

# Population Dynamics of Plant-parasitic Nematodes on Cover Crops of Corn and Sorghum<sup>1</sup>

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**Abstract:** Buildup of plant-parasitic nematode populations on corn (*Zea mays*), soybean (*Glycine max*), and sorghum (*Sorghum bicolor*) were compared in 1991 and 1992. Final population densities (Pf) of *Meloidogyne incognita* were lower following sorghum than after soybean in both seasons, and Pf after sorghum was lower than Pf after corn in 1992. In both seasons, Pf differed among the sorghum cultivars used. No differences in Pf on corn, sorghum, and soybean were observed for *Criconebella* spp. (a mixture of *C. sphaerocephala* and *C. ornata*) or *Paratrichodorus minor* in either season. Pf levels of *Pratylenchus* spp. (a mixture of *P. brachyurus* and *P. scribneri*) were greatest after corn in 1992, but no differences with crop treatments were observed in 1991. When data from field tests conducted with corn and sorghum during the past four seasons were pooled, negative linear relationships between  $\ln(\text{Pf}/\text{Pi})$  and  $\ln(\text{Pi})$  were observed for *Criconebella* spp. and *P. minor* on each crop, and for *M. incognita* on corn ( $\text{Pi}$  = initial population density). Although  $\ln(\text{Pf}/\text{Pi})$  and  $\ln(\text{Pi})$  were not related for *M. incognita* with pooled sorghum data, separate relationships were derived for various sorghum cultivars. Regression equations from pooled data were used to obtain estimates of equilibrium density and maximum reproductive rate, and these estimates were used to construct models expressing nematode Pf across a range of initial densities. Many of these models were robust, encompassing a range of sites, season, crop cultivars, and planting dates. Quadratic models derived from pooled field data provided an alternative method for expressing Pf as a function of Pi.

**Key words:** corn, *Criconebella ornata*, *Criconebella sphaerocephala*, cropping system, equilibrium density, *Glycine max*, *Meloidogyne incognita*, nematode, *Paratrichodorus minor*, population dynamics, *Pratylenchus brachyurus*, *Pratylenchus scribneri*, sorghum, *Sorghum bicolor*, soybean, *Zea mays*.

The choice of appropriate rotation crops is important for minimizing buildup of plant-parasitic nematodes in cropping systems in the southeastern United States (6,9,13,14). In north Florida, a number of summer crops are available for use in rotation systems (9-11). Corn (*Zea mays* L.) and sorghum (*Sorghum bicolor* (L.) Moench) are recommended, particularly when a convenient source of forage or silage for animal feed is desired (4,10).

In Florida and Alabama, corn rotations have been ineffective in reducing population levels of root-knot nematodes. Sorghum reduced population densities of *Meloidogyne arenaria* (Neal) Chitwood, although populations recovered after a susceptible crop such as peanut (*Arachis hypogaea* L.) or soybean (*Glycine max* (L.)

Merr.) was grown (15,16). In north Florida, sorghum cover crops were reported to be effective in reducing densities of *M. incognita* (Kofoid & White) Chitwood (4,9, 10). However, during 1991 a series of experiments were conducted in which *M. incognita* increased on the sorghum cultivar used (11).

The primary objective of our present study was to provide additional data comparing the population dynamics of plant-parasitic nematodes on summer cover crops of corn, sorghum, and soybean. Sorghum cultivars that previously supported high (11) or low (4,10) population densities of *M. incognita* were included in the same study. Additional objectives were to summarize recent data (4,10,11) on nematode population dynamics on corn and sorghum in north Florida and to determine patterns in population increase on these crops across a variety of conditions.

