

Dynamics of Concomitant Field Populations of *Hoplolaimus columbus* and *Meloidogyne incognita*¹

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Abstract: From the fall of 1968 through the summer of 1973, a Georgia cotton field with a lengthy history of the Cotton Stunt Disease Complex was sampled for the presence of plant parasitic nematodes. Although *Meloidogyne incognita* was recovered on all sampling dates, concomitant populations of *Hoplolaimus columbus* were not recovered until the spring of 1970. During the succeeding four growing seasons, the population density and horizontal distribution of *H. columbus* increased, and *H. columbus* replaced *M. incognita* as the predominant phytopathogenic species. A second Georgia cotton field containing concomitant populations of *H. columbus* and *M. incognita* was observed from the fall of 1971 through the summer of 1973. In this case the horizontal distribution of both species remained relatively constant and the population density of *H. columbus* increased steadily. In both locations, the presence of either *H. columbus* or *M. incognita* significantly inhibited the presence of the concomitant species. In general, however, the initial spring or final fall population densities of *H. columbus* or *M. incognita* had no significant influence on the population density of the concomitant species. The data are also discussed in relation to the biological significance of *H. columbus* in the southeastern coastal plain. *Key Words:* cotton, soybean, *Gossypium hirsutum*, *Glycine max*, evolutionary biology.

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In 1956, Krusberg and Sasser (9) reported that *Hoplolaimus galeatus* (Cobb), Thorne stunted cotton (*Gossypium hirsutum* L.) plants in North Carolina. They also observed that population densities of *Meloidogyne* spp. and *Pratylenchus* spp. were low in the presence of concomitant populations of *H. galeatus*. In 1960, *Hoplolaimus* spp. were reported as occasionally associated with poor

growth of cotton in Alabama, Georgia, North Carolina, South Carolina, and Virginia (1). *Hoplolaimus* spp. were found frequently in Louisiana and occasionally in Texas, but not associated with disease symptoms in Louisiana and Texas cotton fields.

Sher (10) reported *Hoplolaimus columbus* Sher from three soybean fields and one cotton field in South Carolina. In 1968, Fassuliotis et al. (6) found high populations of *H. columbus* associated with severe stunting of soybean [*Glycine max* (L.) Merr.] and cotton plants in nine counties in South Carolina. They also observed a lack of concomitant stylet-bearing nematode species in samples containing moderate to high populations of *H. columbus*. Smith (11) demonstrated that *H. columbus* was a pathogenic endoparasite of soybean, with a 45- to 49-day life cycle. Bird and Hogger (3) recovered *H. columbus* from roots of two species of nutsedge (*Cyperus esculentus* L. and *C. rotundus* L.) commonly associated with agronomic crop production in Georgia. In unpublished observations made between 1969 and 1973, the senior author observed *H. columbus* in several fields in Burke, Crisp, Dooly, Jefferson, and Screven Counties, Georgia. Soybean, cotton, corn (*Zea mays* L.) and rye (*Secale cereale* L.) were the most common hosts. It is generally thought that *H. columbus* is increasing in geographical distribution and becoming an increasingly severe problem in agronomic crop production in the southeastern coastal plain.

A cotton field at the Southeast Georgia Branch Experiment Station, Midville, Ga., was used for evaluation of fungicides, herbicides, or nematicides from the fall of 1968 through the summer of 1973. At the beginning of this period, the experimental site had a 10-yr history of the Cotton Stunt Disease Complex (4). *Meloidogyne incognita* (Kofoid & White) Chitwood was recovered from soil samples taken in 1968 and 1969; whereas, *H. columbus* was first recovered in 1970. During the succeeding four growing seasons, *H. columbus* became the predominant phytopathogenic nematode species. The objective of this report is to describe the dynamics of concomitant field populations of *M. incognita* and *H. columbus* during the first four growing seasons after the probable introduction of *H. columbus*.

MATERIALS AND METHODS

During the 1968 growing season, an experiment was established at the Southeast Georgia Branch Experiment Station on Marlboro sandy loam (76.2% sand, 9.0% silt, and 14.8% clay). The experiment was designed to evaluate fungicides for the control of the Cotton Stunt Disease Complex. In October, soil samples taken from each plot were processed for nematodes using a modified centrifugation-sugar flotation technique (8). The same experimental site was divided into 40 plots and used in 1969 to evaluate combinations of fungicides, herbicides, and nematicides. Soil samples from each plot were collected prior to planting (6 May 1969) and late in the growing season (Fig. 1), and processed for nematodes as described previously. In the spring of 1970, the experimental site (137.2 × 30.9 m) was permanently divided into six blocks, each containing eight plots (15.4 × 3.8 m). Each block was separated by a 9.1-m alley. Soil samples were taken from each of the 48 plots prior to planting and late in the growing season from April 1970, through March 1973 (Fig. 1). All samples were taken to a depth of 20 cm, using a 2.5-cm diam sampling tube. The samples were processed as described previously. Each initial spring sample consisted of eight cores of soil taken at random from each plot; whereas, the final late-season samples were obtained by taking four cores of soil from each of the center two rows of each plot. The plots were also sampled at monthly intervals throughout the growing season.

