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Determining Consistency of Spatial Dispersion of Nematodes in Small Plots[1]

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Abstract: Nematode population densities in field plots were estimated by collecting samples consisting of 12 soil cores. Plots encompassed a variety of plant hosts and sampling dates, and provided data on the population densities of seven species of plant-parasitic nematodes. Three separate samples were collected per plot on each sampling date to obtain estimates of the mean and variance of numbers for each species. For each nematode species, these estimates were used to derive the Taylor's Power Law regression over plots having identical hosts and sampling dates. For some nematode species, comparisons of regression equations among different sampling dates on the same host revealed similarities in values of a and b from Taylor's Power Law. Parameters of Taylor's Power Law relationships were used to develop sampling plans and to obtain estimates of sample precision. Precision estimates from specific and general sampling plans are illustrated for *Belonolaimus longicaudatus*.

Key words: population estimation, sample precision, sampling, spatial dispersion, Taylor's Power Law.

The uneven horizontal dispersion of nematodes in soil is well documented (8) and poses an important limitation to precision in the development of sampling plans (12,16). Therefore, confidence intervals around nematode population density estimates are usually quite broad, even when numerous cores are collected to make the soil sample (12,17). Increasing the number of cores per sample improves both the accuracy (6) and precision (1,6) of density estimates. There are limits to the degree of precision attainable by a single sample consisting of many cores (16). Nevertheless, collecting several multiple-core samples from the same area is a means of improving precision beyond levels attainable by single-core samples (9,11).

In addition to maximizing precision, another desirable feature of a sampling plan is its consistent applicability in a wide variety of situations. Taylor's Power Law (21)

$$s^2 = a\bar{x}^b \qquad (1)$$

can be used to relate the variances (s^2) to the means ($\bar{x}$) of nematode population densities over a series of plots. The parameters a and b derived from equation 1 have been used to provide some measure of consistency in spatial dispersion of nematodes, as well as for developing and evaluating sampling plans (1–3,5,12). No differences were found ($P \leq 0.05$) in these parameters between *Tylenchulus semipenetrans* Cobb samples collected from eight locations per citrus tree at various sites compared with samples collected from 16 locations per tree at a single site on various sampling dates (3). The consistency of a and b despite differences in sampling location, time, and methodology suggests similar dispersion patterns and implies that either sampling plan would give similar results. Boag et al. (1) calculated common a and b values for population densities of virus-vector nematodes from different fields, finding some similarity in b values but much heterogeneity among a values. Values of b decreased as the distance between cores decreased (1,2). Values of b were also fairly consistent regardless of plot size, but a tended to increase as the size of the area sampled increased (12).

The objectives of this study were to determine the consistency of nematode dispersion (as measured by the parameters of Taylor's Power Law) and to evaluate adaptability of sampling plans in determining precision estimates under a range of

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conditions, i.e., various sites, crops, and sampling times. In this study, an individual sample consisted of 12 cores collected from a 3-m × 3-m plot. This methodology avoids variability in a with changing plot size (12) and considers the likelihood of increasing precision by collecting multiple 12-core samples rather than a single sample composed of a large number of cores.

Materials and Methods

Spatial dispersion: Data on sampling of plant-parasitic nematode species were obtained from several studies (13–15), all of which involved 3-m × 3-m plots on Arredondo fine sand (93.0–98.0% sand, 0.4–4.5% silt, 1.5–3.5% clay; pH 5.6–6.5, 0.9–1.8% organic matter). Plots were sampled on various occasions from October 1986 to October 1988 and were either fallow or planted to maize (*Zea mays* L. cv. Pioneer X304C), soybean (*Glycine max* (L.) Merr., cv. Davis), rye (*Secale cereale* L.), or hairy vetch (*Vicia villosa* Roth). In every case, an individual soil sample consisted of 12 cores collected 20 cm deep with a 2.5-cm sampling cone (4). The sampling pattern consisted of dividing the plot into 12 equal sections and removing one core per section. On each sampling date, three replicate 12-core samples were collected from each plot. The number of plots sampled varied from 8 to 32, depending on the crop and sampling date. Nematodes were extracted from a 100-cm^3 portion of each sample by a modified sieving-centrifugation technique (10).

The mean ($\bar{x}$) and variance (s^2) of counts of each species per 100-cm^3 of soil from each sampling date were computed over the three 12-core samples taken from each plot. Data on $\bar{x}$ and s^2 from individual plots then were used to derive regression equations of the form $\log_{10} s^2 = \log_{10} a + b \log_{10} \bar{x}$ across all plots with the same crop and sampling date. Equations derived from different crops and sampling dates were compared by testing for significant ($P \leq 0.05$) differences among regression coefficients (7).