## MATERIALS AND METHODS

**Field tests:** Field experiments were carried out at the University of Florida Green Acres Agronomy Research Farm in Ala-

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chua County, on an Arredondo sand (94% sand, 3.5% silt, 2.5% clay; pH 6.7; 2.0% organic matter). Following a winter cover crop of rye (*Secale cereale* L. cv. Wrens Abruzzi), a summer-crop rotation experiment was established in a randomized complete block design, with five summer crop treatments and five replications. Treatments consisted of the tropical corn hybrid Pioneer X304C harvested for grain, Pioneer X304C used as silage, forage sorghum DeKalb FS25E, grain sorghum Asgrow Chaparral, and Howard soybean. The experiment was carried out in each of three seasons. Data from 1990 have been presented previously (4), and results from 1991 and 1992 are reported herein.

Plots were planted on 14 May 1991 and 1 June 1992 with an in-row subsoil minimum-tillage planter. Individual plots (15 m<sup>2</sup>) consisted of four rows 5 m long and spaced 75 cm apart. Corn was planted at 80,000 seeds/ha, sorghum at 250,000 seeds/ha, and soybean at 515,000 seeds/ha. Fertilizer applications and management of insects and weeds were as described previously (4). Overhead irrigation was applied as needed.

Plots were sampled for initial (Pi) nematode population densities on 14 May 1991 and 1 June 1992 and for final (Pf) numbers on 30 September 1991 and 21 September 1992. Each soil sample consisted of six composited cores 2.5 cm d × 20 cm deep per plot collected within plant rows in a systematic pattern. From each composited sample, a 100-cm<sup>3</sup> subsample was removed for nematode extraction, using a modified sieving and centrifugation procedure (5). Nematode count data were log-transformed (log<sub>10</sub>[x + 1]) before analysis of variance, and single degree of freedom orthogonal contrasts (3,19) were determined for corn vs. soybean, sorghum vs. soybean, and corn vs. sorghum. All data reported are untransformed means, and all differences, correlation coefficients, and r<sup>2</sup> values reported in the text were significant at P < 0.10.

*Pooled data from field tests:* Mean nema-

tode population densities on corn and sorghum cultivars from field tests (4,10,11) conducted in Alachua and Marion counties during the past 4 years (including present data) were pooled. Methodology varied among these studies, but in all cases, data consisted of mean Pi and Pf of *M. incognita*, *Paratrichodorus minor* (Colbran) Siddiqi, *Criconemella* spp., and *Pratylenchus* spp. on each sorghum and corn cultivar at each site. The 36 data sets for corn encompassed various cultivars: Pioneer X304C, Pioneer 3320, Pioneer 3098, Florida SYN-1, and Northrup King 508. Of the 20 sorghum data sets, 9 consisted of Asgrow Chaparral, and the remaining 11 consisted of DeKalb FS25E, DeKalb BR64, or DeKalb SX-17. At all locations, soils consisted of 90–94% sand, with <3% organic matter. Planting dates for crops ranged from 17 April to 18 July, and harvest dates ranged from 18 July to 24 October. The time between collection of initial (Pi) and final (Pf) samples ranged from 78 to 139 days. Ferris (1,2) has demonstrated that the relationship between ln(Pf/Pi) and ln(Pi) may be linear across a range of sites. Therefore, linear regression equations were derived relating ln(Pf/Pi) to ln(Pi) for each of the four nematode genera across the 36 corn entries and across the 20 sorghum points.

For nematode and crop combinations from which linear regression equations were derived, estimates of the maximum rate of reproduction (*a*) and equilibrium density (*E*) were obtained (1,2,17). From the regression equation ln(Pf/Pi) = ln(*c*) - *b* ln(Pi), the equilibrium density can be calculated (2) from ln(*E*) = [ln(*c*)]/*b*. The value of *a* was estimated as the regression equation prediction for the lowest Pi observed in the data set (1). Estimates of *E* and *a* were then substituted into the equation derived by Seinhorst (17),

$$Pf = \frac{a \cdot E \cdot Pi}{(a - 1)Pi + E}$$

to obtain theoretical models relating Pf and Pi for specific nematodes and crops.