A second cotton field at the Southeast Georgia Branch Experiment Station used for the evaluation of pesticides (nematicide-insecticides) had concomitant populations of *M. incognita* and *H. columbus*. The field was divided into 24 permanent plots (15.4 × 7.6 m), and sampled for nematodes from the fall of 1971 through the summer of 1973 (Fig. 4). The soil sampling and nematode extraction techniques were the same as those described for the first experimental site.

RESULTS AND DISCUSSION

In the first field, *M. incognita* was recovered from a majority of the plots sampled in 1968 and 1969; however, *H. columbus* was not detected until the spring of

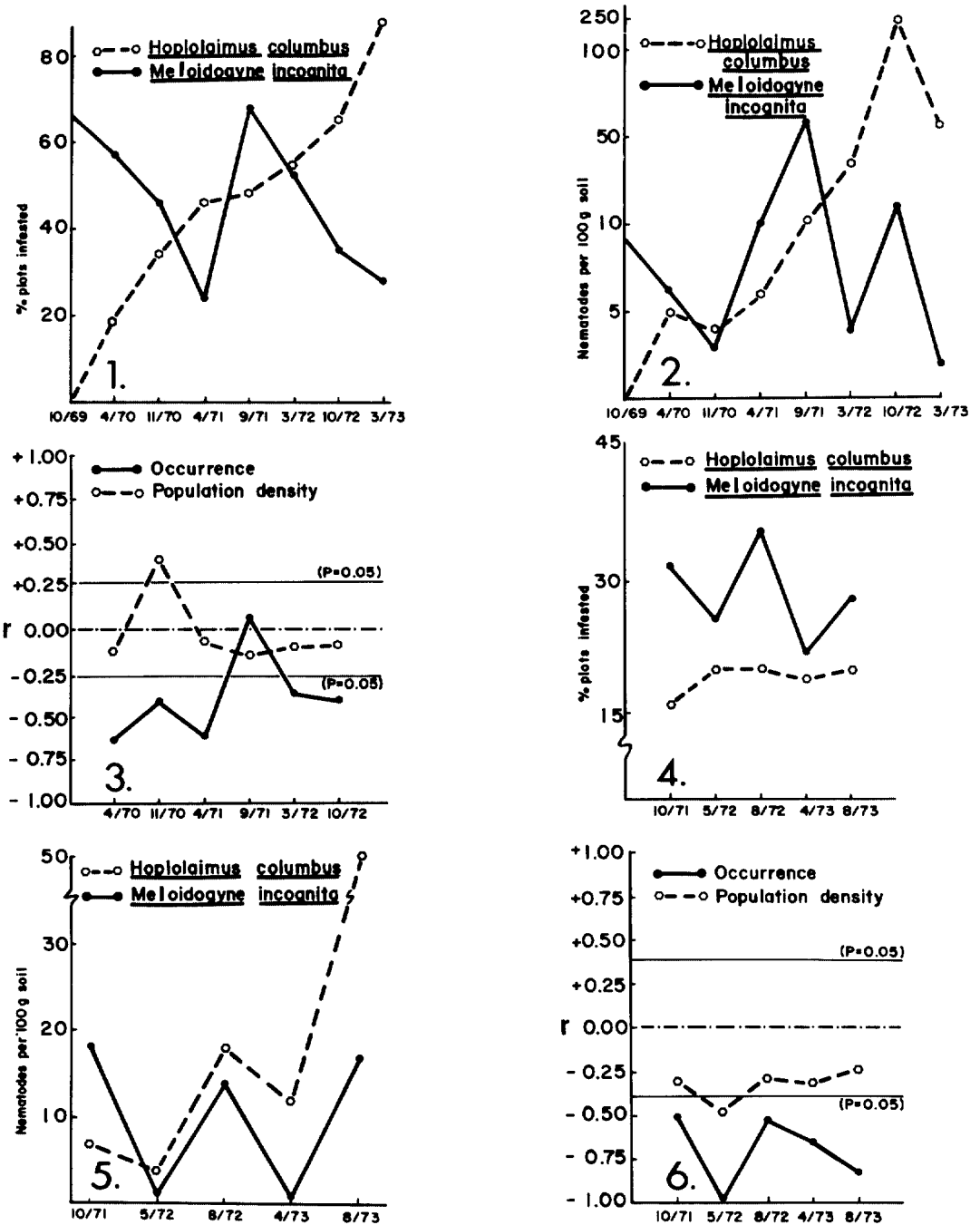


FIG. 1-6. Dynamics of concomitant nematode field populations in Georgia. 1) Horizontal distribution of *Hoplolaimus columbus* and *Meloidogyne incognita* in a cotton field (Field No. 1). 2) Population dynamics of concomitant field populations of *Hoplolaimus columbus* and *Meloidogyne incognita* associated with cotton (Field No. 1). 3) Influence of *Meloidogyne incognita* and *Hoplolaimus columbus* on the occurrence and population dynamics of the concomitant species, as indicated by simple linear correlation (Field No. 1). 4) Horizontal distribution of *Hoplolaimus columbus* and *Meloidogyne incognita* in a Georgia cotton field (Field No. 2). 5) Population dynamics of concomitant field populations of *Hoplolaimus columbus* and *Meloidogyne incognita* associated with cotton (Field No. 2). 6) Influence of *Meloidogyne incognita* and *Hoplolaimus columbus* on the occurrence and population dynamics of the concomitant species, as indicated by simple linear correlation (Field No. 2).

1970 (Fig. 1 and 2). *Pratylenchus brachyurus* (Godfrey) Filipjev and Schuurmans-Stekhoven, *Trichodorus christiei* Allen, *Criconemoides* sp., *Helicotylenchus* sp., and *Tylenchorhynchus* sp. were recovered throughout the experimental period. They had, however, either a low frequency of occurrence or low population density and were not considered to be major components of the pathological problem. Their relative population densities and horizontal distribution remained fairly constant throughout the experimental period.

Between 1970 and 1973, the number of plots infested with *H. columbus* increased continuously from 0 to 86%; whereas, the number of plots infested with *M. incognita* fluctuated between 24 and 68% (Fig. 1). The population density of *H. columbus* increased steadily through the fall of 1972 (Fig. 2). The population density of *M. incognita* fluctuated, however, and in all years except 1970, the initial spring population densities of *M. incognita* were lower than the final fall population densities (Fig. 2). During 1970, both the vegetative growth and crop yields were lower than in any of the other years. In all years, the maximum population densities of both species occurred between early August and the middle of September.