Sampling plans: Precision of sampling plans for selected situations was evaluated by computing standard error to mean ratios (E) and confidence interval half-width to mean ratios (D) (20) for n = 3 samples. When parameters a and b of Taylor's Law are known, D can be found (5) from

$$n = (t_{\alpha[n-1]}/D)^2 \, a\bar{x}^{(b-2)} \qquad (2)$$

where $t_{\alpha[n-1]}$ is the appropriate Student's t value for confidence limits of $1 - \alpha$ and $n - 1$ degrees of freedom (19), $D = t_{\alpha[n-1]} E$. When parameters of Taylor's Power Law are not available, D or E can still be estimated (20) from $\bar{x}$ and s^2 for an individual plot by

$$D = t_{\alpha[n-1]} s/\bar{x}\sqrt{n} \text{ or } E = s/\bar{x}\sqrt{n} \qquad (3)$$

Results and Discussion

Spatial dispersion: For most crops and sampling dates, linear relationships ($P \leq 0.05$) were obtained between $\log_{10} s^2$ and $\log_{10} \bar{x}$ of densities of *Belonolaimus longicaudatus* Rau (Table 1). Typical linear regressions are illustrated for *B. longicaudatus* from maize plots (Fig. 1A) and soybean plots (Fig. 1B). The regression parameters for maize plots sampled in 1987 were not different ($P \leq 0.05$) from those sampled in 1988; therefore, the parameter values of a = 1.38 and b = 1.32 calculated across all maize plots (Table 1) were satisfactory measures of dispersion of *B. longicaudatus* on this host.

On soybean, differences ($P \leq 0.05$) in slope and intercept existed between regression equations for *B. longicaudatus* for each year (Table 1). The points for each season (Fig. 1B) overlapped less than for maize (Fig. 1A). The regression lines for soybean plots were better defined (r^2 = 0.96–0.97) and, therefore, more easily separated than for maize plots, for which one of the lines was less well defined ($r^2 = 0.82$) due to a greater degree of variability among the points.

There were no differences ($P \leq 0.05$) in Taylor's Power Law coefficients among sampling dates for *B. longicaudatus* in fallow plots or in plots planted to rye (Table 1). There were differences ($P \leq 0.05$)

