Seasonal Population Dynamics of Selected Plant-Parasitic Nematodes on Four Monocultured Crops[1]

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Abstract: Seasonal fluctuations in field populations of *Meloidogyne incognita, Pratylenchus zeae, P. brachyurus, Criconemoides ornatus, Trichodorus christiei,* and *Helicotylenchus dihystera* on monocultured corn, cotton, peanut, and soybean were determined monthly for 4 yr. Population densities of *M. incognita* were greater in corn and cotton plots than in peanut and soybean plots from July until January. Those of *Pratylenchus* spp. were greater on corn and soybean than on cotton and peanut during all months except May and June. *C. ornatus* populations were greater on corn and peanut than on cotton and soybean during all months. *C. ornatus* on corn and peanut was more numerous in July than in other months. There was no significant increase in populations of *T. christiei,* except on corn in June. *H. dihystera* was greater in cotton and soybean plots than in corn and peanut plots from August through December. *Key Words: Zea mays, Arachis hypogaea, Gossypium hirsutum, Glycine max.*

Some research has been done on the seasonal fluctuations in populations of plant-parasitic nematodes associated with given crop plants (2, 5, 6, 7, 12). We are unaware of any reports on the effects of monocropping corn, cotton, peanut, and soybean on nematode population densities in the southeastern USA. Such information is needed in planning cropping systems to minimize damage to crops by nematodes. The information would also be valuable to a nematode advisory service. The present investigation was designed to study the seasonal population fluctuations of certain endo- and ectoparasitic nematodes in four monocrop systems.

MATERIALS AND METHODS

Plots were established in 1968 on Tifton sandy loam (sand 75%, silt 10%, and clay 15%, naturally infested with *Meloidogyne incognita* (Kofoid & White) Chitwood, *Pratylenchus zeae* Graham, *P. brachyurus* (Godfrey) Filip, & Sch. Stek. (ca. 90% *P. zeae* and 10% *P. brachyurus*), *Criconemoides ornatus* Raski, *Trichodorus christiei* Allen, and *Helicotylenchus dihystera* (Cobb) Sher. The land had been cultivated for more than 35 years, primarily to corn (*Zea mays* L.), peanut (*Arachis hypogaea* L.), and cotton (*Gossypium hirsutum* L.).

Our cropping systems consisted for a 4-yr monoculture of (i) corn 'Coker 71'; (ii) cotton 'Coker 201'; (iii) peanut 'Starr'; and (iv) soybean [*Glycine max* (L.) Merr. 'Hampton'].

Fertilizer (672 kg/ha 4-12-12, N-P-K) was broadcast in the spring each year. The soil was disked and turned 20-30 cm deep with a moldboard plow each spring. Dates for land preparation and planting for each year are listed in Table 1. The soil was disked after crops were harvested and remained fallow until March or April. All crops were grown on beds 12 m long, each containing two rows 71 cm apart. Each experimental plot consisted of five beds 91 cm apart. The experimental design was a randomized complete block with six replications.

Soil samples (1,000 cc) for nematode assays were taken monthly beginning May, 1968 through December, 1971, to provide information on fluctuations within a season. Soil samples consisted of 20 cores (2×20 cm), collected randomly from the root zone of plants. Soil samples were mixed thoroughly, and a 150-cc aliquant for each treatment was processed by a centrifugal-flotation method (10) to separate nematodes from the soil. Samples then were placed in calibrated dishes for counting.

RESULTS

Nematode population densities followed essentially the same pattern each year on a given crop, but levels differed among years; therefore, data are presented as the average

TABLE 1. Land preparation and planting dates for corn, cotton, peanut, and soybean.

