

## SPATIAL ARRANGEMENT OF NEMATODES AROUND FOUR SPECIES OF TROPICAL FRUIT TREES

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## ABSTRACT

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Nematode population densities at various distances from the trunk were determined for four species of tropical fruit trees: guava (*Psidium guajava*), avocado (*Persea americana*), mango (*Mangifera indica*), and 'Tahiti' lime (*Citrus* x 'Tahiti'). Sampling in the drip-line just inside the outer boundary of the tree canopy gave the best results in consistently detecting maximum levels of plant-parasitic nematodes for all four species of fruit trees tested. Significantly fewer nematodes were found nearer to the trunk in guava and avocado. In mango and lime no significant differences with location were observed, other than those associated with the trickle irrigation system. Sampling near the outlets of the trickle irrigation system, which were located near the trunks of lime and guava, revealed significantly lower numbers of nematodes than sampling near the edge of the canopy.

*Additional key words:* *Criconemella sphaerocephala*, *Hemicriconemoides mangiferae*, *Pratylenchus brachyurus*, *Quinisulcius acutus*, *Rotylenchulus reniformis*, *Tylenchulus semipenetrans*.

## RESUMEN

McSorley, R., y J.L. Parrado. 1982. Distribución espacial de los nematodos alrededor de cuatro frutales tropicales. *Nematropica* 12:247-255.

La densidad de la población de nematodos a varias distancias del tronco fué determinada para cuatro especies de frutales tropicales: Guayaba (*Psidium guajava*), Aguacate (*Persea americana*), Mango (*Mangifera indica*) y Limón persa (Tahiti Lime) (*Citrus* x 'Tahiti'). Las muestras tomadas a lo largo de la línea de irrigación por goteo, justamente dentro del borde exterior de la copa de la planta dieron los mejores resultados en la determinación de los niveles máximos de nematodos parasíticos, para las cuatro especies estudiadas. Significativamente menos nematodos fueron encontrados más cerca del tronco en la guayaba y el aguacate. En el mango y el limón no fueron observadas diferencias significativas en relación con el lugar donde se tomaron las muestras, con excepción de las diferencias asociadas con el sistema de irrigación. Las muestras tomadas cerca de la salida del agua del sistema de irrigación por goteo, los cuales fueron instalados cerca del tronco del limón y la

guayaba, revelaron significativamente un número menor de nematodos que cuando las muestras se tomaron cerca del borde de la copa de la planta.

*Palabras claves adicionales:* *Criconemella sphaerocephala*, *Hemicriconemoides mangiferae*, *Pratylenchus brachyurus*, *Quinisuclius acutus*, *Rotylenchulus reniformis*, *Tylenchulus semipenetrans*.

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## INTRODUCTION

Accurate assessment of nematode populations in the field is essential in nematology and depends directly on the sampling method used. Recent research has focused on the development of accurate sampling plans for field crops (5, 12). However, little attention has been given to the development of sampling plans for tree crops. Current recommendations (8) indicate that samples around trees be taken near the drip-line of the tree, and area approximated by the outer edge of the canopy. Presumably, this should be the area with the most active feeder roots and highest nematode populations. Sampling for nematodes near the drip-line has been widely used for citrus (6, 9, 13, 14, 15, 16). A detailed study of the spatial arrangement of samples around a perennial crop is available for grapevines (2). Nematode populations varied with distance from the vine, and the recommendation was to sample each vine in the same location, where population densities were greatest and variability least. In addition, differences in levels of plant-parasitic nematodes were noted depending on whether samples were collected within a row or between rows (3).

The current study was conducted to determine the best location for sampling beneath four kinds of tropical and subtropical fruit trees in south Florida. The suitability of sampling near the drip-line was assessed, as well as differences in sampling in rows or between rows as occurred in the grapevine study (3). In addition, trickle irrigation systems are often used on limes and other tree crops in south Florida (1), and it was desirable to note whether location of irrigation outlets may affect sampling patterns. By using four different species of fruit trees, it could be determined whether a general sampling pattern could be recommended for all trees or whether individual sampling plans should be developed for each tree species.