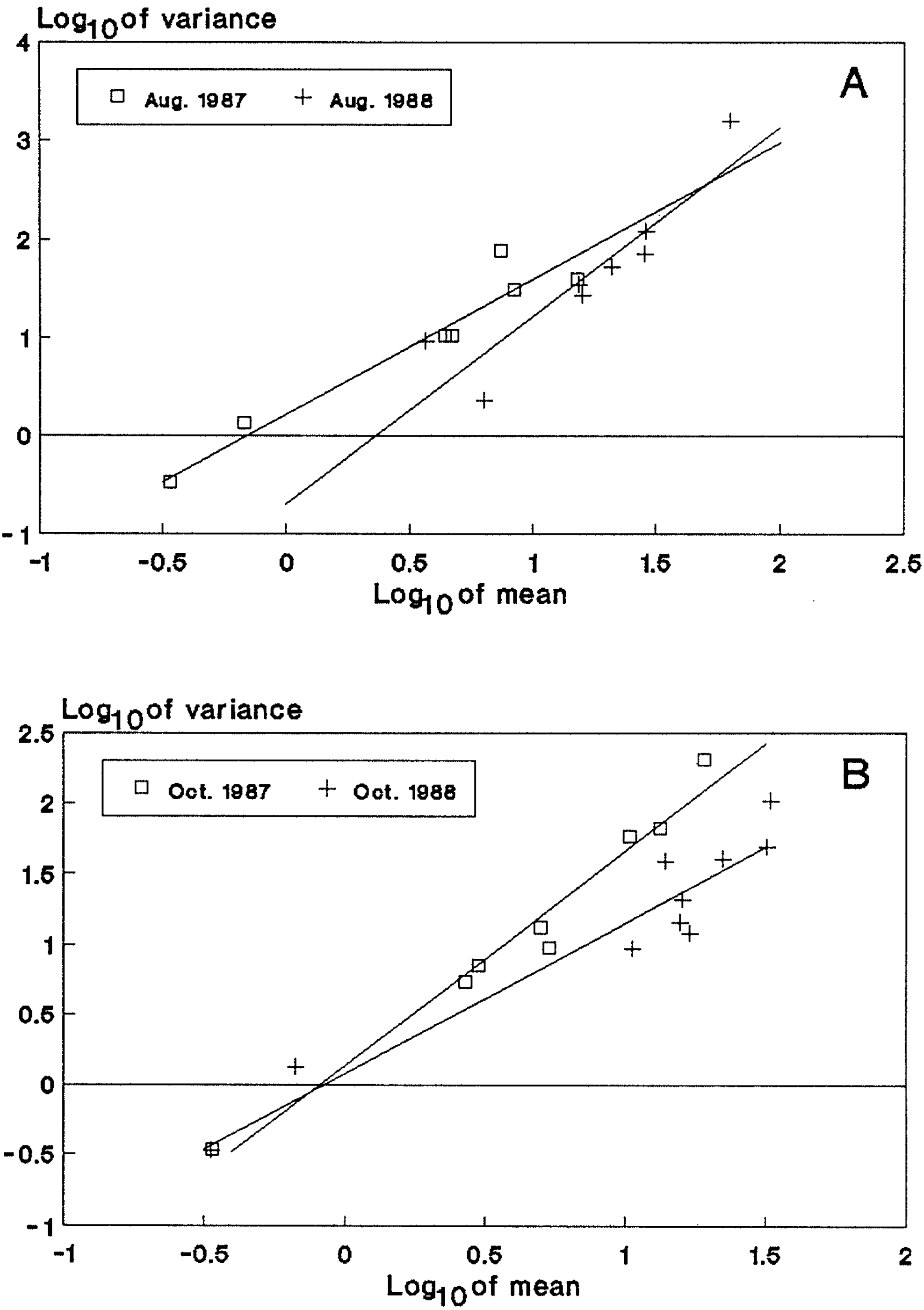

FIG. 1. Relationships between y = $\log_{10}$ of variance and x = $\log_{10}$ of mean densities of *Belonolaimus longicaudatus* per 100 cm^3 soil. A) Maize. August 1987: $y = 0.22 + 1.38x$, $r^2 = 0.96$; August 1988: $y = -0.70 + 1.92x$, $r^2 = 0.82$. B) Soybean. October 1987: $y = 0.12 + 1.53x$, $r^2 = 0.97$. October 1988: $y = 0.07 + 1.08x$, $r^2 = 0.96$.

TABLE 1. Coefficients (a and b) of Taylor's Power Law for densities of *Belonolaimus longicaudatus* and *Criconemella sphaerocephala*/100 cm^3 soil from 156 3-m × 3-m plots.

		Belonolaimus longicaudatus				*Criconemella sphaerocephala*			
Crop	Sampling date	N	r^2	a	b	N	r^2	a	b
Fallow	Oct. 1986	15	0.45**	1.35	1.26	32	0.89***	0.37	1.98
	Mar. 1987	8	0.65*	0.73	1.28	14	0.86***	0.75	1.50
	June 1987	10	0.64**	0.93	1.31	16	0.93***	0.73	1.73
	Nov. 1987	17	0.70***	0.96	1.32	32	0.68***	0.85	1.46
	Mar. 1988	10	0.81***	1.46	1.06	15	0.75***	0.56	1.50
	May 1988	8	0.70**	0.92	1.46	16	0.55***	1.15	1.04
	All dates	68	0.72***	1.07	1.27	125	0.81***	0.74†	1.58
Maize	Aug. 1987	9	0.96***	1.68	1.38	15	0.73***	0.17	1.87
	Aug. 1988	8	0.82**	0.20	1.92	16	0.82***	0.55	1.68
	All dates	17	0.89***	1.38	1.32	31	0.75***	0.28	1.79
Soybean	Oct. 1987	8	0.97***	1.33	1.53	16	0.86***	0.40	1.82
	Oct. 1988	13	0.96***	1.18	1.08	7	0.14 NS	—	—
	All dates	21	0.91***	1.41†	1.17‡	23	0.78***	1.48	1.38
Rye	Feb. 1987	9	0.82***	2.36	1.24	16	0.94***	0.15	2.21
	Apr. 1987	4	0.85	1.68	0.80	8	0.66*	0.44	1.43
	Feb. 1988	7	0.39 NS	—	—	16	0.74***	1.51	1.40
	Mar. 1988	4	0.93*	3.47	0.87	8	0.79**	0.09	2.43
	All dates	24	0.70***	2.14	1.04	48	0.77***	0.39	1.79†
Vetch	Feb. 1987	8	0.002 NS	—	—	15	0.97***	1.03	1.67
	Apr. 1987	5	0.91*	3.91	1.27	8	0.98***	0.86	1.77
	Feb. 1988	9	0.42	0.62	1.23	16	0.75***	0.56	1.46
	Mar. 1988	4	0.19 NS	—	—	8	0.96***	0.66	1.83
	All dates	26	0.34**	0.76†	1.46	47	0.89***	0.78†	1.62
All crops	All dates	156	0.73***	1.26†	1.23	274	0.83***	0.76†	1.59‡