		Planting dates			
		April			
Year	Date land prepared	Corn	Cotton	Peanut	Soybean
1968	26-27 March	1	11	26	27 May
1969	1-2 April	3	21	23	12 May
1970	7-8 April	8	21	21	1 June
1971	14-15 April	19	23	16	20 May

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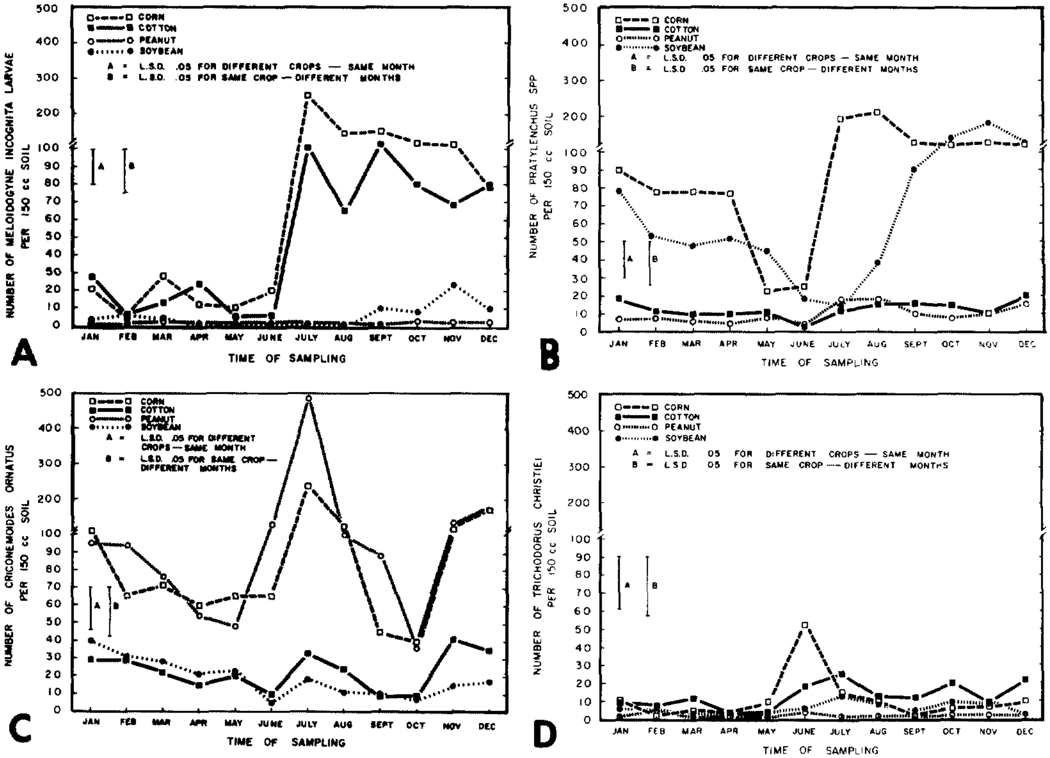

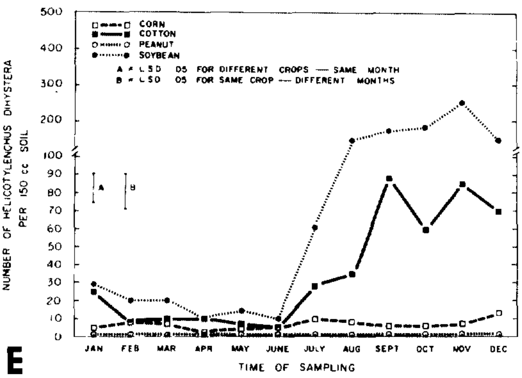

FIG. 1 (A to E). Seasonal fluctuations of two endoparasitic and three ectoparasitic nematodes on four monocultured crops, as determined at monthly intervals for 4 yr. Curves for all nematode species were obtained by plotting averages of six replicates for each month over 4 yr. **A)** *Meloidogyne incognita;* **B)** *Pratylenchus* spp. (*P. zeae* and *P. brachyurus*); **C)** *Criconemoides ornatus;* **D)** *Trichodorus christiei;* and **E)** *Helicotylenchus dihystera.*

number of nematodes per 150 cc of soil per month across all years.

Endoparasites: Corn and cotton supported significantly ($P = 0.01$) greater numbers of *Meloidogyne incognita* larvae than did peanut and soybean (Fig. 1-A). A few larvae were found in corn and cotton plots from January through June; their numbers increased significantly ($P = 0.05$) in July, declined in August, increased again in September, and then declined again in October and November. A decline in corn plots continued through December, but a slight increase occurred in cotton plots. Numbers of larvae in soybean plots remained low throughout the year, but increased significantly ($P = 0.05$) in November. No significant increase occurred on peanut.

