Population Dynamics of Plant Nematodes in Cultivated Soil: Effect of Sod-based Rotations in Tifton sandy loam[1]

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Abstract: In an 8-year sod-based rotation study, nematode population densities varied with different row-crop sequences and grass sods. In continuous row-crop rotations (cotton-corn-peanut), cotton and corn favored rapid increase of *Belonolaimus longicaudatus* and *Trichodorus christiei.* Numbers of *Pratylenchus brachyurus* were quite variable on all crops. Peanuts favored an increase of *Criconemoides ornatum* but suppressed the other three species. 'Coastal' bermudagrass supported more than twice the number of *B. longicaudatus* than did 'Pensacola' bahiagrass. Numbers of *T. christiei* and *P. brachyurus* also were larger on bermudagrass than on bahiagrass. Numbers of *C. ornatum* were largest in row-crop sequence culture. Average numbers of *B. longicaudatus, T. christiei,* and *P. brachyurus* in a sod-based, 3-years of row-crop sequence were smallest when cotton and corn did not follow each other. These nematodes were further suppressed when the sequence corn-peanut-cotton followed bahiagrass. Numbers of *C. ornatum* were smallest when corn and cotton followed each other, except after 3 years of bahiagrass. Nematode populations were less influenced by row-crop sequence following bermudagrass than they were following bahiagrass. *Key Words:* Crop rotation, Population dynamics, *Belonolaimus, Trichodorus, Pratylenchus, Criconemoides,* Grass sod, Cotton, Corn, Peanuts, Bermudagrass, Bahiagrass.

Sods of 'Coastal' bermudagrass and 'Pensacola' bahiagrass were reported to suppress development of four important plant-parasitic nematode species, including *Pratylenchus zeae* and *Trichodorus christiei* (3). Also, it was reported *Belonolaimus longicaudatus* increased rapidly on 'Coastal' bermudagrass and to a lesser extent on bahiagrass (4). Both studies indicated bermudagrass and bahiagrass suppress some nematode species but not others. However, the increasing use of forage grasses in rotation with row crops (1, 2, 7) for physical soil improvement warranted further studies on the relation of selected grasses to plant-parasitic nematodes. Consequently, we assayed nematode populations in an established sod-based rotation to determine which grass sods and row-crop sequences were most effective in suppressing nematode populations.

MATERIALS AND METHODS

Selected cropping systems were established in 1961 in Tifton sandy loam, naturally infested with *B. longicaudatus* Rau, *P. brachyurus* (Godfrey) Filip & Sch. Stek., *T. christiei* Allen, and *C. ornatum* Raski. The land had been in cultivation for over 40 years, primarily with cotton (*Gossypium hirsutum* L.), corn (*Zea mays* L.), and peanut (*Arachis hypogaea* L.). The cropping systems were: (i) continuous row-crop sequences of corn 'Coker 71,' peanut 'Early Runner,' and cotton 'Coker 100A'; (ii) 3-year sod base of 'Coastal' bermudagrass (*Cynodon dactylon* (L) Pers.) followed by 3 years of different row-crop sequences; (iii) 3-year sod base of 'Pensacola' bahiagrass (*Paspalum notatum* Fluegge) followed by 3 years of different row-crop sequences; (iv) 3 years of row-crop sequences followed by 3 years of bermudagrass; (v) 3 years of row-crop sequences followed by 3 years of bahiagrass. The row-crop sequences

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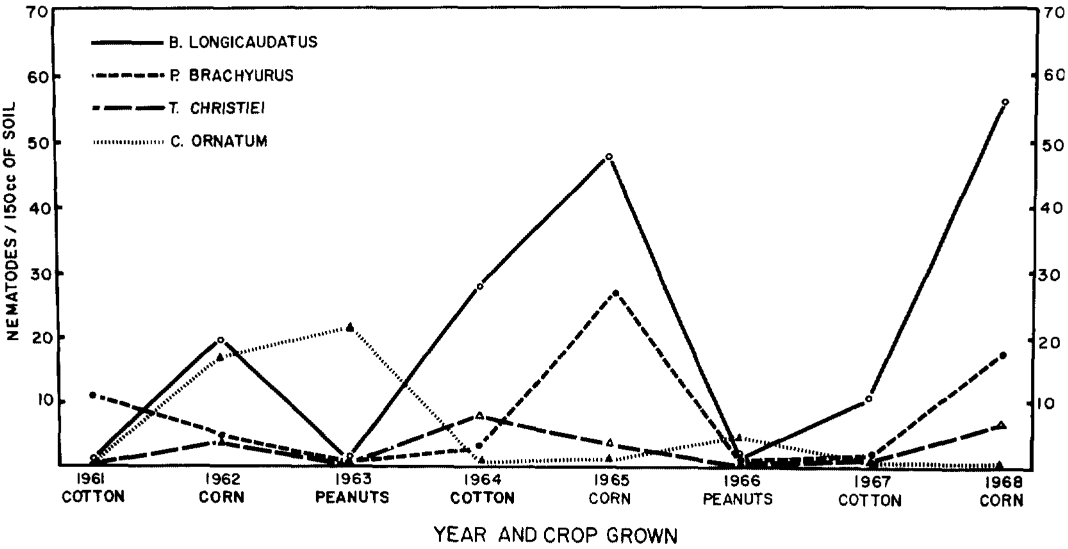

