Population Dynamics of Selected Plant-Parasitic Nematode Species on Guayule

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ABSTRACT

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Reproduction of *Criconemella xenoplax, Helicotylenchus pseudorobustus, Meloidogyne incognita*, and *Pratylenchus scribneri* on guayule (*Parthenium argentatum*) was evaluated under greenhouse conditions. Guayule was not a host for *M. incognita* or *P. scribneri* but supported *H. pseudorobustus* at about one-third of the initial inoculum level. Soil populations of *C. xenoplax*, on the other hand, increased ($P = 0.05$) to about five times the initial inoculum level. No reduction in plant root or shoot weight was observed during the 9-mo experimental period relative to the population increase of *C. xenoplax*. Lack of development of common nematode pathogens of annual crops on guayule enhances its usefulness as a perennial crop for marginal semiarid regions. Nematode problems might be anticipated where high populations of *C. xenoplax* develop.

Additional key words: native latex, rubber production

Large quantities of latex can be extracted from stems of guayule (*Parthenium argentatum* Gray) and used to produce natural rubber. The plant is a woody perennial endemic to the Chihuahuan and Sonoran deserts of the United States and Mexico and thrives in some otherwise marginal agricultural land in these areas. The commercial potential of guayule as a source of latex is under investigation in the United States, Mexico, Australia, and South Africa.

Little information is available on nematode pathogens of guayule in a monocrop system. Nematodes have been associated with major disease problems in perennial crops (1–3,8), but their association with guayule has not been thoroughly investigated. Norton (11) and Thorne and Allen (Root-knot nematode survey of guayule nurseries and plantations in California, 1 August 1943, USDA Emergency Rubber Project, *unpublished*), reported the presence of *Helicotylenchus* sp., *Hoplolaimus tylenchiformis, Pratylenchus* sp., and *Xiphinema americanum* associated with guayule in the field but did not evaluate population development.

This study was designed to evaluate the host potential and growth of guayule as influenced by four common species of plant-parasitic nematodes.

MATERIALS AND METHODS

Helicotylenchus pseudorobustus (Steiner) Golden, a semiendoparasite; *Pratylenchus scribneri* Steiner, a migratory endoparasite; and *Meloidogyne incognita* Kofoid & White race 3, a sedentary endoparasite, were isolated from field soil near Las Cruces, NM, in 1981. *Criconemella xenoplax* (Raski) Luc & Raski, a migratory ectoparasite, was isolated from a 4-yr-old guayule planting in an abandoned cotton field. Monospecific populations of each nematode were maintained in pot cultures in the greenhouse. *C. xenoplax* was reared on grape (*Vitis vinifera* L. 'Thompson Seedless'). All other species were reared on tomato (*Lycopersicum esculentum* L. 'Rutgers').

Six-month-old guayule plants (*P. argentatum* '593') were transplanted from sterile sand into 15-cm-diameter plastic pots containing 1,500 cm^3 of autoclaved sandy loam soil (66% sand, 21% silt, and 13% clay; pH 8.0; 0.5% organic matter). Pots were then infested with an aqueous suspension of 1,000 eggs of *M. incognita* or 1,000 juveniles and adults of *C. xenoplax, H. pseudorobustus*, or *P. scribneri* applied 2 cm below the soil surface surrounding fresh transplants. Eggs of *M. incognita* were extracted from tomato roots with 0.75% NaOCl, a modification of the sodium hypochlorite method (5). *C. xenoplax* and *H. pseudorobustus* inoculum were obtained from soil by the centrifugal-flotation method (9) and *P. scribneri* from tomato roots by Bird's shaker method (4).

Plants were harvested at 6-wk intervals over a 9-mo period. Shoot fresh weight, root and shoot oven-dry (96 hr at 85 C) weight, and numbers of nematodes were recorded for each pot. Nematode extraction involved processing 500 cm^3 of soil per pot with a semiautomatic elutriator and centrifugal flotation (9). In addition, *P. scribneri* were extracted from 1–2 g fresh weight of guayule roots (4) and *M. incognita* eggs were extracted from 10 g of roots with NaOCl (5).