## MATERIALS AND METHODS

Four fruit crops growing at various locations in Dade county, Florida, were sampled in this study: guava (*Psidium guajava* L.), avocado (*Persea americana* Mill.), mango (*Mangifera indica* L.), and 'Tahiti' lime (*Citrus* x 'Tahiti'). The soil type was a Rockdale fine sandy loam, with pH of 7.3-7.8. The shallow nature of this soil (4) prohibits sampling deeper than 15 cm due to the occurrence of limestone rock at that depth. Methods for producing tree crops on this soil type are discussed elsewhere (1).

*Guava.* The guava grove consisted of 4-year-old trees sampled on October

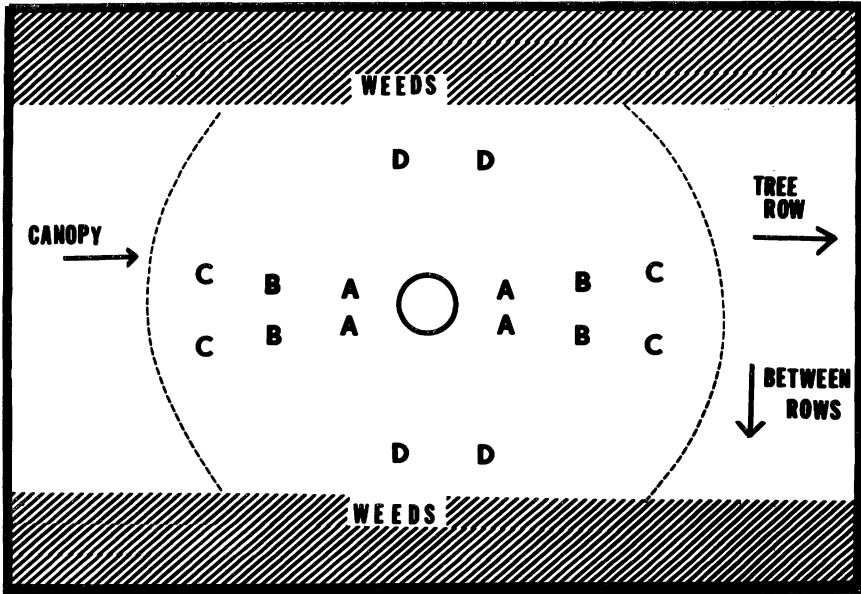


Fig. 1. Schematic diagram of sampling pattern around a guava trunk. Sampling locations: A = 0.5 m from trunk in row; B = 1.0 m from trunk in row; C = 1.5 m from trunk in row; D = 1.0 m from trunk away from row. Location of trickle irrigation outlet varies.

8, 1981. Individual trees were spaced 3.0 m apart and the distance between rows was 4.5-6.0 m. The sampling pattern around an individual tree is illustrated in Fig. 1, and shows several complications encountered in sampling a single tree. The radius of the guava canopy was slightly less than 2.0 m, and the branches of the two adjacent trees overlapped in the row. Trees were trimmed between rows to within about 1.5 m of the trunk. Weed growth occurred between rows to this distance from the trunk, but no weeds occurred beneath the dense guava canopies. A trickle irrigation system with one outlet per tree, located less than 0.5 m from the trunk, had been set up in this grove, but was not in use during the time of sampling, since the trees were sampled during the rainy season. Individual soil samples were collected from five locations around the guava trunk: 1) 0.5 m, 2) 1.0 m, and 3) 1.5 m from the trunk in the row; 4) 1.0 m from the trunk between rows; and 5) near the trickle irrigation outlet. The 1.0 m distance between rows was used since a 1.5 m distance sometimes fell in a weedy area, a factor that would alter nematode distribution (10).