RESULTS

*Green Acres Agronomy Research Farm, 1991*: Population densities of *Criconebella* spp. (a species mixture dominated by *C. sphaerocephala* (Taylor) Luc & Raski, with <20% *C. ornata* (Raski) Luc & Raski) were greater in soybean plots than in corn plots initially, but final numbers showed no differences from the cropping treatments (Table 1). Final population densities of *M. incognita* were greater on soybean than on the other two crops (Table 1). The Pf for *M. incognita* across all corn plots did not differ from the Pf across all sorghum plots. However, Pf in the forage sorghum plots with DeKalb FS25E was lower than Pf across corn plots, whereas Pf following Asgrow Chaparral sorghum did not differ from Pf in corn plots. The contrast in Pf among the two sorghum cultivars was significant. No differences were found in Pi or Pf among treatments for *P. minor*, *Pratylenchus* spp., or *Xiphinema* spp. (Table 1).

*Green Acres Agronomy Research Farm, 1992*: No differences among crop treatments were observed among initial or final population densities of *Criconebella* spp. or *P. minor* (Table 2). Pf for *M. incognita* was lower on sorghum than on either of the other two crops (Table 2). Among sorghums, Pf following DeKalb FS25E was lower than Pf following Asgrow Chaparral. Numbers of *Pratylenchus* spp. (a fairly equal mixture of *P. brachyurus* (Godfrey) Filipjev & Schuurmans Stekhoven and *P. scribneri* Steiner) were initially greater in the corn plots and remained so throughout the season (Table 2). *Xiphinema* spp. increased from very low levels to higher Pf on sorghum than on corn (Table 2).

*Pooled data from field tests*: On corn a strong negative relationship existed between the rate of population increase and initial density of *M. incognita* (Fig. 1A). Linear relationships were also observed for *Criconebella* spp. and for *P. minor* on corn (Table 3). The relationship between  $\ln(\text{Pf}/\text{Pi})$  and  $\ln(\text{Pi})$  was much weaker for *Pratylenchus* spp., with  $r^2 = -0.129$  (Table 3).

When all sorghum data were pooled, a

TABLE 1. Initial (Pi) and final (Pf) nematode population densities on corn, sorghum, and soybean crops at the Green Acres Agronomy Research Farm, 1991.

Crop	Cultivar	Nematodes/100 cm <sup>3</sup> soil														
		Criconebella spp.			Meloidogyne incognita			Paratrichodorus minor			Pratylenchus spp.			Xiphinema spp.		
		Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS
Corn (silage)	Pioneer X304C	3	102	6	273	46	38	32	368	0	11					
Corn (grain)	Pioneer X304C	56	152	5	144	38	20	24	59	0	6					
Sorghum (forage)	DeKalb FS25E	26	202	15	35	40	56	15	140	4	17					
Sorghum (grain)	Asgrow Chaparral	53	327	3	122	49	69	31	60	0	15					
Soybean	Howard	113	89	22	678	36	22	49	100	1	6					
Contrasts:																
Corn vs. soybean		**	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sorghum vs. soybean		NS	NS	NS	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Corn vs. sorghum		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Data are means of five replications. \*, \*\* indicate single degree of freedom orthogonal contrasts significant at  $P \leq 0.05$  and  $P \leq 0.01$ , respectively; NS = contrast not significant at  $P \leq 0.10$ .

TABLE 2. Initial (Pi) and final (Pf) nematode population densities on corn, sorghum, and soybean crops at the Green Acres Agronomy Research Farm, 1992.

