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Meloidogyne incognita and *Rotylenchulus reniformis* and Associated Soil Textures from Some Cotton Production Areas of Texas[1]

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Abstract: The incidence of *Meloidogyne incognita* and *Rotylenchulus reniformis* on cotton was determined in 1989–92 from 1,089 soil samples collected from 31 counties that account for nearly 60% of the 2.2 million hectares planted to cotton in Texas. *Meloidogyne incognita* was commonly found in the Southern High Plains and Brazos River Valley regions of Texas (57% and 34%, respectively, of samples) but was found in less than 8% of samples from the Central Blacklands, Coastal Bend, Low Plains, or the Upper Gulf Coast regions. *Rotylenchulus reniformis* was widely distributed in the Brazos River Valley (24% of samples) and found occasionally in the Upper Gulf Coast (8% of samples). *Meloidogyne incognita* was found only rarely in soils with greater than 40% clay content, whereas *Rotylenchulus reniformis* was frequently found in finely textured soils but was less common in soils with greater than 40% sand content. In samples infested with *M. incognita* or *R. reniformis*, population densities of these species were at least 10-fold greater than population densities of other plant-parasitic species present in the sample. Root-knot and reniform nematodes were not found together in high population densities (>100 individuals/500 cm^3) in the same sample.

Key words: cotton, *Gossypium hirsutum*, incidence, *Meloidogyne incognita*, nematode, reniform nematode, root-knot nematode, *Rotylenchulus reniformis*, soil texture, survey.

Upland cotton (*Gossypium hirsutum*) is one of the major crops of Texas, with 1.9 to 2.2 million hectares planted annually from 1986 through 1990. Although the greatest concentration of cotton is in the 16-county Southern High Plains region, with 906,000 hectares planted in 1990, production occurs throughout the state, with 126 counties each containing 400 or more hectares annually. *Meloidogyne incognita* races 3 and 4 and *Rotylenchulus reniformis* are present in Texas and can result in substantial cotton yield losses (8,12). The incidence of theses two species has been documented for two of the major cotton production regions of the state, the Southern High Plains for *M. incognita* (7), and the Lower Rio Grande Valley for *M. incognita* and *R. reniformis* (2,9). *Meloidogyne incognita* was detected in 47% of 2,016 samples from six High Plains counties and in 17% of 1,221 fields from the Lower Rio Grande Valley. *Rotylenchulus reniformis* was present in nearly 20% of the fields sampled from the Lower Rio Grande Valley and on one farm in the Southern High Plains. In the Lower Rio Grande Valley, *M. incognita* was most frequently associated with coarsely textured sandy soils, whereas *R. reniformis* was more frequently associated with silty and clayey soils (2,9). The strong association of root-knot nematodes with coarse soils had been reported in numerous agricultural soils (2,5,11,13).

The objectives of the present study were to examine the incidence of *M. incognita* and *R. reniformis* in other major cotton production regions of Texas and to determine whether relationships between incidence and soil texture are similar to those reported previously (8,9,12).

MATERIALS AND METHODS

Soil samples for nematode analysis were collected from ca. 1,000 cotton fields in the Brazos River Valley, Central Blacklands, Coastal Bend, Southern High Plains, Low Plains, and Upper Gulf Coast regions of Texas from 1989–92 (Fig. 1). All samples were collected after the full bloom stage of crop development (July–September).

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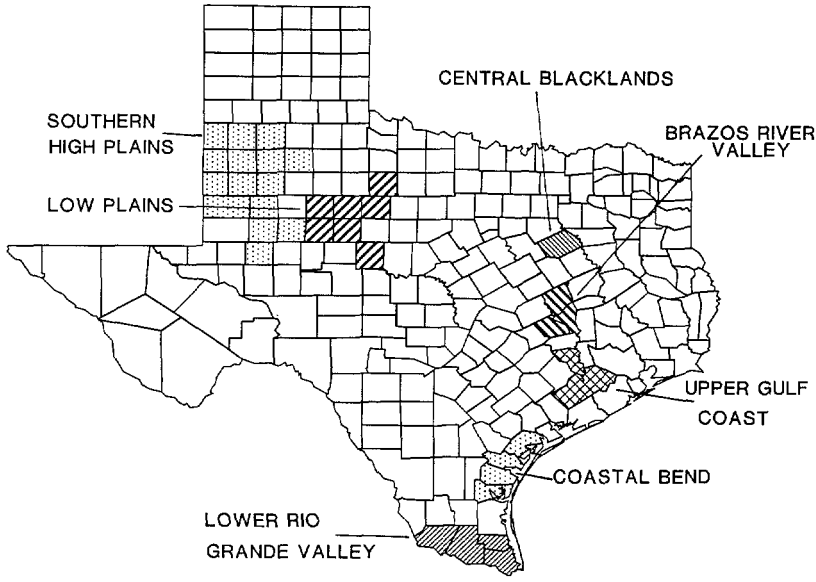

FIG. 1. Counties sampled in six major cotton production regions of Texas in a survey of the incidence of *Meloidogyne incognita* and *Rotylenchulus reniformis* on cotton. The Lower Rio Grande Valley was not surveyed in this study but is another major cotton production region surveyed previously (9).

