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Survey of Current Distribution of *Rotylenchulus reniformis* in the United States

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Abstract: The reniform nematode, *Rotylenchulus reniformis,* has been reported from all Gulf Coast states, Arkansas, Hawaii, North Carolina, and South Carolina. Experts in 11 states identified the counties or parishes where the nematode is found and provided information regarding associated soil parameters, climate, crops, and crop management. *Rotylenchulus reniformis* has been detected in 187 counties and parishes of the southeastern United States and is most widespread in Louisiana, Mississippi, Alabama, Florida, and Georgia. In every state except Florida and Hawaii, economically damaging soil populations were associated with continuous cotton production. Other crops considered to be damaged by *R. reniformis* were soybean, tobacco, several vegetables, and pineapple (Hawaii). There was no consistent relationship between the nematode's presence and soil texture, soil pH, rainfall, or irrigation regime. However, certain respondents associated damage from the nematode primarily with silty or clay soils (Texas, Hawaii, Florida, and Georgia) or with silty soils with exceptionally low pH (Hawaii and Louisiana).

Key words: geographical distribution, reniform nematode, *Rotylenchulus reniformis,* soil type, survey.

The reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, occurs primarily in tropical and subtropical regions of the world where it parasitizes a wide array of crop plants. This nematode was first detected in the continental United States in Georgia in 1940 (11), the same year as the original species description from Hawaii (6) was published. Since then, *R. reniformis* has been reported from all Gulf Coast states and from North Carolina, South Carolina, and Arkansas (5). Most information on the distribution and economic impact of *R. reniformis* in the United States is in commodity group and state experiment station reports; there is no assessment of the nematode's agronomic significance on a national scale. Therefore, we conducted a survey to compile information on the distribution and agronomic impact of *R. reniformis.*

Materials and Methods

A questionnaire was mailed to selected scientists in universities, USDA, and regulatory agencies in states where *R. reniformis* was known to occur. In certain cases, questionnaires were followed by telephone calls or written requests for additional information. Eighteen persons in 11 states were contacted. The information requested included the counties or parishes where soil samples containing the nematode had been collected and the associated soil texture, soil pH, irrigation regime, and cropping history. We also asked for each respondent's opinion regarding the importance of *R. reniformis* as an agronomic pest in his state, which crops were affected, and how much crop damage in the state was indicated by data from field experiments and state surveys. Finally, we requested a confirmation of when and by whom the nematode was first discovered in the state.

Results and Discussion

When the survey results were compiled, we found no consistent relationship between the presence of *R. reniformis* and soil texture, soil pH, rainfall, or irrigation regime (Table 1). Soil textures ranged from clay to silt to sand, and pH varied from 4 to 8. However, infestations of the nema-

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TABLE 1. Survey responses regarding soil and climatic factors associated with infestations of *Rotylenchulus reniformis* in the United States.

State	First report (reference)	Soil description†	Soil pH	Rainfall (cm)	Irrigated? (yes or no)
Alabama	Minton & Hopper, 1959 (7)	—‡	5–7	102–127	Both
Arkansas	Robbins, 1982 (9)	—	—	—	—
California	Nematode absent				
Florida	Steiner, 1942 (13)	Clay, silt, muck, sandy soil in some ornamentals	—	125	Both
Georgia	Smith, 1940 (11)	#1: Mostly "heavy red" soils that class as sandy clay loam #2: Sandy soil, sandy loam	—	76–89	Both
Hawaii	Linford & Oliveira, 1940 (6)	Silty clays	4–5	64–150	Both
Louisiana	Smith & Taylor, 1941 (12)	Variable but mostly loamy sand; some very silty	5–8	157–193	No
Mississippi	1968 (G. W. Lawrence, pers. comm.)	Sandy soil, sandy loam	—	115–165	Both
N. Carolina	Brodie, 1961 (2)	80–90% sand	5.5–6	107–117	No
S. Carolina	Fassuliotis, 1967 (4)	#1: Sand, loamy sand #2: Sandy	—	127	Most
Texas	Norton, 1959 (8)	Mostly silt loam, clay, clay loam, sandy clay loam	7–8	46–99	Most

† #1 and #2 indicate responses of two different contacts within a state.
‡ Not reported.

tode were associated with finely textured soils in Texas, Georgia, and Florida and with silty soils with low pH in Hawaii and Louisiana. The nematode occurred on both irrigated and unirrigated land and in regions with annual precipitation ranging from 46 to 193 cm. In every state except Hawaii and Florida, the nematode's distribution was associated primarily with cotton, especially with continuous cotton production (Table 2). Other crops associated with *R. reniformis* were soybean, tobacco, pineapple, and vegetables.

Rotylenchulus reniformis was reported from

TABLE 2. Survey responses regarding incidence of *Rotylenchus reniformis*, cropping histories, and pest status.