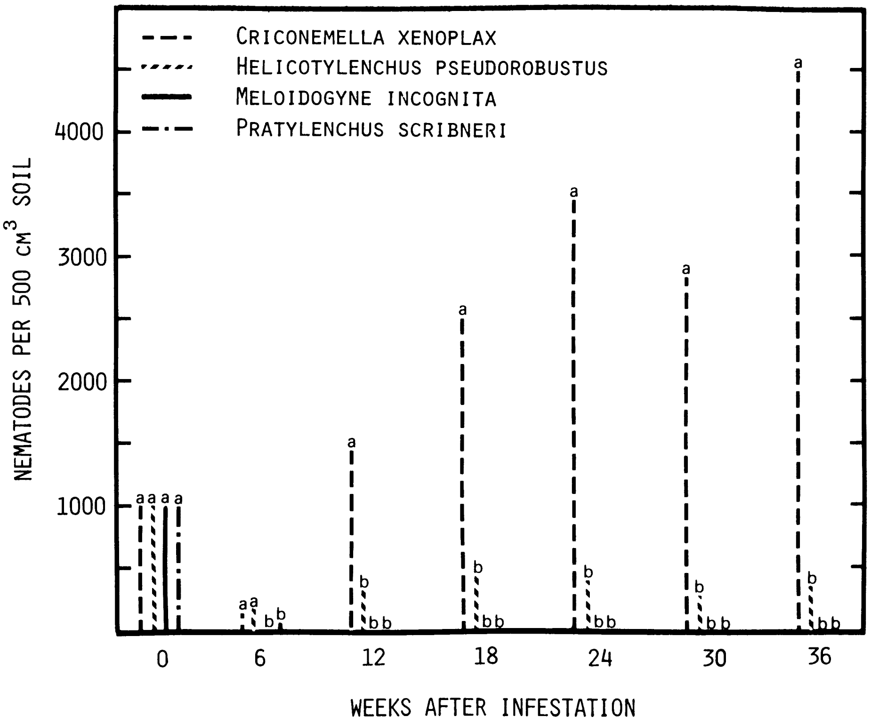

Fig. 1. Recovery of four plant-parasitic nematode species over a 36-wk period from greenhouse-grown guayule. Mean separation within each date is by the Newman-Keuls range test ($P = 0.05$).

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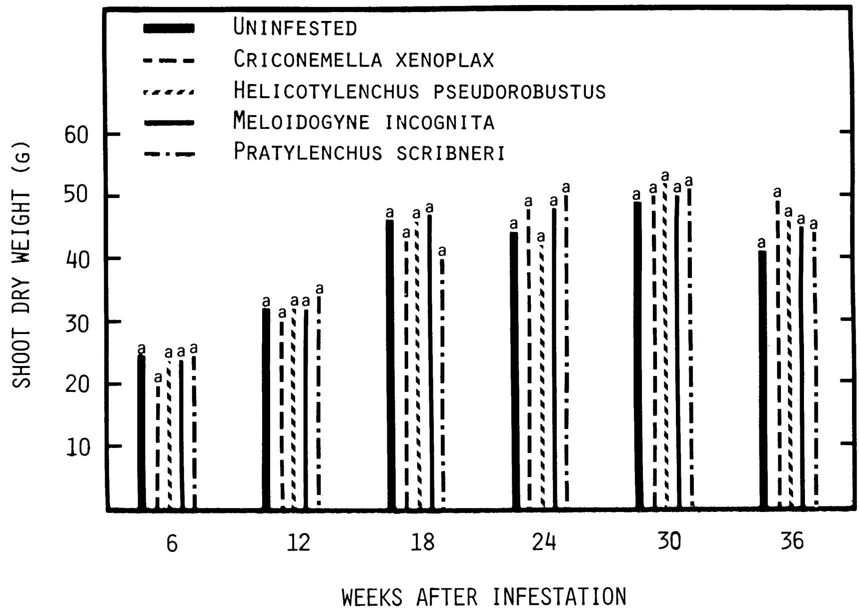

Fig. 2. Influence of nematodes on shoot production from greenhouse-grown guayule transplants. Mean separation within each date is by the Newman-Keuls range test ($P = 0.05$).