Fields to be sampled were selected arbitrarily along principal highways through cotton production areas of each county sampled. A single sample was collected from most fields, excepting fields >40 hectares where two samples were collected. Each sample was a composite of 10 to 15 subsamples collected to a depth of 25 cm with a narrow spade or a 2.5-cm-d soil probe. With the single exception of samples from the Low Plains, nematodes were extracted from 100-g subsamples incubated on a Baermann funnel for 48 hours (1). Nematodes were extracted from samples collected from the Low Plains by elutriation–centrifugation of 500-cm^3 subsamples (1,3).

Soils were analyzed for percentage of sand, silt, and clay by the Bouyoucos hydrometer method and were classified using the textural class triangle (6). Soil pH was determined from aqueous slurries (2 parts distilled water to 1 part soil) that were incubated for 10 minutes at room temperature before measurement (6). Samples from the High Plains were not analyzed for textural class, nor were pH values determined; however, most agricultural soils in this region are sandy, with a pH of 7.0 to 8.5 (4).

TABLE 1. Incidence of *Meloidogyne incognita* (Mi) and *Rotylenchulus reniformis* (Rr) associated with cotton in Texas.

Region	No. counties sampled	Cotton production†	Total samples	Percentage infested	
				Mi	Rr
Central Blacklands	1	8.1	20	0	0
Brazos River Valley	3	15.9	169	34	24
Upper Gulf Coast	3	23.9	111	2	8
Coastal Bend	4	69.2	54	0	0
Low Plains	7	197.9	308	7	0
Southern High Plains	13	972.9	427	57	0
Total	31	1,287.9	1,089	Means 16.7	5.3

† Total cotton production in 1990 (hectares planted × 10^3) for counties surveyed.

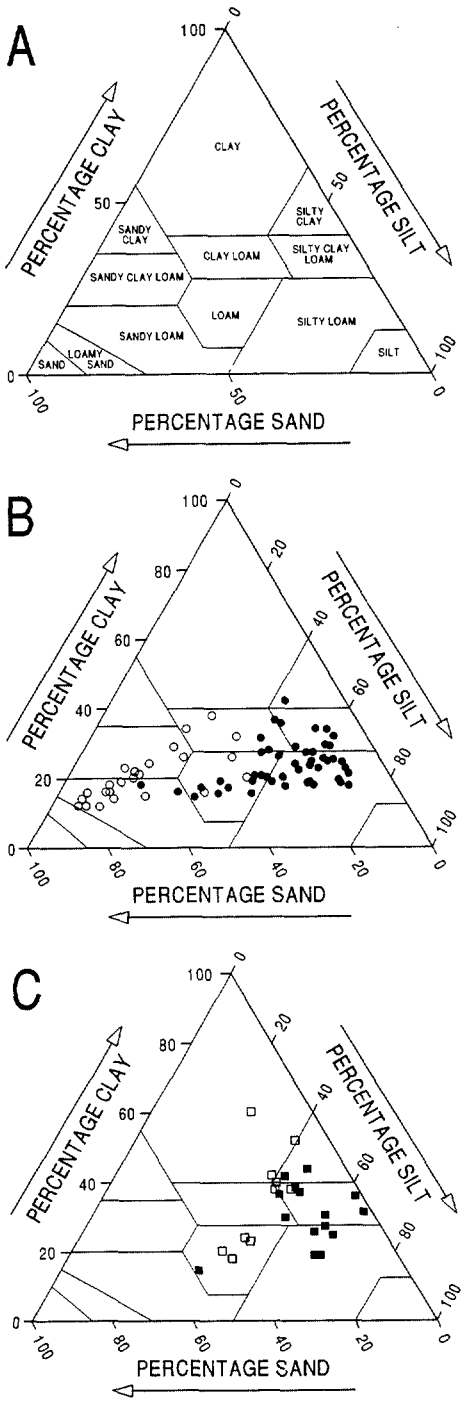

FIG. 2. Distribution of *Meloidogyne incognita* and *Rotylenchulus reniformis* by soil textural class. A) Soil triangle for textural classification of soil based on percentage of sand, silt, and clay (6). B) Distribution of *M. incognita* in the soils of the Brazos River Valley (closed circles) and Low Plains (open circles). C) Distribution of *R. reniformis* in soils from the Brazos River Valley (closed squares) and Upper Gulf Coast (open squares).

