Influence of Cultivar, Age, Soil Texture, and pH on *Meloidogyne incognita* and *Radopholus similis* on Banana

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ABSTRACT

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Radopholus similis and *Meloidogyne incognita* were detected in seven banana cultivars, but their population densities differed considerably. Roots of cultivars Giant Cavendish, Cardaba, and Bungulan contained higher populations of *R. similis* than of *M. incognita;* the reverse was true in Dwarf Cavendish, Lacatan, and Latundan. Population densities of both nematode species were low in Saba cultivar. The population of *R. similis* progressively increased and that of *M. incognita* declined with age of Giant Cavendish plantations. This relationship was also observed in plants that had "tip-over" disease and severe root necrosis because of infestation by *R. similis.* Necrotic roots apparently were not suitable for *M. incognita.* Nematodes were present in all soil textures, but both species reproduced better in sandy loam than in soil of finer texture. Population development was most successful at soil pH 5.0–5.6.

Banana (*Musa paradisiaca* L.) is a leading export crop of the Philippines, grown on more than 300,000 ha. The largest banana-producing regions are in the southern and northern Mindanao (6). In a nationwide survey in 1974 and 1975, we found a number of plant-parasitic nematodes associated with different cultivars. The most common species were *Meloidogyne incognita* Chitwood and *Radopholus similis* (Cobb) Thorne, which cause serious damage on banana (1,4). The distribution and population densities of these species varied considerably in different localities.

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This study was done to determine the influence of cultivar, age of plantation, soil texture, and pH on the field distribution and population densities of *R. similis* and *M. incognita.*

MATERIALS AND METHODS

Samples of banana roots and of soil were collected from farms mainly in the provinces of Davao del Norte and Davao del Sur in Mindanao where more than 25,000 ha of Giant Cavendish banana are commercially grown. Approximately 400-cc soil and 4-g (wet weight) root samples per plant hill were randomly collected. All root samples were cut into pieces (1–2 cm long), fixed in FAA for at least 48 hr, and stained for 3–4 min in boiling acid-fuchsin lactophenol.

Stained roots were kept in clear lactophenol in vials. Later the roots were dissected under a stereomicroscope and the nematodes were identified and counted.

The soil and root samples were collected from the same sites. At each site about 600 cc of soil was obtained approximately 40 cm from the base of the plant at a depth of 15–30 cm. Each soil sample was placed in an individual plastic bag and taken to the nematology laboratory. A 200 cc subsample was sent to the Department of Soil Science for soil identification and pH determination. The results of assays for nematodes other than *R. similis* and *M. incognita* were published elsewhere (3).

RESULTS

Cultivar. The field distribution and population densities of *M. incognita* and *R. similis* varied among cultivars (Fig. 1). The population density of *M. incognita* was greatest in roots of Dwarf Cavendish, Lacatan, and Latudan; the density of *R. similis* was greatest in roots of Giant Cavendish, Bungulan, and Cardaba. Both species were least numerous in Saba.

Age of plantation. The Giant Cavendish plantations in Davao del Norte were from 2 mo to 4 yr old. In plantations less than 1 yr old, the population densities of *M. incognita* and *R. similis* were relatively low and more or less similar (Fig. 2). During the second year, populations increased significantly by 13 times or more; *R. similis* showed highest increases.

The population density of the two species shifted considerably in the 3-yr-old plantations. *R. similis* further increased its population density, and *M. incognita* declined to a point below that attained in the second year. Based on this trend, *R. similis* would be expected to become the primary problem and *M. incognita* the secondary problem in older plantations. Plants with severe root necrosis and tip-over contained more *R. similis* than *M. incognita* (Fig. 3). The reverse was true in the plants without tip-over because roots had less necrosis and therefore greater feeding sites for *M. incognita*.

Soil texture and pH. The field distribution and population density of the two nematode species differed with the various texture of soil (Fig. 4) and pH. Both species reproduced best in sandy loam soils. *M. incognita* population development was lowest in clay loam soil and that of *R. similis* was lowest in clay soil.

The effect of soil pH on *M. incognita* and *R. similis* is presented in Fig. 5. Both nematode species were detected at various levels in acidic and alkaline soils, but the numbers of both species were largest at pH 5.0–5.6. Population densities were generally reduced in extremely acidic or alkaline soil, but *R. similis* was more tolerant than *M. incognita* to extreme acidic soil.

DISCUSSION

Field distribution and population densities of *R. similis* and *M. incognita* vary significantly with cultivars, age of plantation, soil texture, and pH. Differences associated with banana cultivars may be expected since they are genetically different; Lacatan is diploid, whereas Dwarf and Giant Cavendish, Cardaba, and Saba are triploid.

Theoretically, the nematode population would be expected to continue to increase as a banana plantation becomes older; this was true with *R. similis* but not with *M. incognita*. This may be because severe infestation by *R. similis* causes necrosis of roots and *M. incognita* fails to infest and survive on these dead tissues. Thus numbers of *M. incognita* would decline in the presence of *R. similis*.

The effect of soil texture may be related to factors including particle size oxygen availability and others. Upadhyay et al (8) found that *Ditylenchus dipsaci* reproduced only in clay soils, whereas *M. hapla* preferred sandy and peat soils. Van Gundy et al (10) observed that *Tylenchulus semipenetrans* reproduced well in soil containing 10–15% clay. Townshend (7) reported that more *Pratylenchus penetrans* and *P. minyus* penetrated corn roots grown in a sandy loam than roots grown in clay or fine textured soils. O'Bannon et al (5) demonstrated that *R. similis* reproduced well on citrus in coarse soil and that *P. coffeae* was favored by fine soils. The present study confirms the preference of *R. similis* and *M. incognita* for coarse soils, especially sandy loam.

