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Geographical Distributions of *Rotylenchulus reniformis*, *Meloidogyne incognita*, and *Tylenchulus semipenetrans* in the Lower Rio Grande Valley as Related to Soil Texture and Land Use

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Abstract: A survey was conducted over a 22-year period to evaluate the influence of soil texture and land use on the geographical distributions of *Rotylenchulus reniformis*, *Meloidogyne incognita*, and *Tylenchulus semipenetrans* in the lower Rio Grande valley. The distributions of *R. reniformis* and *M. incognita* were related to soil texture, whereas *T. semipenetrans* occurred wherever host plants were present regardless of soil texture. The incidence of *M. incognita* was greatest in elevated sandy loams and moderately well-drained silts of modern flood terraces of the Rio Grande river. *Rotylenchulus reniformis* occurred predominantly in clay silts and clays of ancient flood terraces. Clay loams and sandy clay loams of the central, irrigated portion of the lower Rio Grande valley appeared favorable for *M. incognita* and *R. reniformis*. Differences between the geographical distributions of these two species could not be attributed to host crops.
Key words: citrus, geographical distribution, *Meloidogyne incognita*, population ecology, *Rotylenchulus reniformis*, survey, *Tylenchulus semipenetrans*.

The lower Rio Grande valley (LRGV) is an irrigated alluvial plain extending 200 km inland from the mouth of the Rio Grande river. A subtropical climate permits year-round cultivation of various crops on both sides of the river. Major crops are onion (*Allium cepa* L.), cantaloup (*Cucumis melo* var. *cantalupensis* Naud.), cabbage (*Brassica oleracea* L.), cotton (*Gossipium hirsutum* L.), carrot (*Daucus carota* L.), corn (*Zea mays* L.), pepper (*Capsicum annuum* L.), lettuce (*Lactuca sativa* L.), sorghum (*Sorghum bicolor* (L.) Moench.), sugarcane (*Saccharum officinarum* L.), and citrus (*Citrus* spp.). Seventy percent of the cropland harvested for vegetables in Texas is in the LRGV, and Texas ranks third in the United States in fresh market vegetable cropland (2).

Although the presence of potentially damaging nematode pests in the LRGV has been recognized for several decades (7), there is little published information concerning the geographical distributions of the species present, and one publication is seriously misleading. Lambe and Horne (6) reported in 1963 that *Rotylenchulus reniformis* Linford and Oliveira occurred on only 81 ha in the entire region, and that the nematode was of minor importance. Two years later, a survey conducted by Birchfield et al. (1) indicated that *R. reniformis* was present in 40% of 80 fields sampled in widely scattered areas. Published information is also needed concerning the distributions of *Meloidogyne incognita* (Kofoid and White) Chitwood and *Tylenchulus semipenetrans* Cobb in the region.

Nematode analyses of soil samples from more than 1,500 fields and orchards throughout the LRGV were done between 1965 and 1987. Our objective was to compile these data, determine the geographical origin of each sample, and thereby map the known distributions of *R. reniformis*, *M. incognita*, and *T. semipenetrans* with respect to soil texture, land use, and landmarks.

Materials and Methods

Origins of data: Data were retrieved from six sources: 1) the 80 fields sampled by

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Birchfield et al. in 1965 (1); 2) 287 samples taken in a valley-wide cotton survey conducted by W. H. Thames in 1966; 3) 343 samples taken in a cotton survey conducted by C. M. Heald in 1978; 4) 370 miscellaneous samples processed by C. M. Heald, 1966–86, primarily to identify suitable sites for field experiments; 5) 454 samples processed by S. L. Flanagan, 1977–87, for growers and pesticide distributors; and 6) original descriptions of 100 samples from a valley-wide citrus survey conducted by C. M. Heald in 1968 (4). In most cases, each sample was a composite of 3–10 subsamples, 0–30 cm deep, taken from a single field. All samples were processed by Baermann funnel and when available, plant roots were examined microscopically. For ca. 25% of the noncitrus samples a bioassay for *R. reniformis* and *M. incognita* was done, usually with cantaloup or tomato.