Crop	Cultivar	Nematodes/100 cm <sup>3</sup> soil														
		Criconemella spp.			Meloiodgyne incognita			Paratrichodorus minor			Pratylenchus spp.			Xiphinema spp.		
		Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS	Pi	Pf	NS
Corn (silage)	Pioneer X304C	95	737	NS	19	1,043	NS	82	134	NS	135	805	NS	1	11	@
Corn (grain)	Pioneer X304C	129	1,386	NS	23	916	NS	60	17	NS	31	362	NS	1	4	NS
Sorghum (forage)	DeKalb FS25E	118	378	NS	11	71	NS	56	40	NS	34	96	NS	0	46	NS
Sorghum (grain)	Asgrow Chaparral	162	509	NS	42	219	NS	86	56	NS	24	78	NS	1	29	NS
Soybean	Howard	123	164	NS	30	765	NS	52	23	NS	15	79	NS	1	18	**
Contrasts:																
Corn vs. soybean		NS	NS	NS	NS	NS	NS	NS	NS	NS	**	**	NS	NS	@	NS
Sorghum vs. soybean		NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Corn vs. sorghum		NS	NS	NS	NS	***	NS	NS	NS	NS	@	**	**	NS	**	**

Data are means of five replications. @, \*, \*\*, \*\*\* indicate single degree of freedom orthogonal contrasts significant at  $P \leq 0.10$ ,  $P \leq 0.05$ ,  $P \leq 0.01$ , and  $P \leq 0.001$ , respectively; NS = contrast not significant at  $P \leq 0.10$ .

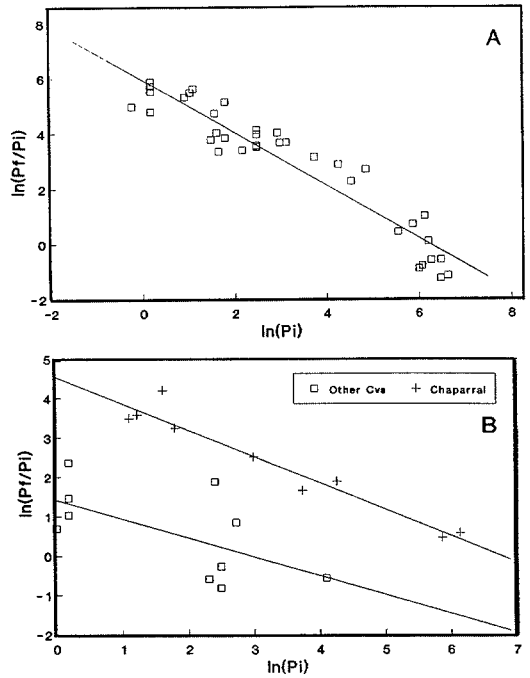


FIG. 1. Regressions between  $\ln(Pf/Pi)$  and  $\ln(Pi)$  for *Meloidogyne incognita* from field tests in north Florida, 1989–1992. A) Corn. Equation for regression line:  $\ln(Pf/Pi) = 5.95 - 0.956 \ln(Pi)$ ,  $r^2 = 0.901$ . B) Sorghum. Equations for regression lines:  $\ln(Pf/Pi) = 4.53 - 0.669 \ln(Pi)$ , with  $r^2 = 0.937$  for Asgrow Chaparral;  $\ln(Pf/Pi) = 1.42 - 0.480 \ln(Pi)$ , with  $r^2 = 0.381$  for other cultivars.

relationship between  $\ln(Pf/Pi)$  and  $\ln(Pi)$  was not evident for *M. incognita* (Table 3, Fig. 1B). However, when data for Asgrow Chaparral and for other cultivars were analyzed separately, negative relationships were evident for both groups of data (Fig. 1B, Table 3). Inverse linear relationships were obtained for both *Criconemella* spp. and *P. minor* across all sorghum sets, but not for *Pratylenchus* spp. (Table 3).

Estimates of *a* and *E* were obtained by calculation from regression equation data for *M. incognita*, *P. minor*, and *Criconemella* spp. on corn and sorghum (Table 4). An estimate of *a* could also be obtained by inspection of the data, but this was quite subjective. In examining our data and ranking in order of *Pi*, it was apparent that for the lowest *Pi* values, *Pf/Pi* was much higher than the other values of *Pf/Pi* in the data set. An average of these exceptionally high

TABLE 3. Regression coefficients for equations relating  $\ln(\text{Pf}/\text{Pi})$  to  $\ln(\text{Pi})$  for four nematodes on corn and sorghum.