Corn and soybean supported significantly ($P = 0.05$) greater numbers of *Pratylenchus* spp. than did cotton and peanut (Fig. 1-B). *Pratylenchus* spp. generally declined in corn and soybean plots from January until May and July, respectively. Maximum numbers were recovered from corn in August and from soybean in November. No significant changes occurred in numbers on cotton and peanut.

Ectoparasites: Corn and peanut supported significantly ($P = 0.05$) higher numbers of *C. ornatus* than did cotton and soybean (Fig. 1-C). *C. ornatus* in corn and peanut plots generally declined from January until April and May, respectively. Both crops supported the highest numbers of *C. ornatus* in July. Numbers in corn and peanut plots declined after July, reached the lowest level in October, and increased significantly ($P = 0.01$) in November. *C. ornatus* in cotton and soybean plots followed generally the same trend as in corn and peanut plots, but at lower levels.

There was no significant increase in numbers of *T. christiei,* except on corn in June (Fig. 1-D).

Population densities of *H. dihystera* in all plots were low from January until July, when densities in soybean and cotton plots increased (Fig. 1-E). Numbers of *H. dihystera* were significantly higher in soybean and cotton plots in the fall than in the spring; the highest numbers were recovered in September and November from cotton and soybean plots, respectively. There were no significant differences in densities of *H. dihystera* in corn and peanut plots.

DISCUSSION

High densities of *Meloidogyne incognita* in corn and cotton plots during the summer and fall were not surprising, because both crops are susceptible to the root-knot nematode (1, 4). The population peaks of *M. incognita* on corn and cotton generally agree with those found in similar investigations. Sasser and Nusbaum (12) found the maximum population density of *M. incognita* in November; however, since they assayed soil samples for nematode densities only in February, May, November, and March, the populations in their study could have peaked sometime between May and November, as our data indicate. The population peaks do not fully agree with those in other investigations. Barker et al. (2) found the maximum population of *Meloidogyne* spp. in February. They indicated that excessive moisture in January induced eggs of *Meloidogyne* spp. to hatch, and large numbers of larvae were detected in February.

Low numbers of *M. incognita* on peanut and soybean were expected since peanut is a poor host (9, 11, 12), and Hampton soybean has low resistance (9).

Corn and soybean were good hosts for *Pratylenchus* spp., whereas cotton and peanut were not. Maximum population densities on corn during early summer were similar to results reported by Ferris and Bernard (7) and Szczygiel (13) on other crops. Our results on soybean agree with those reported by Good (8), who found *Pratylenchus* spp. in large numbers in soil during the fall when roots of crops decomposed.

Good (8) found that *C., ornatus* increased under monoculture of peanut but decreased under monoculture of corn. In our study, *C. ornatus* increased on both crops. The seasonal fluctuations of population densities on peanut and corn were similar, but occurred earlier than those reported by Barker et al. (2). This may be related to earlier plantings in Georgia than in North Carolina.

All crops supported *T. christiei* at low levels, with the only significant increase occurring on corn in June. This supports other findings (3, 8, 9). *T. christiei* is widespread in Coastal Plain soils and is a poor competitor in polyspecific communities.

Seasonal fluctuations of *H. dihystera* do not fully agree with those in other reports. The increase in numbers during July and August was comparable to that reported by Barker et al. (2). Nematodes showed a marked decline from August until November, attributable to disking of the soil in August. Densities of *H. dihystera* in cotton and soybean plots, continued to increase after July and peaked in September and November, respectively. Soil, in our study, remained undisturbed throughout the growing season and was disked after crops were harvested in November or December.

We realize that many factors, such as climate, season, soil moisture, and cultural practices, may influence shifts in population densities of nematodes. We feel that our data can be used in planning cropping systems to manage complex communities of mixed nematode genera. Also, it should be valuable to a nematode advisory service.

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