Data analyses: For each sample, computer fields were designated for the following information: sample number, investigator, year, month, current crop, two previous crops, coordinates describing the sample location, and nematode species. The geographical origin of each sample was plotted manually, according to the original written description, on a 1:126,720-scale road map (Texas Department of Highways and Public Transportation), and coordinates with respect to standardized north-south and east-west axes were recorded with a tablet digitizer. With the aid of appropriate software, the computer database was searched according to various combinations of criteria and the locations of samples meeting those criteria were determined.

To examine relationships among soil texture, land use, and nematode distributions, the boundaries of major soil series associations in the LRGV, as classified by the USDA Soil Conservation Service (5,9,10), were digitized for each of the four counties of the LRGV and numerically spliced to produce a single map of the entire region. This map was drawn by a computer-driven plotter onto photostatic copies of an irrigation district map (International Boundary and Water Commission, United States and Mexico), the original highway map, and the original soil classification maps. Alignment of landmarks indicated error in the digitization procedure to be < 0.5% of the 200-km length of the valley. Soil sample locations then were plotted onto the soil classification map (Fig. 1, Table 1), and the soil type was recorded for each sample.

Results and Discussion

Of the 1,466 locations sampled over 22 years, 804 were cotton fields, 245 were citrus orchards, and the remainder were fallow fields, usually to be planted to vegetables, or fields with vegetables. Among noncitrus samples where the crop could be determined, more than 90% of the crops were good hosts for both *R. reniformis* and *M. incognita*. The mean sampling density within irrigated field crop regions was 42 samples/100 km². Few samples came from the nonirrigated pasturelands of the northwestern LRGV or from the saline coastal region, which is primarily uncultivated.

Tylenchulus semipenetrans is widespread in citrus orchards in the LRGV. Ninety-three percent of the 245 citrus orchards sampled were positive for *T. semipenetrans*. There was no apparent relationship between soil texture and the occurrence of negative samples (Fig. 2). The few negative samples usually were identifiable as having been taken just after soil fumigation. Heald (4) also reported 90% occurrence of *T. semipenetrans* in LRGV citrus orchards in 1968. Widespread distribution of *T. semipenetrans* probably resulted from the nearly universal planting of susceptible sour orange (*Citrus aurantium* L.) rootstocks in the LRGV, frequent movement of contaminated grove care and harvesting equipment between orchards, and planting of infected nursery stock. Establishment of new grove sites with trees free of *T. semipenetrans* following the freeze disaster of December 1983 may alleviate the problem somewhat (3).

Meloidogyne incognita and *R. reniformis* were detected in samples from 251 and 408 fields, respectively. Our results indicate that soil texture strongly influences their dis-