Nematode	Regression coefficients†					
	Corn‡			Sorghum§		
	$\ln(c)$	$b$	$r^2$	$\ln(c)$	$b$	$r^2$
<i>Meloidogyne incognita</i>	5.95	0.956	0.901**	—	—	0.110 ns
<i>Criconemella</i> spp.	3.84	0.536	0.859**	4.93	0.722	0.880**
<i>Paratrichodorus minor</i>	3.08	1.000	0.844**	3.57	1.091	0.752**
<i>Pratylenchus</i> spp.	3.19	0.321	0.129*	—	—	0.119 ns
<i>M. incognita</i>						
Asgrow Chaparral sorghum only				4.53	0.669	0.937**
Other sorghum cultivars only				1.42	0.480	0.381*

\*, \*\* indicate  $r^2$  significant at  $P \leq 0.05$  and  $P \leq 0.01$ , respectively; ns = not significant at  $P \leq 0.05$  (coefficients not given).

† Regression coefficients for equations of the form  $\ln(\text{Pf}/\text{Pi}) = \ln(c) - b \cdot \ln(\text{Pi})$ .

‡ Regression equations for corn based on 36 points.

§ Regression equations for sorghum based on 20 points—9 for Asgrow Chaparral and 11 for other cultivars.

Pf/Pi values could give an estimate of  $a$ . For example, for *P. minor* on corn, the lowest values of Pi were 0.2, 0.2, and 0.5 *P. minor* per 100 cm<sup>3</sup> soil, and the Pf/Pi corresponding to these were 108, 242, and 67, respectively. For all other points in the data file for *P. minor* on corn,  $\text{Pi} \geq 1.0$  and  $\text{Pf}/\text{Pi} \leq 43$ . Therefore, an estimate of  $a$  was made by averaging the Pf/Pi for the three lowest population densities, giving a value of  $a \approx 139$ . Similar rationale was used to obtain estimates of  $a$  for other cases as well (Table 4). Some values were close to values of  $a$  estimated by calculation from regression equations (e.g., for *Criconemella* spp. on sorghum) but others were not (e.g., for *M. incognita* on Asgrow Chaparral sorghum).

When calculated estimates of  $a$  and  $E$  were substituted into the equation  $\text{Pf} = a \cdot E \cdot \text{Pi} / [(a - 1)\text{Pi} + E]^{-1}$ , values of Pf predicted by the model were correlated ( $r = 0.343$ ) with the actual Pf values measured for *M. incognita* on corn (Fig. 2A). The correlation between actual and predicted values of Pf for *M. incognita* was stronger on Asgrow Chaparral ( $r = 0.910$ ) than on the other sorghum cultivars ( $r = 0.510$ ) (Fig. 2B). Measured Pf of *Criconemella* spp. correlated with Pf values predicted by the model (Fig. 3A) on both corn ( $r = 0.590$ ) and sorghum ( $r = 0.459$ ), but actual and predicted Pf values for *P. minor* were not correlated on either crop (Fig. 3B).

TABLE 4. Estimates of  $E$ , equilibrium density, and  $a$ , maximum multiplication rate, for various nematodes on corn and sorghum, based on pooled data from field tests in Florida, 1989–1992.

Crop†	Nematode	$E \ddagger$	Lowest Pi	$a$	$a$
			from data (Nemas/100 cm <sup>3</sup> )	(calculated)§	(inspection)¶
Corn	<i>Meloidogyne incognita</i>	505	0.8	475	213
Sorghum (Chaparral)	<i>M. incognita</i>	872	3.0	12	45
Sorghum (Other cvs.)	<i>M. incognita</i>	19	1.2	3.8	5.9
Corn	<i>Criconemella</i> spp.	1,292	0.2	110	68
Sorghum	<i>Criconemella</i> spp.	924	0.6	200	248
Corn	<i>Paratrichodorus minor</i>	22	0.2	109	139
Sorghum	<i>P. minor</i>	26	1.0	36	52

† Crop data pooled across all corn or sorghum cultivars, except as noted.