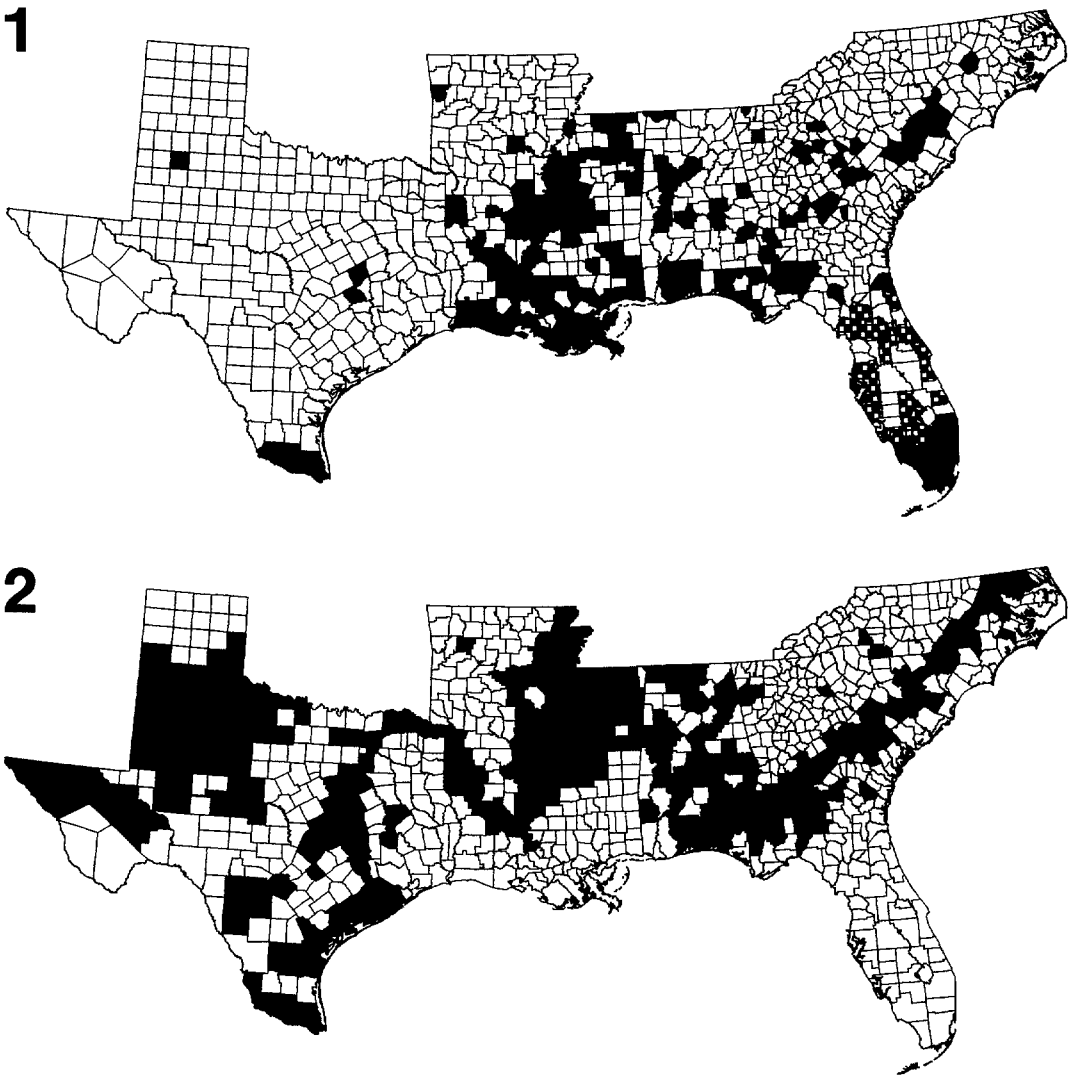
State	Cropping history	Crops economically affected	Number of counties or parishes where found
Alabama	Mostly continuous cotton; also cotton–soybean rotation	Cotton	13
Arkansas	Cotton, vegetables	Uncertain	3
Florida	Various	Vegetable crops, cotton, some ornamentals	34
Georgia	Cotton	Cotton, some vegetables	30
Hawaii	Pineapple	Pineapple	3
Louisiana	Cotton	Soybean, cotton	45
Mississippi	Cotton	Cotton	42
N. Carolina	Continuous cotton or cotton in rotation	Cotton; soybean and tobacco to a lesser extent	2
S. Carolina	Continuous cotton and soybean–tobacco–cotton rotation	Cotton; also soybean, tobacco	11
Texas	Continuous cotton; also vegetables	Cotton, some vegetables	7

187 counties and parishes of the southeastern United States and appeared to be particularly widespread in Louisiana (45 of 64 parishes), Mississippi (42 of 82 counties), and Georgia (30 of 159 counties). Although the nematode has been found in 34 counties in Florida, respondents from Florida emphasized that this figure and the portion of the state that these counties represent is misleadingly large. Counties in Florida are much larger than those of other southern states and most reports of the nematode from central Florida were isolated cases of contaminated, container-grown ornamentals which undergo rigorous quarantine inspections before export. The nematode occurs commonly in field soil only in the five southernmost counties of the Florida peninsula (J. H. O'Bannon and R. N. Inserra, pers. comm.).