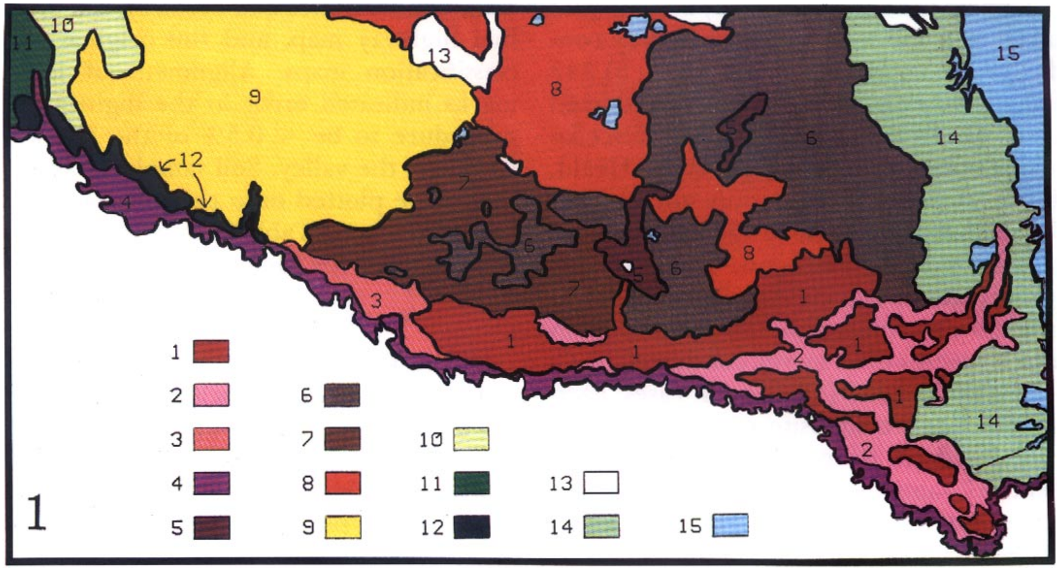

FIG. 1. Major soil associations of the lower Rio Grande valley as given in Table 1 and major bodies of water—15.

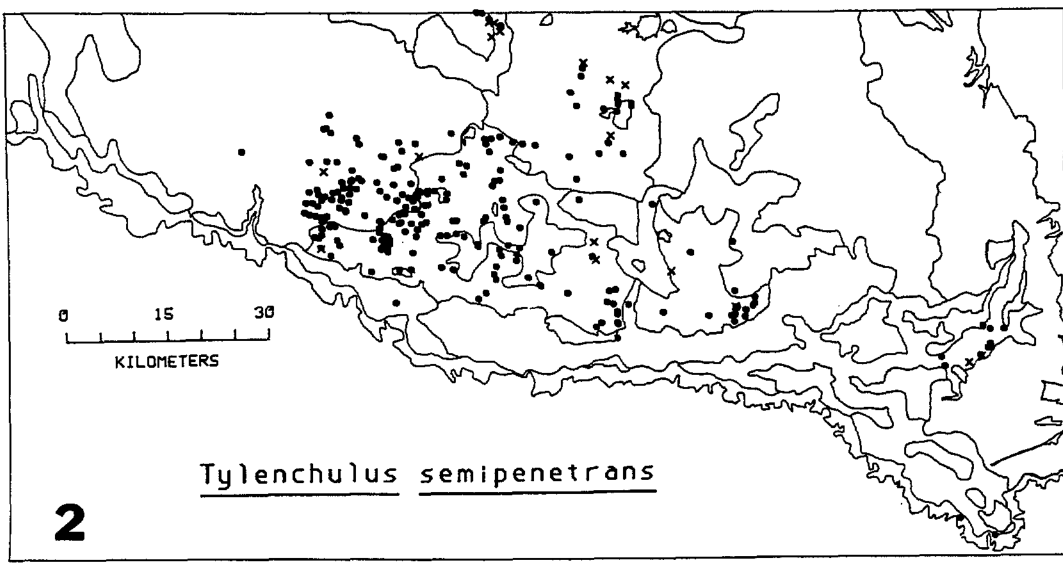

FIG. 2. Distribution of 245 citrus orchards sampled during 1968–87 in the lower Rio Grande valley, indicating where *Tylenchulus semipenetrans* was detected (•) and was not detected (×). Boundaries indicate soil series associations given in Figure 1.