‡ Calculated from  $\ln(E) = [\ln(c)]/b$ , with estimates of  $b$  and  $c$  obtained from regression equations in Table 3.

§ Calculated as the value of Pf/Pi obtained by substituting the lowest value of Pi from the data file into the appropriate regression equation from Table 3.

¶ Estimated by inspection of data.

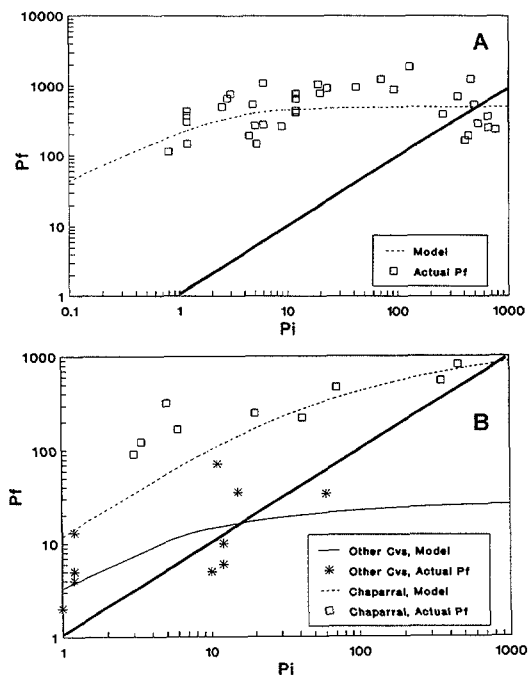


FIG. 2. Relationships between Pf and Pi (log scale) for *Meloidogyne incognita*, Calculated from Seinhorst's (18) model  $Pf = a \cdot E \cdot Pi[(a - 1)Pi + E]^{-1}$ , compared to actual Pf data. The bold line indicates the maintenance line where Pf = Pi. A) Corn. B) Sorghum.

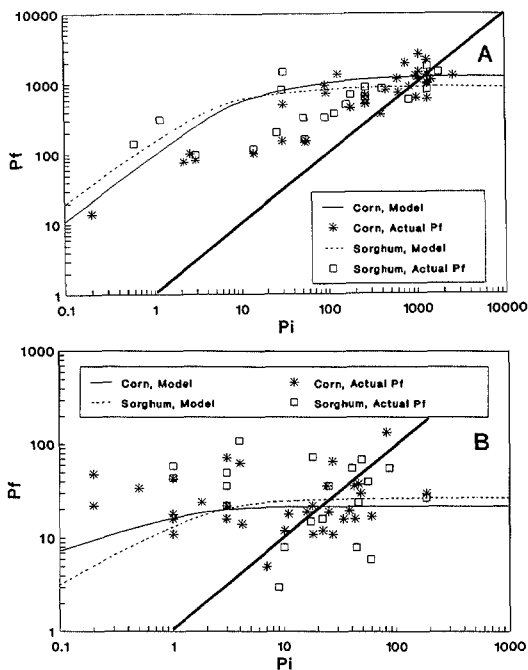


FIG. 3. Relationships between Pf and Pi (log scale) for plant-parasitic nematodes on corn and sorghum, calculated from Seinhorst's (18) model  $Pf = a \cdot E \cdot Pi[(a - 1)Pi + E]^{-1}$ , compared to actual Pf data. The bold line indicates the maintenance line where Pf = Pi. (A) *Criconemella* spp. on corn and sorghum. B) *Paratrichodorus minor* on corn and sorghum.

