RELATIONSHIP OF PLANT-NEMATODES AND EDAPHIC FACTORS IN COLOMBIAN GRAIN SORGHUM PRODUCTION[1]

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ABSTRACT

Trevathan, L. E., J. A. Cuarezma-Terán, and L. M. Gourley. 1985. Relationship of plant-parasitic nematodes and edaphic factors in Colombian grain sorghum production. Nematropica 15:145-153.

The plant-parasitic nematodes most commonly found associated with sorghum in the Cauca Valley, Colombia, were: *Pratylenchus zeae, Tylenchorhynchus martini,* and *Helicotylenchus dihystera. Pratylenchus zeae* occurred in 100% of the samples and averaged 744 nematodes/250 cm^3 of soil. Significant correlations were found between certain soil properties and nematode populations, including pH, phosphorus, sodium, and calcium. Cation exchange capacity, sand, silt, clay, organic matter, and other elements assayed were not correlated with plant-parasitic nematode populations.

Additional key words: lesion, spiral, and stunt nematodes, Sorghum bicolor.

RESUMEN

Trevathan, L. E., J. A. Cuarezma-Teran y L. M. Gourley. 1985. Relación entre los nematodos parasiticos de las plantas y los factores edaficos en la producción del sorgo en Colombia. Nematropica 15:145-153.

Los nematodos parasíticos más comúnmente encontrados asociados con el sorgo en el Valle Cauca, Colombia, fueron: *Pratylenchus zea, Tylenchorhynchus martini,* y *Helicotylenchus dihystera.* El *P. zeae* ocurrio en el 100% de las muestras con un promedio de 744 nematodos/250 cm^3 de suelo. Se encontraron correlaciones significativas entre cietras propiedades del suelo y las poblaciones de nematodos, incluyendo el pH y los elementos fósforo, sodio y calcio. La capacidad de cambio de cationes, la arena, el silt, la arcilla, la materia organica y otros elementos analizados no estuvieron correlacionados con las poblaciones de nematodos parasíticos.

Palabras claves adicionales: nematodo de las lesiones, nematodo espiral, Sorghum bicolor.

INTRODUCTION

In recent years sorghum [*Sorghum bicolor* (L.) Moench] has become a grain crop of increasing importance in South America. In Colombia, the crop was grown on 198,000 ha in 1982 with an average yield of 2,600 kg/ha (11). Grain sorghum produced in Colombia is particularly useful in the country's animal husbandry system which is devoted prin-

cipally to small animal production. The importance of grain sorghum for human consumption in Colombia has yet to be realized.

Investigations have been conducted to determine the nematodes associated with both maize and grain sorghum in Central and South America (1,2,16,17,20,22,24). However, information from Colombia is limited regarding the speciation of plant-parasitic nematodes, their occurrence, and relationships with edaphic factors. This study was conducted to identify phytoparasitic nematodes associated with grain sorghum in the Cauca Valley of Colombia. Ancillary objectives included the determination of population densities, relative distribution, and the effects of soil type and chemical and physical soil properties on nematode population densities in the field.

MATERIALS AND METHODS

In 1983, 74 fields comprising 1,400 ha were sampled in the Colombian Cauca Valley. Large fields were divided into sections (9-10 ha) for sampling. Seven root and soil subsamples taken at random within each section per field were combined to form one sample. Each subsample consisted of 10-15 g of roots and 200-300 cm^3 of soil from the root zone of a mature sorghum plant. Samples were collected from fields where sorghum had grown for at least two consecutive years. Samples were collected with a soil auger which extracted a core 20 cm x 3 cm.

Nematodes were extracted from 250 cm^3 of soil by Cobb's decanting and sieving method (5). Soil samples were left on decanting plates for 48 hr. A modification of the same method was used for the extraction of cysts of *Heterodera* spp. After being killed by heating at 60 C for one min, nematodes were concentrated and fixed for identification and measurements by the glycerol-ethanol method (23). Soil property analyses for pH, phosphorus, sodium, calcium, texture, cation exchange capacity (CEC), and organic matter were performed by the Soil Testing Laboratory at Centro International de Agricultura Tropical (CIAT) in Palmira.