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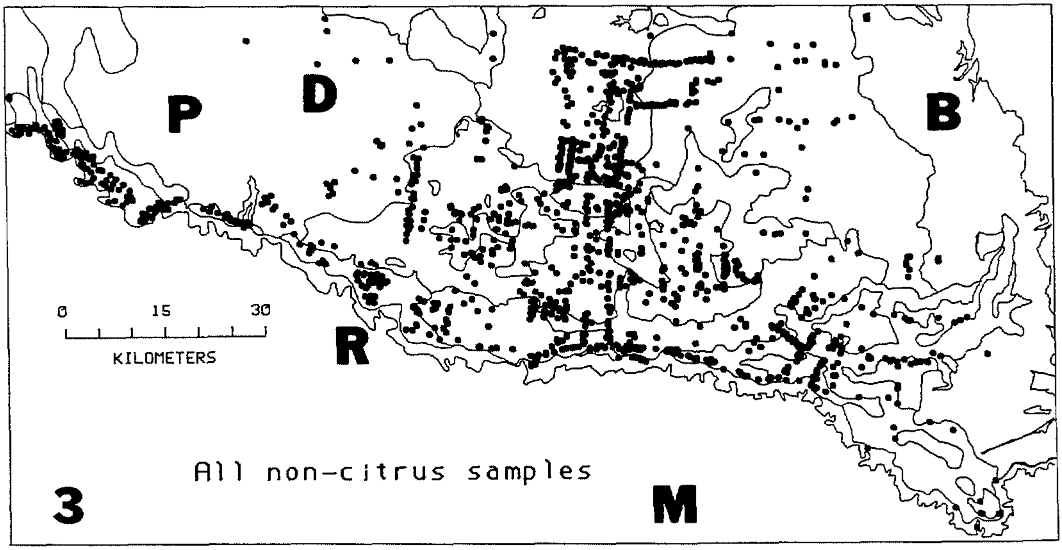
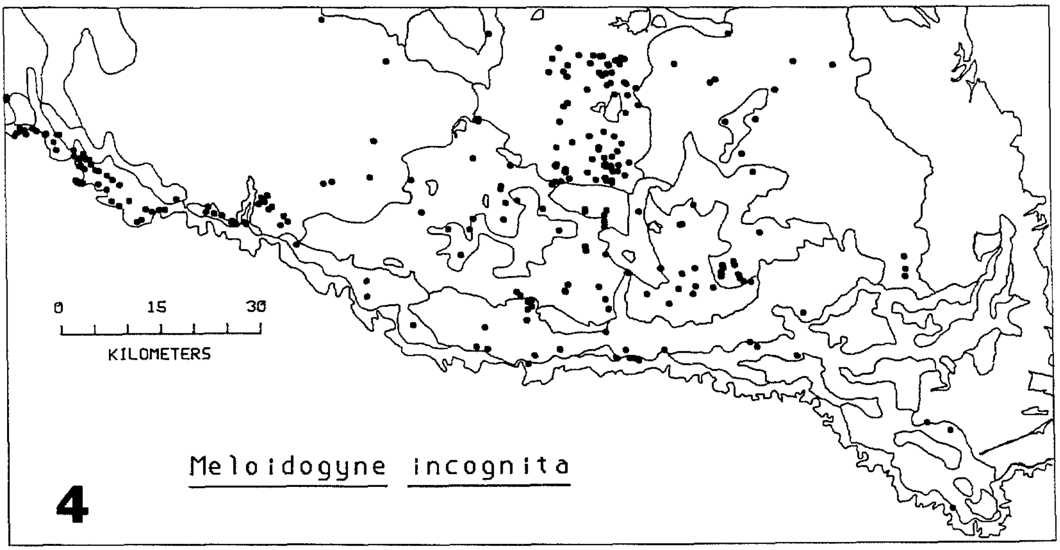
FIGS. 3–5. 3) Distribution of 1,220 crop fields (•) from which soil samples were taken, 1965–87, in the lower Rio Grande valley of Texas. Areas that were not sampled appreciably include the Rio Grande river (R), Mexico (M), dryland cotton and sorghum area (D), pasture areas (P), and brushland areas (B). Area along the river to the west and the large central region, where the greatest numbers of samples were taken, are irrigated and intensely cultivated to various field and vegetable crops. 4) Distribution of 251 crop fields (•) where *Meloidogyne incognita* was detected, 1965–87. 5) Distribution of 408 crop fields (•) where *Rotylenchulus reniformis* was detected, 1965–87.