The effects of soil pH on nematode reproduction have been reported. Van Gundy and Martin (9) observed that *T. semipenetrans* on citrus increased fourfold in a neutral (pH 7.0) loam soil, compared with acid (pH 5.0) loam or acidic sandy loam. *T. semipenetrans* reproduces well in sandy clay loam at pH 6.0–6.6 (2). However, it is not clearly understood how soil pH and soil texture

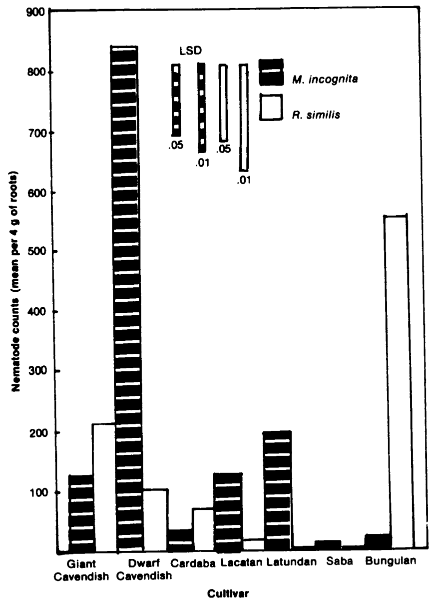

Fig. 1. Distribution and population density of *Meloidogyne incognita* and *Radopholus similis* on 10–40 samples of each banana cultivar.

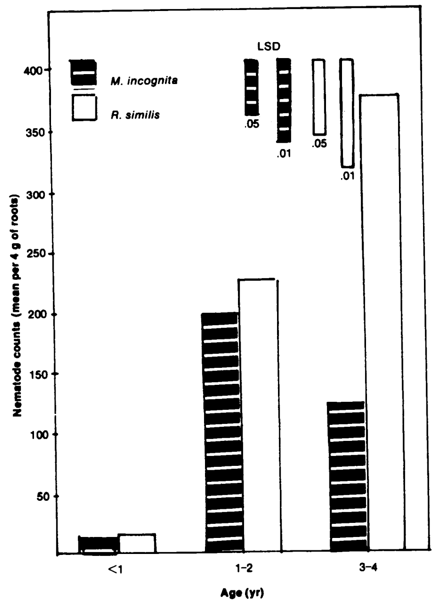

Fig. 2. Distribution and population density of *Meloidogyne incognita* and *Radopholus similis* on less than 1, 1–2, and 3–4 yr old Giant Cavendish banana plantations (20–30 samples for each age level).

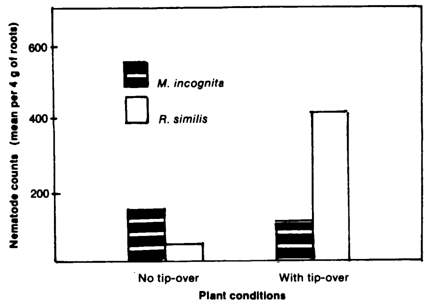

Fig. 3. *Meloidogyne incognita* and *Radopholus similis* in 40 samples of Giant Cavendish banana plants with and 40 without tip-over.

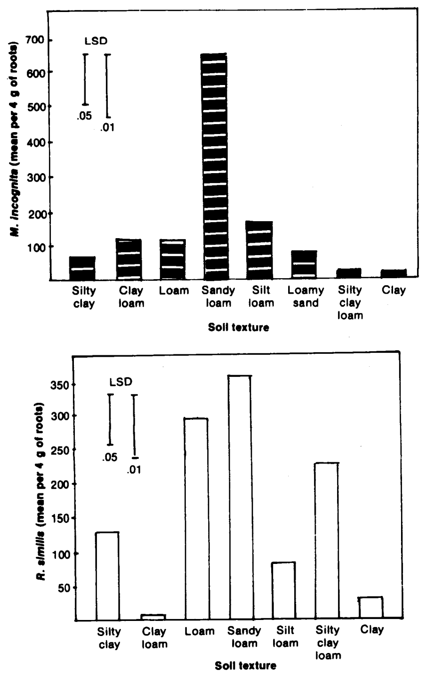

Fig. 4. Distribution and population density of *Meloidogyne incognita* (top) and *Radopholus similis* (bottom) in different soil textures (15–20 samples of each soil class).

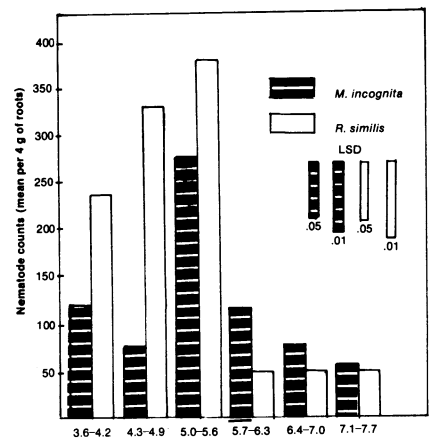

Fig. 5. Distribution and population density of *Meloidogyne incognita* and *Radopholus similis* in soils of different pH levels (15–20 samples for each level).

affect the reproduction of *R. similis* and *M. incognita* on banana.

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