DISCUSSION

Final population densities of *M. incognita* were lower following DeKalb FS25E than following Asgrow Chaparral in both years when these sorghum cultivars were included in the same tests. Lower Pf of *M. incognita* following DeKalb FS25E were consistent with previous tests (4,10) involving this cultivar, whereas the high Pf values reported following Asgrow Chaparral in a previous test (11) were likely due to cultivar choice.

Considerable data now exist on nematode population increases on corn and sorghum in north Florida (4,10,11). General relationships between  $\ln(Pf/Pi)$  and  $\ln(Pi)$  were evident for several nematodes on corn and sorghum (Table 3), similar to that reported for *M. incognita* from tomato (*Lycopersicon esculentum* Mill.) across a number of locations in California (1). For *M. incognita* on corn in Florida (Fig. 1A, Table 3), the relationship between rate of popu-

lation increase and Pi was robust, because data from a range of sites, seasons, cultivars, and planting dates were included. Although the data for corn encompassed five different cultivars, all points were represented by the same regression equation. Strong linear relationships between  $\ln(Pf/Pi)$  and  $\ln(Pi)$  were also apparent for *P. minor* and for *Criconemella* spp. on corn and on sorghum (Table 3), even though ring nematode populations contained mixtures of two species, *C. sphaerocephala* and *C. ornata* (4,10,11).

Although linear regressions of  $\ln(Pf/Pi)$  on  $\ln(Pi)$  may be easily derived from field data, such relationships may be of limited value for predictive purposes. Because Pi occurs on both sides of the regression equation, it follows that the associated  $r^2$  values may be artificially high. Therefore, the main utility of such regressions may be to provide methodology for estimating a

and  $E$  values for use in Seinhorst's (17) model. Seinhorst's model has been validated in pot tests for a variety of nematodes and hosts (17), and the data presented here for corn and sorghum and data from California for *M. incognita* on tomato (1) suggest that the model is applicable across field sites with a range of  $P_i$ . Unfortunately, Seinhorst's model (17) is difficult to derive empirically from field data because of difficulty in estimating  $E$  and particularly  $a$ . The difficulty in estimating  $a$  is particularly evident and likely accounts for deviations of Seinhorst's (17) model from the field data at low  $P_i$  for *M. incognita* on Asgrow Chaparral sorghum (Fig. 2B) and for *Criconebella* spp. on corn (Fig. 3A). The regression of  $\ln(P_f/P_i)$  on  $\ln(P_i)$  provides a quantitative alternative to visual inspection for estimating the parameters of Seinhorst's (18) model.

Future research may reveal other models that may be useful in expressing the relationship between  $P_f$  and  $P_i$  over a range of population densities. For example, quadratic equations could be obtained relating  $\ln(P_f)$  and  $\ln(P_i)$  for *M. incognita* ( $R^2 = 0.315$ ) and *Criconebella* spp. ( $R^2 = 0.826$ ) on corn (Fig. 4). For *Criconebella* spp. (Fig. 4B), all points lie on the increasing portion of the quadratic curve, which is approximately linear over the range of the data. This model is less realistic than one that predicts levelling off at an equilibrium density. However, when high nematode population densities limit the food source and result in  $P_f$  less than  $E$ , the quadratic function may provide a very suitable representation of biological reality. Such may be the case for *M. incognita* on corn, on which a decline in  $P_f$  below  $E$  was observed at high ( $>500$ ) values of  $P_i$  (Fig. 4A). Seinhorst (18) recognized this effect of host damage on nematode numbers and postulated alternative models that are somewhat similar in shape to quadratic models.