Only nonzero points are used in determining regression equations; N = number of nonzero points; r^2 = coefficient of determination for fit to equation $\log_{10} s^2 = \log_{10} a + b \log_{10} \bar{x}$ where s^2 = variance and $\bar{x}$ = mean of three 12-core samples per plot. Asterisks denote significance at $P \leq 0.05$ (*), $P \leq 0.01$ (**), and $P \leq 0.001$ (***). Coefficients significant at $P \leq 0.10$ are unmarked. NS = not significant. Dashes (—) indicate no a and b values calculated for nonsignificant relationships.

† Significant ($P < 0.05$) differences among a values for these dates.

‡ Significant ($P < 0.05$) differences among b values for these dates.

among a values for different sampling dates of vetch plots, but in general, relationships between $\log_{10} s^2$ and $\log_{10} \bar{x}$ were poorly defined. A general regression equation relating $\log_{10} s^2$ and $\log_{10} \bar{x}$ for *B. longicaudatus* was developed using data for all 156 plots, but different ($P \leq 0.05$) a values were incorporated into this relationship (Table 1).

Linear relationships ($P \leq 0.05$) were obtained between $\log_{10} s^2$ and $\log_{10} \bar{x}$ of *Criconemella sphaerocephala* (Taylor) Luc & Raski for all crops and sampling dates except soybean in October 1988 (Table 1). Since no differences ($P \leq 0.05$) in a or b values existed across sampling dates, a common relationship across both maize sampling dates (N = 31 plots) may be applicable. Common relationships incorporating data from all sampling dates were less useful for fallow, vetch, rye, or all crops together since differences ($P \leq 0.05$) in a or b existed within these groups.

No differences ($P \leq 0.05$) in a or b were observed among dates for fallow plots sampled for soil populations of *Pratylenchus brachyurus* (Godfrey) Filipjev & Stekhoven nor for plots planted to rye or soybean (Table 2). Differences in a values were obtained among the different sampling dates for maize and vetch. No differences among parameters were noted when data from all 288 plots were pooled, probably because of the increased variability associated with all the plots (Table 2). This relationship was general for *P. brachyurus* in all situations studied, but r^2 was only 0.75.

Based on parameters of Taylor's Power Law, dispersion of *Meloidogyne incognita* (Kofoid & White) Chitwood juveniles in soil was similar on each of the two sampling dates for plots planted to maize, soybean,

TABLE 2. Coefficients (a and b) of Taylor's Power Law for densities of *Pratylenchus brachyurus* and *Meloidogyne incognita*/100 cm^3 soil from 288 3-m × 3-m plots.

Crop	Sampling date	*Pratylenchus brachyurus* N	r^2	a	b	*Meloidogyne incognita* N	r^2	a	b
Fallow	Oct. 1986	32	0.64***	0.40	1.73	23	0.74***	1.73	1.22
	Mar. 1987	16	0.43**	2.59	1.10	12	0.39*	2.27	0.77
	June 1987	16	0.61***	1.08	1.41	13	0.89***	0.87	1.84
	Nov. 1987	32	0.71***	0.55	1.61	18	0.87***	1.26	1.69
	Mar. 1988	16	0.68***	0.96	1.39	5	0.69	1.63	0.90
	May 1988	16	0.88***	0.90	1.40	8	0.95***	1.35	1.48
	All dates	128	0.78***	0.87	1.50	79	0.82***	1.32	1.47‡
Maize	Aug. 1987	16	0.68***	2.40	1.46	7	0.98***	3.23	1.62
	Aug. 1988	16	0.46**	1.63	1.25	8	0.85**	2.00	1.38
	All dates	32	0.72***	0.63†	1.69	15	0.91***	2.82	1.39
Soybean	Oct. 1987	16	0.64***	1.05	1.48	9	0.63*	1.93	1.12
	Oct. 1988	16	0.80***	1.23	1.48	16	0.85***	1.22	1.57
	All dates	32	0.75***	1.26	1.45	25	0.83***	1.41	1.49
Rye	Feb. 1987	16	0.13 NS	—	—	11	0.85***	1.42	1.36
	Apr. 1987	8	0.64*	2.59	1.22	0	—		
	Feb. 1988	16	0.63***	2.75	1.15	7	0.94***	1.74	1.64
	Mar. 1988	8	0.68*	1.14	1.35	0	—		
	All dates	48	0.62***	2.14	1.22	18	0.88***	1.51	1.45
Vetch	Feb. 1987	16	0.76***	0.24	1.81	6	0.95***	3.02	1.50
	Apr. 1987	8	0.94***	1.51	1.58	4	0.97*	1.62	1.33
	Feb. 1988	16	0.64***	0.35	1.64	10	0.94***	1.46	1.54
	Mar. 1988	8	0.89***	0.04	2.47	5	0.06 NS	—	—
	All dates	48	0.76***	0.45†	1.66	25	0.88***	1.32†	1.56
All crops	All dates	288	0.75***	0.85	1.52	162	0.85***	1.41	1.49