FIG. 1. Number of nematodes recovered from continuous row-crop rotation.

were: (**A**) corn-peanut-cotton; (**B**) cotton-corn-peanut, and (**C**) peanut-cotton-corn. Planting, fertilization, and cultivation were consistent with recommended farming practices of the area.

The experimental design was a split-split plot with time of sod (before or after row crops) representing whole plots (49.5 × 9.1 m), type of sod representing sub-plots (16.5 × 9.1 m), and row crop sequence representing sub-subplots (5.5 × 9.1 m). The experiment was replicated 4 times.

Soil samples (1,000 cc) for nematode assays, taken during July or August of each growing season, consisted of 20 cores (2.1 × 20 cm) randomly located within each sub-subplot. These were thoroughly mixed, and a 150 cc aliquant was wet-sieved (20 and 325-mesh) and Baermann-pan extracted for 48 hr to separate nematodes from the soil.

RESULTS

Populations of *B. longicaudatus, P. brachyurus, T. christiei*, and *C. ornatum* were uniform in the experimental area; no significant differences were detected between replications. Numbers of all nematode species increased during the first cycle of 3 years of row crops. Significant differences detected between years were attributed to moisture differences at time of sampling (data not given).

Population densities of all nematode species were influenced by different cropping systems. Under continuous row-crop sequences (control), *B. longicaudatus, P. brachyurus*, and *T. christiei* increased most rapidly on corn and cotton but practically none on peanut (Fig. 1). These species were suppressed by peanut to below detectable levels in some cases. Numbers of *C. ornatum* were largest on peanuts, and after 1963 their number was extremely small on corn and not detected on cotton.

Kind of sod markedly influenced nematode populations, particularly *B. longicaudatus*. Numbers of *B. longicaudatus* recovered from bermudagrass were more than twice those recovered from bahiagrass and

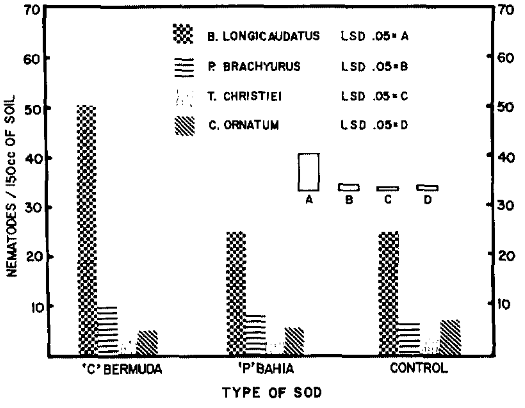

FIG. 2. Average number of nematodes recovered from different grass sods and from continuous row-crop rotations (control).

crop-sequence controls (Fig. 2). Numbers of *P. brachyurus* were significantly greater on bermudagrass than on bahiagrass but differences were relatively small. *T. christiei* and *C. ornatum* was favored slightly by continuous row-crop sequences (control). Bermudagrass and bahiagrass were equally favorable for increase of *T. christiei* and *C. ornatum.*

An interaction between row-crop sequence and type of sod was evident, depending upon the crop sequence following 3 years of sod. Nematode population increase was least favored by *Sequence* **A** (corn-peanut-cotton) following bahiagrass than following bermudagrass, or in the continuous crop-sequence control (Fig. 3). *Sequence* **B** (cotton-corn-peanut) favored *B. longicaudatus* increase in the control plots but was much less favorable following the sod bases. *Sequence* **C** (peanut-cotton-corn) in control plots and following bermudagrass was equally favorable for *B. longicaudatus*, but was much less favorable for *B. longicaudatus* when following bahiagrass. Increase of *P. brachyurus* was greatest in *Sequences* **A** and **B** following the sod bases; however, populations were larger following bermudagrass than following bahiagrass. *T. christiei* was not significantly influenced by crop sequence regardless of sod-base, but numbers