The experiment was designed as a series of six latin squares with individual squares destructively sampled at 6-wk intervals over the 9-mo experiment. Each latin square contained five replicates of four treatments and an uninoculated control. Data from each sampling date were analyzed using analysis of variance and treatment differences partitioned with the Newman-Keuls range test.

RESULTS

All nematode populations initially declined after inoculation, with *M. incognita* and *P. scribneri* completely absent by week 12 of the study (Fig. 1). *H. pseudorobustus* recovered to about one-third of the initial inoculum level by week 12 and persisted at that level for the remainder of the experiment. Populations of *C. xenoplax* began to increase after the first 6-wk sampling date to five times the initial inoculum level by week 36. A decline in the populations of *C. xenoplax* and *H. pseudorobustus* occurred between weeks 24 and 30, but both nematodes recovered by week 36 (Fig. 1).

Significant increases in populations of *C. xenoplax* occurred ($P = 0.0001$) compared with the other nematode treatments (Fig. 1); however, no differences in shoot dry weight were observed as a result of the rise in *C. xenoplax* populations (Fig. 2). Shoot fresh weight and root dry weight were also unaffected by *C. xenoplax* in this experiment.

DISCUSSION

Plant-parasitic nematode development on guayule varied greatly among the species examined. The failure of the two endoparasitic species, *M. incognita* and *P. scribneri*, to survive on guayule is significant because both have wide host ranges and are recognized parasites of woody perennials (2,6,13). Their inability to survive may be caused in part by the accumulation of latex in guayule roots. Unlike other rubber-producing plants, guayule accumulates granules of latex intracellularly rather than exclusively in resin canals, and cells adjacent to these high rubber production areas are often densely packed with such granules (10). This plant characteristic could limit movement and feeding by endoparasitic nematodes.

The development of *C. xenoplax* populations on guayule may pose a problem for long-term production of this crop in certain locations. *C. xenoplax* is a known pathogen of other woody perennials (1–3) and is an important component in various disease complexes affecting woody plants (7,12). Although no significant reductions in plant growth associated with *C. xenoplax* population increases were observed in this study, long-term effects of continued nematode development could produce different results. In the greenhouse, where conditions for plant growth are maintained near optimum, influences of stress factors such as nematodes may be less pronounced than under normal field conditions, particularly in a semiarid environment. Similarly, the rate of increase for *C. xenoplax* (Fig. 1) indicates that nematode populations remained in a rapid growth phase after 36 wk and might be expected to reach higher densities with time.

The decrease in *C. xenoplax* populations between weeks 24 and 30 probably reflects a change in environmental suitability for nematode development. This drop occurred during a period in early autumn when, before use of supplemental heaters, daily temperature fluctuations in the greenhouse are greatest. No corresponding reductions in plant parameters were observed, so it is unlikely that availability of food contributed to this temporary decline.

This study indicates guayule is a good host for *C. xenoplax* but a nonhost for *M. incognita* and *P. scribneri*, two endoparasitic nematodes commonly associated with annual and perennial crops in the southwestern United States. Lack of host suitability toward these particular nematodes may enhance the usefulness of guayule as a cropping alternative on marginal land in semiarid regions. However, the presence of *C. xenoplax* could result in a potential nematode pest problem of guayule in a standard perennial monocropping system. The carrying capacity of guayule for *H. pseudorobustus* may have been exceeded with the initial inoculum density, because this nematode persisted at about one-third that level throughout the experiment.

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