RESULTS

Plant-parasitic nematodes commonly associated with grain sorghum in the Cauca Valley were *Pratylenchus zeae* Graham, *Helicotylenchus dihystera* (Cobb) Sher, *Tylenchorhynchus martini* Fielding, *Heterodera* spp., *Rotylenchulus parvus* (Williams) Sher, *R. reniformis* Linford and Oliveira, *Criconemella* sp., and *Peltamigratus* sp. *Pratylenchus zeae* occurred in 100% of the samples (Table 1) with the greatest mean population density of 744 nematodes/250 cm^3 of soil. *Tylenchorhynchus martini* and *H. dihystera* were the next most frequently extracted nematodes with relative den-

Table 1. Plant-parasitic nematodes recovered from sorghum fields in the Cauca Valley, Colombia, 1983.

Nematode	Absolute Frequency (%)	Absolute Density[x]	Relative Density (%)[y]
Pratylenchus zeae	100	744[z]	57
Helicotylenchus dihystera	70	234	18
Tylenchorhynchus martini	46	304	23
Heterodera spp.	8	13	1
Rotylenchulus parvus	8	6	1
Rotylenchulus reniformis	4	3	0
Criconemella spp.	7	2	0
Peltamigratus spp.	1	1	0

[x]Average number of each nematode found in all samples.
[y]Absolute density/sum of average density of all plant-parasitic nematodes.
[z]Number of nematodes per 250 cm^3 of soil.

sities of 23 and 18% and absolute densities of 304 and 234 nematodes/ 250 cm^3 of soil, respectively. Brown cysts of *Heterodera* sp. were found in 13 soil samples from random locations throughout the valley. The numbers of cysts in soil ranged from 3 to 50 per 250 cm^3.

Significant correlations between soil properties and nematode populations are presented in Fig. 1. *Helicotylenchus dihystera* and *T. martini* were positively correlated with pH and Na level. These nematodes, and the total number of plant-parasitic nematodes, were also positively correlated with the level of P. *Pratylenchus zeae* was negatively correlated with pH, Na, and Ca, but was recovered in highest numbers from grain sorghum fields with a pH of 6.0. *Helicotylenchus dihystera* and *T. martini* were most prevalent at a pH of 8.0. The correlation between pH and total nematode population was not significant.

Pratylenchus zeae, H. dihystera, and total number of plant-parasitic nematodes were more prevalent when the soil Ca content was between 8 and 24 meq/100 g soil. Nematode populations decreased as Ca content increased, but were relatively uniform when soil Na content was low (0.2-4 meq/100 g soil). Cation exchange capacity, sand, silt, clay, organic matter, and other elements assayed were not correlated with plant-parasitic nematode populations.

