *Rotylenchulus reniformis* in treated and untreated rows at sites 2-4.

P_f (r = -0.397*), Y and the square root of P_f (r = -0.474**), and log Y and P_f (r = -0.553**) did not differ greatly from that obtained from the linear relationship (r = -0.516**). The correlations between Y and counts of *R. reniformis* on 31 October (r = -0.186 ns) and between Y and initial population (r = -0.234 ns) were much weaker than that obtained using counts of the final population. Thus, while yield showed a relationship to final population of *R. reniformis,* potential yield loss could not be anticipated by examining the initial counts. In fact, comparison of the final and initial population for the 18 control rows in the three sites revealed no significant correlation (r = -0.0568 ns). However, correlations between final populations and initial populations of both *Q. acutus* (Fig. 2A) and *H. dihystera* (Fig. 2B) were both highly significant (P = 0.01), with r = 0.717 and r = 0.757, respectively. It is apparent that soil samples taken at planting can be of some use in predicting further development of *Q. acutus* and *H. dihystera* populations, but other methods may have to be used to estimate initial populations of *R. reniformis.* Previous work (3) suggests that a bioassay may provide some estimate of egg populations of *R. reniformis.* In the present study, no significant correlations were found between yield and populations of *Q. acutus* or *H. dihystera* on any sampling date, suggesting that these two nematodes may have little impact on bean yields at the population levels at these sites.

RESUMEN

De varios métodos de aplicación de oxamil en habichuela el de seis aspersiones foliares semanales de 0.56 kg ia/ha de oxamil combinado con una aplicación de 2.24 kg ia/ha de oxamil empapando el terreno en el momento de sembrar fué el más

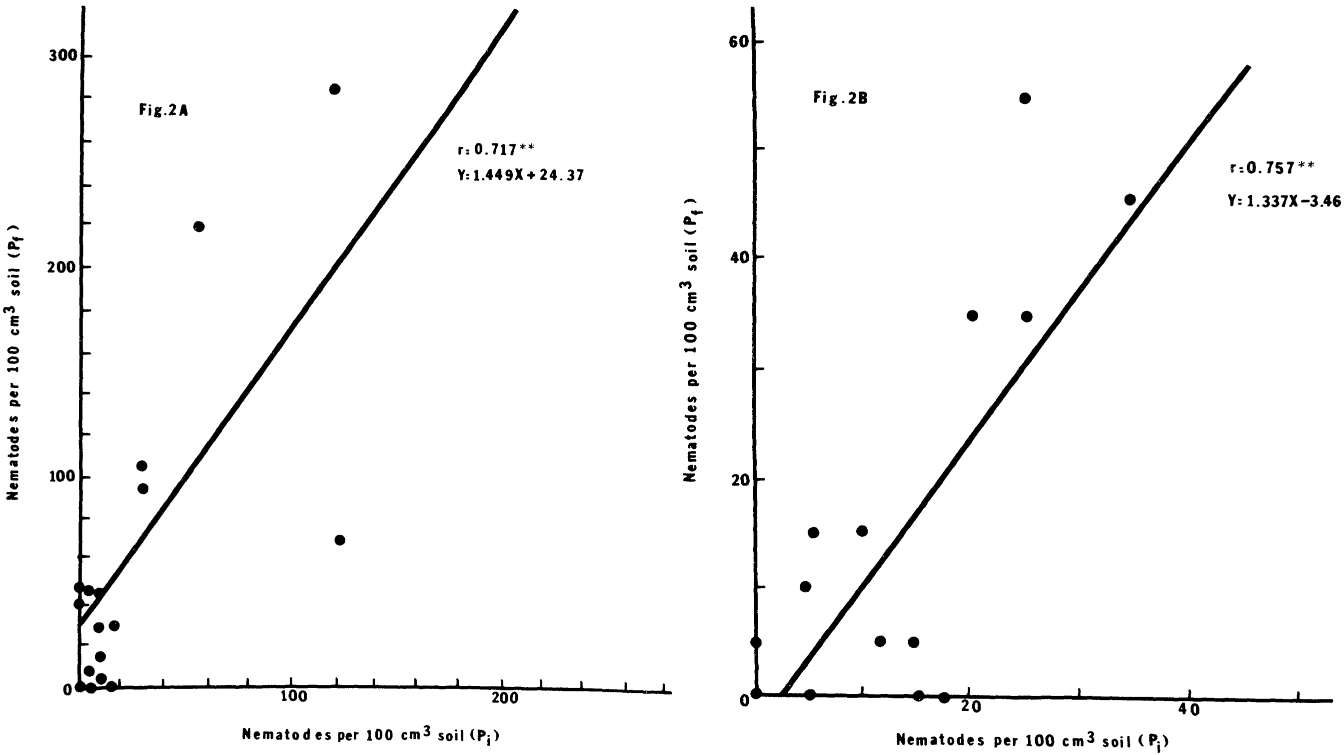

Fig. 2. Relationship between final populations Pf) and initial populations (Pi) of (A) *Quinisulcius acutus* and (B) *Helicotylenchus dihystera* in untreated rows of sites 2-4.

efectivo en la reducción de las poblaciones de *Rotylenchulus reniformis* y *Quinisulcius acutus*. El rendimiento de habichuela estuvo correlacionado negativamente con la población de *R. reniforms* del suelo en el momento de la cosecha pero no con la población en el momento de sembrar a medio período de crecimiento. Las poblaciones finales de *R. reniformis* no estuvieron correlacionadas con las poblaciones iniciales en 18 lotes experimentales, mientras correlaciones altamente significativas (P = 0.01) entre las poblaciones iniciales y finales existieron para *Q. acutus* y *Helicotylenchus dihystera*. Sin embargo no hubo correlación entre los rendimientos y los niveles de población de esos dos nematodos al inicio, mediado y final del crecimiento de la habichuela.
Claves: Phaseolus vulgaris, Helicotylenchus dihystera. Quinisulcius acutus.

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