A soil sample from a given location consisted of soil collected with a hand trowel to a depth of 15 cm from 4 sub-locations which were pooled to form the

single sample. For example, Fig. 1 indicates the 4 sub-locations (C) used to comprise the sampling location of 1.5 m from the trunk. In the laboratory, soil samples were passed through a 4.0 mm sieve to remove rock. Soil moisture was determined gravimetrically, and a 100 cm<sup>3</sup> portion of each sample was processed for nematodes by a modified sieving-centrifugation procedure (7, 11). Counts of each species from the 5 locations around each tree were compared over the 6 replicate trees by an analysis of variance followed by Duncan's New Multiple Range Test.

*Avocado.* This grove consisted of older trees (more than 20 years old) sampled on December 8, 1981. Trees were spaced 7.6 m apart in rows 7.6 m apart, and canopy radius was 3.8 m. The areas between tree rows had been used as roadways and compaction was evident between rows of trees. This area was not sampled. Very few weeds were evident in the grove, and no trickle irrigation system was present. Five locations were sampled around each of 5 different trees: 1) 1.0 m, 2) 2.0 m, and 3) 3.0 m from the trunk in the row; and 4) 1.0 m and 5) 2.0 m from the trunk between rows.

*Mango.* This grove consisted of trees approximately 10 years old, sampled on February 24, 1982. The distance between trees and between rows was 6.1 m. There was no roadway compaction between tree rows as in the avocado grove, and there was no trickle irrigation system. Tree canopies extended about 1.5 m from the trunks, and an area up to 1.75-2.0 m from the trunks had been maintained free of weeds. Samples were collected from 3 locations around each of 6 different trees: 1) 0.5 m, 2) 1.0 m, and 3) 1.5 m from the trunk.

*Lime.* This grove was sampled on February 19, 1982, and consisted of four-year-old trees spaced 6.1 m apart in rows 7.6 m apart. The canopy extended about 1.5 m from the trunk of each tree, with weed growth evident to within 1.3 m of the trunk. A trickle irrigation system was in use at the time of sampling (dry season), and the location of the 2 outlets per tree varied from 0 to 1.0 m from the trunk. Samples were collected from 3 locations around 6 different trees: 1) 1.0 m from the trunk in the row; 2) 1.0 m from the trunk between rows; and 3) near the trickle irrigation outlets. Collections and processing of soil samples and analysis of results in avocado, mango, and lime were similar to that described for the guava sites.

## RESULTS

*Guava. Rotylenchulus reniformis* Linford & Oliveira was common at the guava site. Numbers of this species by sampling location around the tree are presented in Table 1, and were greatest at the 1.5 m in-row and 1.0 m between-row locations. The 1.5 m in-row sample was the most distant sample from the trunk taken, and the nearest to the margin of the guava canopy. Counts near trickle irrigation outlets were significantly lower, and no differences in soil moisture existed among the various sampling locations, since the irrigation system was not in use at this time of the year.

Table 1. Numbers of *Rotylenchulus reniformis* at various sampling locations around guava trees.

Sampling Location	Nematodes per 100 cm <sup>3</sup> of soil <sup>x</sup>	Percent soil moisture <sup>x</sup>
Near trickle irrigation outlet	11 a	15.0
0.5 m from trunk in row	35 a	15.8
1.0 m from trunk in row	80 ab	15.1
1.5 m from trunk in row	165 bc	16.2
1.0 m from trunk between rows	218 c	14.3

<sup>x</sup>Mean of 6 replications. Means in columns followed by the same letter were not significantly different ( $P = 0.05$ ), according to Duncan's New Multiple Range Test.

*Avocado.* Common nematodes in the avocado grove included *R. reniformis*, *Pratylenchus brachyurus* (Godfrey) Filipjev & Schuurmans-Stekhoven, and *Quinisulcius acutus* (Allen) Siddiqi, although the latter species showed no differences with sampling location (Table 2). Maximum levels of *R. reniformis* were observed at 1.0 m from the trunk between rows and at 3.0 m from the trunk in the row, while *P. brachyurus* counts were maximum at 3.0 m from the trunk. Thus, the 3.0 m location would be most useful in detecting both species together.