P
D
B
R
M
0 15 30
KILOMETERS
All non-citrus samples
3


0 15 30
KILOMETERS
Meloidogyne incognita
4

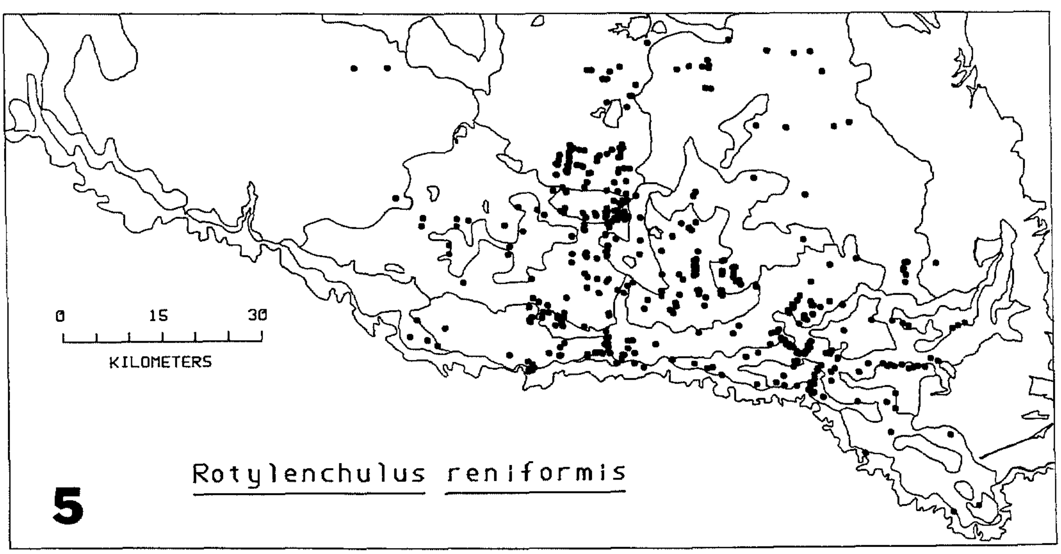

0 15 30
KILOMETERS
Rotylenchulus reniformis
5

TABLE 1. Soil associations and percentages of incidence of *Meloidogyne incognita* (Mi) and *Rotylenchulus reniformis* (Rr) obtained by plotting origins of soil samples from 1,221 crop fields onto general soil maps.

			Noncitrus samples		
Map symbol	Predominant series†	Representative pedon classifications (ca. 0–30 cm)†	Total	Mi (%)	Rr (%)
1	Harlingen, Mercedes, Benito	All clays	196	9	49
2	Laredo, Olmito	Predominantly silty clay with silty clay loam	111	5	58
3	Reynosa, Runn	Predominantly silty clay with silty clay loam	36	11	6
4	Rio Grande, Matamoros	Predominantly silt loam with some silty clay	118	40	8
5	Raymondville, Mercedes	Clay loam and clay	36	11	47
6	Raymondville, Lozano, Lyford, Willamar, Hidalgo and Willacy	Associations of clay loam, sandy clay loam, fine sandy loam	232	17	43
7	Hidalgo	Sandy clay loam	157	15	24
8	Willacy, Hargill, Delfina, Racombes, Randado	Mostly fine sandy loam with some sandy clay loam	266	31	29
9	McAllen, Brennan	Fine sandy loam	36	47	8
10	McAllen, Zapata	Fine sandy loam and loam	0		
11	Copita, Catarina	Fine sandy loam	1		
12	Jimenez, Quemado	Gravelly sandy loam and gravelly loam	23	48	0
13	Comitas, Delfina, Hebronville, Nueces, Sarita, Falfurrias	Predominantly fine sand, with some loamy fine sand, fine sandy loam	2		
14	(Saline, coastal soils, primarily uncultivated)		1		

† Soil Conservation Service, USDA (5,9,10).

tributions, with *M. incognita* occurring predominantly in sandy soils and *R. reniformis* occurring predominantly in fine textured soils (Figs. 3–5). A similar observation was made concerning the distribution of 80 fields sampled during a previous survey of the LRGV (1). In that survey and in ours, the incidence of *M. incognita* within the clays and clay silts of the ancient flood terraces of the Rio Grande was low (5–9%). By comparison, the incidences of samples positive for *M. incognita* were 15, 31, and 47%, respectively, in sandy clay loams, in sandy clay loam to sandy loam, and in sandy loams (Fig. 4, Table 1). A strong tendency for *M. incognita* to occur predominantly in sandy soils has been recognized for several decades (8).