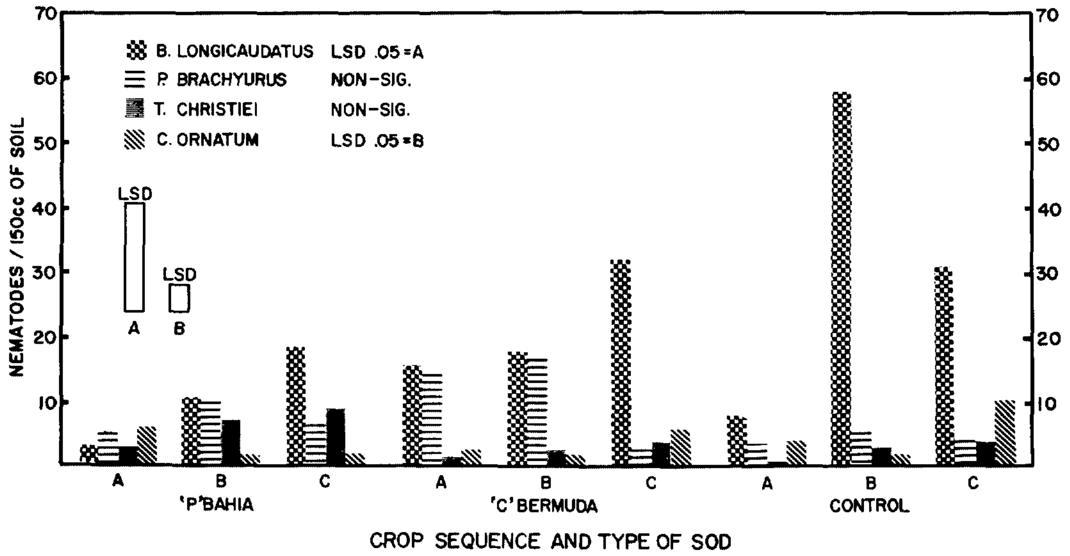

FIG. 3. Average (3 yr) number of nematodes recovered from different row-crop sequences following 3 yr of different grass sods: **A.** corn-peanut-cotton; **B.** cotton-corn-peanut; **C.** peanut-cotton-corn.

recovered were slightly larger following bahiagrass. Crop sequence following sod bases had no influence on *C. ornatum*. Largest numbers of *C. ornatum* were recovered from *Sequence* C in the row-crop sequence control.

DISCUSSION

Our data confirm and extend previously reported results (4). In addition to determining the suitability of certain crop plants as host of *B. longicaudatus*, we have established the sequence in which these crops should be grown in the Tifton, Georgia area for greatest effectiveness in minimizing nematode population increases. Corn and cotton should not follow each other in soil infested with *B. longicaudatus*. If grasses are used in rotation with row crops, particular attention should be given to the plant-parasitic nematode fauna. 'Coastal' bermudagrass is a poor choice for use in soil infested with *B. longicaudatus*. However, if only *P. brachyurus* or *T. christiei* are present, bermudagrass would effectively minimize population increases. In both cases, 'Pensacola' bahiagrass is better for minimizing population increases. However, the susceptibility of bahiagrass to *Meloidogyne* spp. (6) suggests caution in its use in the southeastern United States.

The inability of the Georgia population of *B. longicaudatus* to increase on peanut has been previously documented (4). The cytologic relationship of this population of *B. longicaudatus* to populations in the Carolinas and Virginia is not known. However, differences in their ability to parasitize peanut strongly indicates existence of pathotypes within this species (4).

P. brachyurus is known to parasitize peanut (4). In our test, only small numbers of this nematode were recovered from soil bearing peanut. Since *P. brachyurus* infects pegs and pods of peanut and when peanuts are properly harvested, pegs and pods containing *Pratylenchus* spp. are removed from the field (5), soil samples probably are not indicative of the development of this nematode on peanuts. Mist chamber extraction of peg and pod samples might have measured *P. brachyurus* more accurately, but these were not assayed.

Available yield data indicate that yields of row crops involved in this study are influenced by nematodes, particularly by *B. longicaudatus*. Larger yields were obtained following bahiagrass than following bermudagrass. Yields of all cultivated crops were larger when cropping *Sequence* A followed bahiagrass.

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