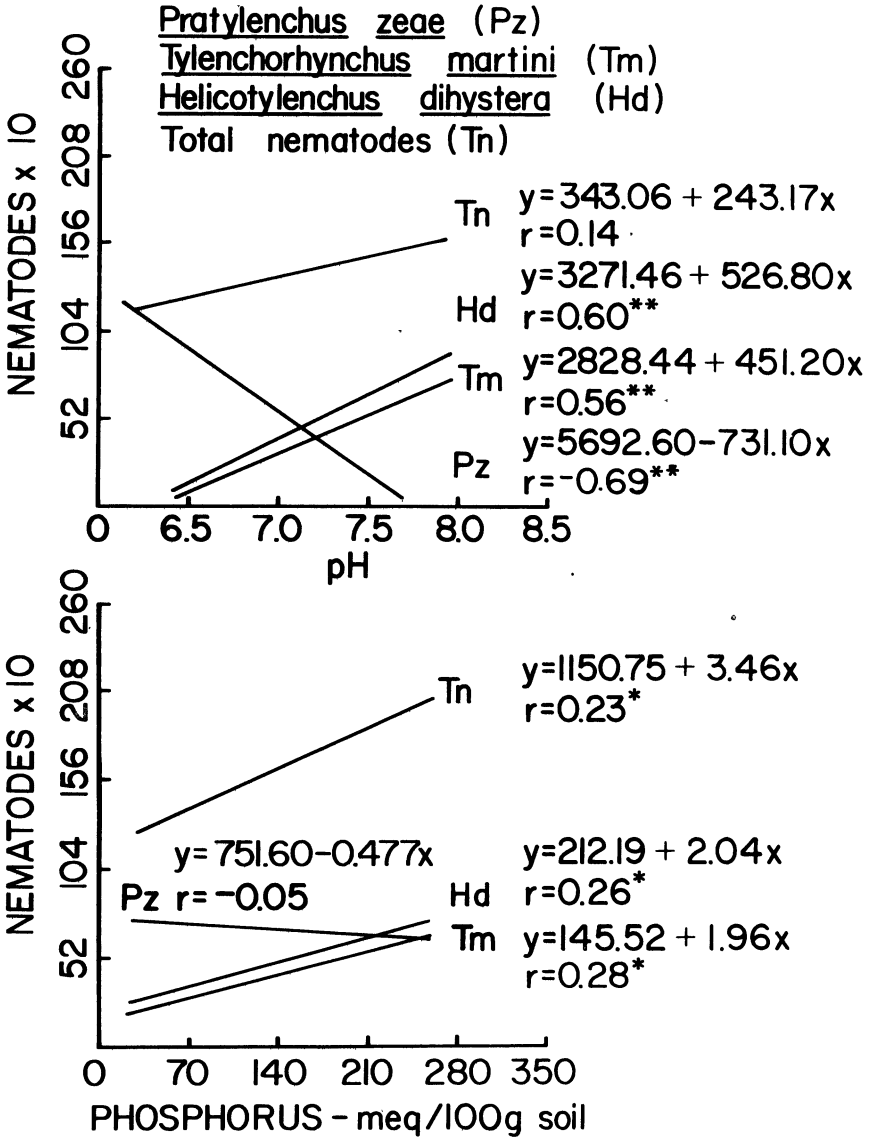
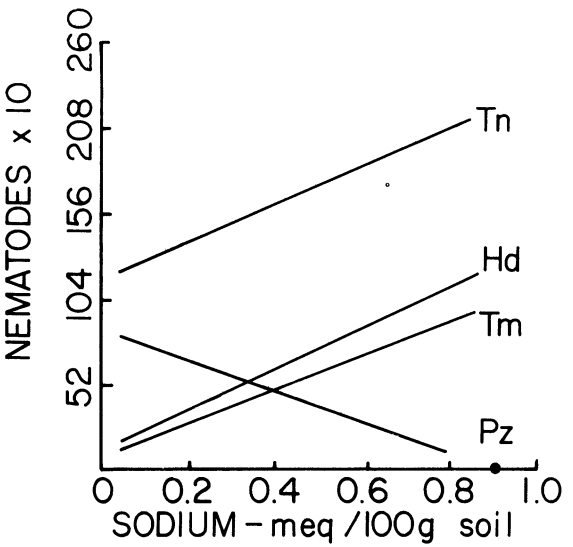


Figure 1. Nematode populations at different pH values, soil phosphorus, sodium, and calcium content in sorghum fields in the Cauca Valley, Colombia, 1983. * Significant at P=0.05, ** Significant at P=0.01.