Beginning in the fall of 1970, both species frequently were recovered from the same plots; however, the negative correlation coefficients indicate that the occurrence of *H. columbus* or *M. incognita* was significantly ($P = 0.05$) inhibited by the presence of the concomitant species (Fig. 3). The increase in the population density of *H. columbus* was not significantly influenced by the concomitant species (Fig. 2 & 3), and must have been governed by other ecological factors.

From October 1971 through August 1973, the horizontal distribution of *H. columbus* and *M. incognita* in the second field remained relatively constant (Fig. 4). The population density of *H. columbus* increased steadily, with the initial spring population densities of both species always lower than those of the preceding fall (Fig. 5). With the exception of seasonal fluctuations, the population density of *M. incognita* remained relatively constant. The population density of *H. columbus* or *M. incognita* had no significant influence on the population density of the concomitant species (Fig. 6).

The presence of *H. columbus* or *M. incognita* significantly ($P = 0.05$) inhibited the occurrence of the concomitant species (Fig. 6). In general, *H. columbus* was the predominant species in the western half of the field, *M. incognita* the predominant species in the eastern half, and both species were recovered from the same plots only in the center of the field.

In most laboratory and greenhouse investigations of concomitant nematode populations, one species has had a detrimental influence on root penetration, reproduction, or equilibrium density of the concomitant species, or no effect at all (7). The present field observations indicate that *H. columbus* can satisfactorily compete with a concomitant population of *M. incognita*, and replace it as the predominant phytopathogenic species.

From the time a species is evolved until it becomes extinct, it undergoes a continuous sequence of evolutionary change based on its relative success in nature (2, 5). This is reflected, in part, by changes in population density, geographical distribution, and ability to compete with other species inhabiting the same or similar ecological niches. Data from the present investigation indicate that *H. columbus* can infest rapidly, increase in population density and increase in horizontal distribution in Marlboro sandy loam. These local phenomena support the hypothesis that *H. columbus* is increasing in geographical distribution and becoming an increasingly severe problem in agronomic crop production in the southeastern coastal plain. This would indicate that *H. columbus* is most likely a neospecies (increasingly abundant with expanding geographical distribution), and that it is beginning to acquire some of the competitive attributes of mesospecies and euspecies (2, 5).

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