*Mango.* *Criconebella sphaerocephala* (Taylor) Luc & Raski, *Hemicriconemoides mangiferae* Siddiqi, and *R. reniformis* were common in the mango grove. Population levels at various locations were apparent (Table 3).

*Lime.* Larvae of *Tylenchulus semipenetrans* Cobb and *R. reniformis* were common around the roots on 'Tahiti' lime (Table 4). *R. reniformis* was more abundant at 1.0 m from the trunk than near the trickle irrigation outlets even though the soil moisture was higher there. Counts of *T. semipenetrans* larvae showed much variability and no significant differences with location.

## DISCUSSION

The recommendation to sample trees near the drip-line, approximated by the outer edge of the foliage, seems to be appropriate for the trees sampled in this study. Nematode populations in samples collected from the drip-line (3.0 m avocado trunks, 1.5 m from the other trees) were never significantly ( $P = 0.05$ ) lower than the highest counts obtained from the various locations around each tree species, and in several cases (avocado, guava) were significantly higher than those obtained from other locations.

Under the conditions of this test, sampling near the trickle irrigation outlets revealed significantly lower nematode populations than sampling in the

Table 2. Nematode numbers at various sampling locations around avocado trees.

Sampling location	Nematodes per 100 cm <sup>3</sup> of soil <sup>x</sup>		
	<i>Rotylenchulus reniformis</i>	<i>Pratylenchus brachyurus</i>	<i>Quinisulcius acutus</i>
1.0 m from trunk between rows	95 b	2 ab	0 a
2.0 m from trunk between rows	49 ab	0 a	1 a
1.0 m from trunk in row	4 a	0 a	1 a
2.0 m from trunk in row	19 ab	2 ab	3 a
3.0 m from trunk in row	60 b	5 b	3 a

<sup>x</sup>Mean of 5 replications. Means in columns followed by the same letter were not significantly different (P = 0.05), according to Duncan's New Multiple Range Test.

Table 3. Nematode numbers at various sampling locations around mango trees.

Sampling location	Nematodes per 100 cm <sup>3</sup> of soil <sup>x</sup>		
	<i>Rotylenchulus reniformis</i>	<i>Criconebella sphaerocephala</i>	<i>Hemicriconemoides mangiferae</i>
0.5 m from trunk	572 a	98 a	75 a
1.0 m from trunk	412 a	196 a	99 a
1.5 m from trunk	204 a	220 a	73 a

<sup>x</sup>Mean of 6 replications. Means in columns followed by the same letter were not significantly different (P = 0.05), according to Duncan's New Multiple Range Test.

Table 4. Nematode numbers at various sampling locations around lime trees.

Sampling location	Nematodes per 100 cm <sup>3</sup> of soil <sup>x</sup>		Percent soil moisture <sup>x</sup>
	<i>Rotylenchulus reniformis</i>	<i>Tylenchulus semipenetrans</i>	
Near trickle irrigation outlet	234 a	1451 a	22.9 a
1.0 m from trunk between rows	825 b	1836 a	16.5 b
1.0 m from trunk in row	750 b	2643 a	17.6 b

<sup>x</sup>Mean of 6 replications. Means in columns followed by the same letter were not significantly different ( $P = 0.05$ ), according to Duncan's New Multiple Range Test.

drip-line. The trickle irrigation outlets had been installed next to the young trees shortly after planting. However, in the four-year-old guava and lime trees studied, maximum populations occurred at a distance (1.0 m or more) from the trunk, rather than very near the trunk (where the outlets remained).

Although sampling near the drip-line gave good results for trees growing on Rockdale soils, this method should also be tested in arid regions, where trickle irrigation may have a more marked influence on nematode populations, and on soil types having deeper profiles which could influence the vertical distribution of nematodes.

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