Rotylenchulus reniformis, in contrast to *M. incognita,* was detected rarely in the sandy loams of the western LRGV and never in the western, gravelly loams and relatively low-clay soils (12–22% clay) of the Rio Grande–Matamoros association along the western flood terraces of the modern Rio Grande (Fig. 5, Table 1). A very high incidence (49–58%) of *R. reniformis* within the Harlingen, Mercedes, and Benito clays (45–78% clay) and in the silty clays and silty clay loams of the Laredo–Olmito association (32–42% clay) suggests that those fine textured soils are highly favorable for *R. reniformis.* The sandy clay loams and clay loams of the north-central LRGV, on the other hand, appear to favor both nematode species. The north-central sandy clay loam region and the eastern clay to silty clay loam region are primary cotton producing areas where, historically, soil texture has not influenced the choice of cotton cultivars grown (Dr. L. N. Namken, pers. comm.). Consequently, differential host preference of the two nematodes does not appear to have contributed to the effect of soil texture on their distributions. *Meloidogyne incognita* was associated with soils of neutral pH, whereas *R. reniformis* occurred primarily in soils that were moderately alkaline (pH = 7.8–8.4). Comparison of nematode samples mapped for 1965–66 with those mapped for 1978–87 indicated that appreciable changes in nematode distributions are not occurring.

Differential soil type preferences of *M. incognita* and *R. reniformis* should be examined rigorously under controlled conditions. If the ecological niches prove limiting, then a better understanding of the causes may provide valuable insight toward nematode management.

Literature Cited

1. Birchfield, W., H. Reynolds, and C. Orr. 1966. Plant-parasitic nematodes of cotton in the lower Rio Grande valley of Texas. Plant Disease Reporter 50: 149–150.

2. Findley, D. S., and W. L. Arends. 1986. 1985 Texas vegetable statistics. Texas Agricultural Statistics Service Bulletin 238, Austin, TX.

3. Findley, D. S., and W. L. Arends. 1986. 1985 Texas citrus tree inventory survey. Texas Agricultural Statistics Service Bulletin 226, Austin, TX.

4. Heald, C. M. 1970. Distribution and control of the citrus nematode in the lower Rio Grande valley of Texas. Journal of the Rio Grande Valley Horticultural Society 24:32–35.

5. Jacobs, J. L. 1981. Soil survey of Hidalgo county, Texas. Soil Conservation Service, United States Department of Agriculture, in cooperation with the Texas Agricultural Experiment Station, College Station, TX.

6. Lambe, R. C., and W. Horne. 1963. The reniform nematode in cotton in the lower Rio Grande valley of Texas. Plant Disease Reporter 47:941.

7. Norton, D. C. 1959. Plant-parasitic nematodes in Texas. Texas Agricultural Experiment Station Miscellaneous Publication 321, College Station, TX.

8. O'Bannon, J. H., and H. R. Reynolds. 1961. Root-knot damage and cotton yields in relation to certain soil properties. Soil Science 6:384–386.

9. Turner, A. J. 1982. Soil survey of Willacy county, Texas. Soil Conservation Service, United States Department of Agriculture, in cooperation with the Texas Agricultural Experiment Station, College Station, TX.

10. Thompson, C. M., R. R. Sanders, and D. Williams. 1972. Soil survey of Starr county, Texas. Soil Conservation Service, United States Department of Agriculture, in cooperation with the Texas Agricultural Experiment Station, College Station, TX.