RESULTS AND DISCUSSION

Rotylenchulus reniformis was found in samples from two counties in the Upper Gulf Coast (Fort Bend and Wharton) and from one Brazos River Valley county (Brazos) that were not known previously to be infested (Table 1) (5). *Meloidogyne incognita* was found frequently in the Brazos River Valley and High Plains (Table 1) but was not detected in any sample from the Central Blacklands or Coastal Bend and was rarely detected in samples from the Upper Gulf Coast or the Low Plains. The high frequency of *M. incognita* on cotton in the Southern High Plains confirms previous observations (8). Soil pH of the samples varied little (7.5 to 8.5), and no apparent relationship between pH and the incidence of either nematode species was noted.

Meloidogyne incognita was rarely found in finely textured soil; only 2% of the samples infested with *M. incognita* had greater than 40% clay (Fig. 2). This and previous observations in Texas (2,9) are consistent with the low incidence of root-knot nematodes in other regions in soils with a high percentage of clay (7,11,13). A tendency for *M. incognita* to be associated with coarsely textured soils may explain, in part its absence in samples from the Central Blacklands and its low incidence in the Upper Gulf Coast, because soils in these regions generally have high clay contents (4). On the other hand, in both the Coastal Blend and the Low Plains, many fields have sandy soils as well as a history of continuous cotton, yet neither region had a high incidence of *M. incognita*. It is unlikely that the low incidence of detection of *M. incognita* in the Low Plains was due to processing those samples by elutriation rather than by Baermann funnel, because elutriation–centrifugation is efficient in extraction of *Meloidogyne* eggs (10).

Rotylenchulus reniformis was commonly associated with finely textured soils, and only 12% of the infested samples had more than 40% sand (Fig. 2). Although this observation is consistent with previous reports on the incidence of *R. reniformis* in the Lower Rio Grande Valley (1,8), *R. reni-*

TABLE 2. Population densities of *Meloidogyne incognita* and *Rotylenchulus reniformis* associated with cotton in Texas.†

Region	*M. incognita*		*R. reniformis*		Next highest‡	
	Mean	Maximum	Mean	Maximum	Mean	Maximum
Low Plains	950	3,940	—	—	40	230
Southern High Plains	250	1,440	—	—	30	200
Upper Gulf Coast			1,100	23,000	20	200

† Values are numbers of eggs and juveniles of *M. incognita*, or total vermiform stages for other genera per 500 cm^3. Nematodes were extracted from samples from the Low Plains and the Upper Gulf Coast by the Baermann funnel method, whereas nematodes were extracted from samples from the Low Plains by elutriation–centrifugation.

‡ Species with next highest population density for the Low Plains was *Tylenchorhynchus* spp., *Pratylenchus* spp. for the Southern High Plains, and *Helicotylenchus* spp. for the Upper Gulf Coast.

formis does occur in soils with a high percentage of sand in other regions of the southern United States (5). This suggests that the influence of soil texture on the distribution of *R. reniformis* is complex and may involve biotic as well as abiotic factors.

Meloidogyne incognita and *R. reniformis* usually occurred at population densities that were 10 or more times greater than the population density of the next most populous plant-parasitic species (Table 2). In no cotton field was any species of plant-parasitic nematode other than *M. incognita* or *R. reniformis* found at a population density over 250 individuals/500 cm^3 soil, regardless of whether samples were processed by elutriation–centrifugation or by the Baermann funnel. The difference in mean population densities of *Meloidogyne* between samples from the Low Plains and the Southern High Plains (Table 2) may be related to extraction technique.

Meloidogyne incognita and *R. reniformis* were rarely found together, and no field was found to have a high population density (>100 individuals/500 cm^3) of both species. In the silty soils of the Brazos River Valley, where 34% of the samples were infested with *M. incognita* and 24% were infested with *R. reniformis*, only 2% of 169 samples were infested with both species. Infrequent simultaneous occurrence of the two species also has been noted in several thousand samples from the Lower Rio Grande Valley (C. M. Heald, unpubl. data) and from Alabama (W. Gazaway, pers. comm.). Controlled experiments are needed to determine if the rare cohabitation of *M. incognita* and *R. reniformis* is due to interspecific competition or to other factors affecting reproduction and (or) survival.

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