The pattern of the national distribution of *R. reniformis* at the county (or parish) level (Fig. 1) reflected strongly the pattern of cotton production in the southeastern United States (14) (Fig. 2) and the Major Land Resource Regions given by the United States Soil Conservation Service (15). Particularly noteworthy are concentrations of *R. reniformis* in the Coastal Plain of South Carolina, Georgia, and Alabama, the lowlands of southern Florida, the Blackland Prairie of northwestern Alabama, the Mississippi Delta in Mississippi and Louisiana, the Red River Valley of Louisiana, and the alluvial plain of the Lower Rio Grande Valley. The nematode has been reported less frequently from the Atlantic and Gulf Coast Lowland Forest and Crop Region, the Carolina and Georgia Sand Hills, and the Southern Piedmont. Discontinuities in distribution patterns at state lines suggested that *R. reniformis* also is present in unreported counties in southwestern Tennessee, southeastern Arkansas, and far southeastern Texas. The northernmost latitude of the known distribution was ca. 35°N, where isolated infestations were reported, each on a single farm. These farms were on the Coastal Plain of North Carolina, on the southern High Plains in the Panhandle of Texas, and in a county on the Arkansas-Oklahoma line in northwestern Arkansas (Fig. 1). A geographical explanation for the absence of *R. reniformis* in cotton production areas of New Mexico, Arizona, and California is the obvious barrier presented by the Chihuahuan desert and other arid or semi-arid lands separating the western cotton-producing regions from the southeastern states. The only reported infested farm on the High Plains of Texas belonged to a grower who had transported farm implements from the Lower Rio Grande Valley, where the nematode is intensely distributed.

Respondents from all states except Arkansas considered *R. reniformis* to be economically damaging, particularly to cotton (all states except Hawaii), and to a lesser extent to soybean (Louisiana, Mississippi, North Carolina, and South Carolina), vegetables (Georgia, Texas, and Florida), and tobacco (North Carolina and South Carolina). The big economic impact of *R. reniformis* on pineapple production in Hawaii has been known for several decades (3). In Florida, *R. reniformis* also is considered an important regulatory pest affecting the export of various container-grown ornamentals. Estimated increases in cotton yield after preplant application of fumigant or nonfumigant nematicides in fields infested with *R. reniformis* were 40% in Alabama, 40–60% in Louisiana, 36–64% in Mississippi, and 33% in Texas. Other crop yield increases were 9–10% in yellow squash in Florida, 40% in cantaloupe in Texas, and 12% in soybeans in Louisiana.

An extensive survey of more than 120,000 ha of cotton land was conducted in Mississippi in 1986–87 (1). Five percent of the fields in each of six counties were sampled. *Rotylenchulus reniformis* was found in 6–31% of the samples from each county; in Madison county, 18% of the fields had densities above the recommended economic threshold of 2,000 vermiform *R. reniformis* per 473 cm^3 (1 pint) of soil, when assayed by a sugar flotation-centrifugation extraction method. A primary concern in Mississippi is that the uniformity of plant



FIGS. 1, 2. Distribution of *Rotylenchulus reniformis* in the continental United States. 1) Counties and parishes with infested fields (solid black areas) or within which contaminated nursery stock has been found (checkered areas), as of 1989. 2) Counties or parishes producing more than 1,000 running bales of cotton in 1988. Both maps were produced with aid of SAS graphics.

stunting in a field with a high population of *R. reniformis* often causes the problem to go unnoticed. Similarly, a large portion of fields are infested in the Lower Rio Grande Valley of Texas, where soil sample records spanning 22 years indicated the presence of *R. reniformis* in 66% of 1,221 fields (10). Most fields were planted to cotton at the time of sampling. On the other hand, some 35,000 soil samples submitted by growers are examined annually in North Carolina. Few samples contain *R. reniformis* and these are generally from Scotland county, which borders South Carolina (J. L. Imbriani, pers. comm.).

Rotylenchulus reniformis is becoming recognized as an important pest of cotton and associated crops in several southern states. A comparison between the chronology of the first reports of *R. reniformis* from the southeastern states and its current distribution suggests that it was present in large areas for many years without detection. Its discovery in new areas in the southeastern

states will not necessarily indicate it is spreading. It would seem unlikely, however, that *R. reniformis* is present in the southwestern states of New Mexico, Arizona, or California, where it has never been found in agricultural land. Generally, infestations appear limited by latitude, rarely occurring north of 35°N, and are associated with cotton production. However, numerous plants are good hosts, and much more needs to be learned about the influence of cropping, soil, and climatic factors on the establishment and buildup of reniform nematode populations.

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