Despite difficulties in estimating parameters, Seinhorst's original (17) model involving  $a$  and  $E$  has proven very useful in realistically characterizing host-parasite relationships, because it considers nema-

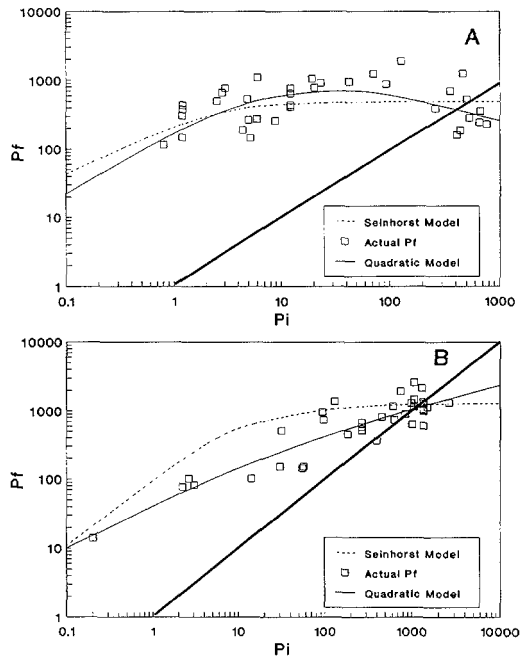


FIG. 4. Comparisons of Seinhorst's models and quadratic models with actual  $P_f$  data for plant-parasitic nematodes on corn. A) *Meloidogyne incognita*. Quadratic equation:  $\ln(P_f) = 0.724 \ln(P_i) - 0.0987 [\ln(P_i)]^2 + 5.285$ ,  $R^2 = 0.315$ . B) *Criconebella* spp. Quadratic equation:  $\ln(P_f) = 0.580 \ln(P_i) - 0.0153 [\ln(P_i)]^2 + 3.733$ ,  $R^2 = 0.826$ .

tode reproduction over a range of initial densities (18). The corn cultivars included in our study were good hosts of *M. incognita* across much of the range of  $P_i$  commonly encountered in fields in north Florida (Fig. 2A). The sorghum cultivar Asgrow Chaparral was also a very good host (Fig. 2B). The other sorghum cultivars (data pooled for DeKalb FS25E, DeKalb BR64, and DeKalb SX-17) could be considered poor hosts (18), because even though some population increase was predicted at low densities ( $<15$  nematodes per  $100 \text{ cm}^3$ ),  $E$  is low, and for most of the density range, a decline to equilibrium densities of  $<20$  nematodes per  $100 \text{ cm}^3$  is predicted (Fig. 2B). Sorghum and corn were both good hosts of *Criconebella* spp., with great increases predicted from initial densities ranging up to 900 *Criconebella* per  $100 \text{ cm}^3$  (Fig. 3A). The calculated curves for *P. minor* on both corn and sorghum were nearly flat and did not provide

a significant fit to the field data (Fig. 3B). On both of these crops, *P. minor* had a tendency to attain a Pf near an equilibrium density of 20–30 *P. minor* per 100 cm<sup>3</sup>, almost regardless of the magnitude of Pi. This result is consistent with recent field observations on five crops (11), on which *P. minor* Pf ranged from 12–36 nematodes/100 cm<sup>3</sup> soil in 30 of 42 cases, resulting in no differences in *P. minor* Pf among crops at six of seven sites.

Relationships such as those developed from Seinhorst's (17) model (Figs. 2,3) are useful in estimating nematode buildup on specific crops and should be helpful in the design of cropping systems (6,9,12). Previous models of nematode buildup on agronomic crops in north Florida fields were primarily linear in form (7,8), probably because they encompassed only a limited range of Pi. Only in a few instances on soybean was there any evidence for restricted growth rates or levelling off at an equilibrium density (8). The present models not only provide a more realistic impression of nematode dynamics over a range of population densities, but they also correspond better with theoretical concepts (17,18) of nematode population growth. Fortunately, existing data on corn and sorghum were adequate to permit recognition of such patterns in cultivated fields in north Florida. However, much additional data will be needed to determine similar relationships for nematodes on soybean and other important agronomic and cover crops in this and other regions.

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