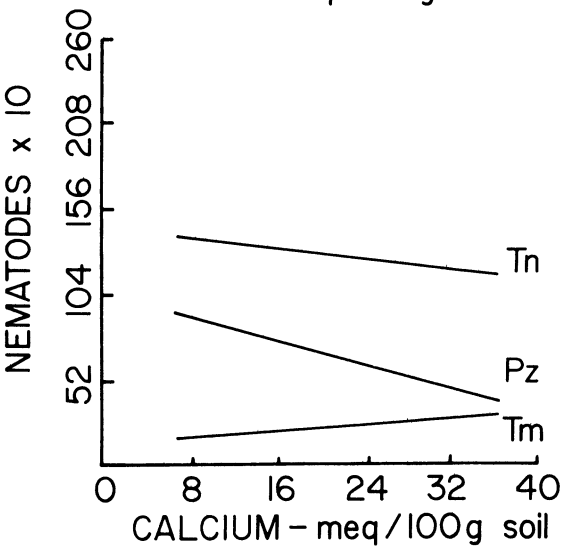


$y = 1159.14 + 1086.25x$
$r = 0.16$

$y = 144.43 + 1180.72x$
$r = 0.34^{**}$

$y = 122.16 + 966.50x$
$r = 0.31^{**}$

$y = 863.94 - 980.20x$
$r = -0.24^{*}$



$y = 1457.67 - 8.40x$
$r = -0.07$

$y = 1065.48 - 18.76x$
$r = -0.24^{*}$

$y = 160.49 + 4.12x$
$r = 0.07$

Most of the fields assayed were clay-textured soils (68%); the remainder were clay-loam (22%), silty-clay (9%), or silty-clay-loam (1%). Most plant-parasitic nematodes were found in clay and clay-loam type soils—809 and 313 nematodes/250 cm^3 soil, respectively. *Helicotylenchus dihystera* occurred in 68% of fine-textured soil samples, while *P. zeae* and *T. martini* occurred in 100 and 24% of samples, respectively.

DISCUSSION

Lesion, spiral, and stunt nematodes have previously been found associated with crops in Colombia (8,10). The soybean cyst nematode has recently been reported in Colombia and is widely distributed in the Cauca Valley (9,19). Gomez-Tovar and Medina (9) found *Heterodera glycines* Ichinohe on both soybeans and dry beans throughout the area. It is not known if the practice of rotating soybeans with grain sorghum resulted in the presence of brown cysts in grain sorghum fields.

The determination of correlations between soil properties and nematode populations revealed the negative relationship between *P. zeae* and soil pH which is consistent with previous reports on other crops. Kincaid and Gammon (13) found that the incidence of *Pratylenchus* spp. varied inversely with soil pH. Maximum disease incidence occurred on tobacco grown in soils with a pH of 5.2 to 6.2. *Pratylenchus alleni* Ferris was found in highest numbers on soybean roots in soil with a pH of 6.0 (4).

The positive correlation of *H. dihystera* and *T. martini* with soil pH values has been previously observed within these genera. Both *Tylenchorhynchus maximus* Allen (21) and *Helicotylenchus pseudorobustus* (Steiner) Golden (18) populations increased with increasing soil pH, but negative correlations of pH with *Tylenchorhynchus nudus* Allen (18) and *Tylenchorhynchus dubius* (Butschli) Filipjev (3) have been reported.

Root development, particularly lateral and fibrous rootlets, is an important response of plants to soil phosphorus. Kirkpatrick et al. (14) reported an increase of *Xiphinema americanum* Cobb with the application of phosphorus in the absence of potassium. In this study, *H. dihystera, T. martini,* and total nematode numbers were greatest in soils high in phosphorus. Enhanced root development may, therefore, promote the rapid buildup of nematode populations. High populations of *Quinisulcius acutus* (Allen) Siddiqi have been reported on sorghum in Mississippi when soil phosphorus levels were adequate to high (6).

There were no significant correlations between cation exchange capacity (CEC) and plant-parasitic nematodes. This may mean that CEC does not influence *P. zeae, T martini, H. dihystera,* or total numbers of plant-parasitic nematodes. Although not directly correlated with

nematode species extracted, the amount of organic matter and clay in soil samples may account for the absence of any correlation with CEC values. Similar results have been reported by Norton *et al.* (18).

Most soils in the Cauca Valley are fine-textured soils cultivated to sugarcane, corn, sorghum, soybeans, and cotton. Soils around Andalucia, Bugalagrande, Tulua, Zarzal, and Buga are predominantly clay-type soils, while those around Cali, Palmira, and Las Praderas are more coarsely textured. Although the results may reflect soil type distribution, the data are consistent with previous studies which reported the predominance of *Helicotylenchus* spp. in clay soils. Norton *et al.* (18) found *H. pseudorobustus* to be common in medium to heavy-textured soils in Iowa. McGlohon *et al.* (15) reported higher numbers of *H. dihystera* in clay-loam than sandy-loam soils. Although the lesion nematode was prevalent in clay soils in this study, it has been reported to occur more frequently and migrate more readily in light sand and sandy-loam soils (7,12). More soils of coarse texture would have to be found and assayed in the area to establish the association of this nematode with soil texture.

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