Only nonzero points are used in determining regression equations; N = number of nonzero points; r^2 = coefficient of determination for fit to equation $\log_{10} s^2 = \log_{10} a + b \log_{10} \bar{x}$ where s^2 = variance and $\bar{x}$ = mean of three 12-core samples per plot. Asterisks denote significance at $P \leq 0.05$ (*), $P \leq 0.01$ (**), and $P \leq 0.001$ (***). NS = not significant. Dashes (—) indicate no a and b values calculated for nonsignificant relationships.

† Significant ($P < 0.05$) differences among a values for these dates.

TABLE 3. Coefficients (a and b) of Taylor's Power Law for densities of *Paratrichodorus minor*/100 cm^3 soil from 95 3-m × 3-m plots.

Crop	Sampling date	N	r^2	a	b
Fallow	Oct. 1986	30	0.64***	1.38	1.20
	June 1987	9	0.91***	1.70	1.72
	Nov. 1987	4	0.67 NS	—	—
	May 1988	5	0.02 NS	—	—
	All dates	48	0.58***	1.44	1.20
Maize	Aug. 1987	13	0.81***	1.47	1.27
Soybean	Oct. 1987	10	0.44*	0.96	1.00
	Oct. 1988	15	0.76***	0.70	1.40
	All dates	25	0.71***	0.83	1.28
Rye	Feb. 1988	5	0.84*	1.43	1.10
Vetch	Feb. 1988	4	0.88	2.17	2.10
All crops	All dates	95	0.63***	1.29	1.21

Only nonzero points are used in determining regression equations; N = number of nonzero points; r^2 = coefficient of determination for fit to equation $\log_{10} s^2 = \log_{10} a + b \log_{10} \bar{x}$ where s^2 = variance and $\bar{x}$ = mean of three 12-core samples per plot. Asterisks denote significance at $P \leq 0.05$ (*), $P \leq 0.01$ (**), and $P \leq 0.001$ (***). Coefficients significant at $P \leq 0.10$ are unmarked. NS = not significant. Dashes (—) indicate no a and b values calculated for nonsignificant relationships.

or rye (Table 2). Differences ($P \leq 0.05$) in b values or a values among sampling dates were evident for fallow plots and vetch plots, respectively.

Paratrichodorus minor (Colbran) Siddiqi and a *Xiphinema* species close to *X. floridae* Lamberti & Bleve-Zacheo were encountered less frequently than the four species mentioned previously. No differences ($P \leq 0.05$) in a or b values were detected among the various sampling dates or crops for either of these species (Tables 3, 4). A *Hoplolaimus* species was found in 10 plots, 5 planted to soybean and 5 to rye. A significant regression ($r^2 = 0.95$; $P \leq 0.01$) was obtained for s^2 and $\bar{x}$ data across all 10 plots, with a = 2.19 and b = 1.74.

Considering data from all species, sampling dates, and crops (1,037 plots), a general regression equation of $\log_{10} s^2 = 0.05 + 1.46 \log_{10} \bar{x}$ was obtained ($r^2 = 0.92$; $P \leq 0.001$; a = 1.12; b = 1.46). This equation

TABLE 4. Coefficients (a and b) of Taylor's Power Law for densities of *Xiphinema* sp./100 cm³ soil from 52 3-m × 3-m plots.

Crop	Sampling date	N	r^2	a	b
Fallow	Mar. 1987	6	0.92**	1.93	1.52
	June 1987	10	0.67**	1.89	1.21
	Nov. 1987	3	0.997*	2.44	1.75
	Mar. 1988	5	0.73	0.72	1.26
	All dates	24	0.76***	1.58	1.32
Maize	Aug. 1987	4	0.85 NS	—	—
Soybean	Oct. 1987	5	0.14 NS	—	—
Rye	Apr. 1987	4	0.80 NS	—	—
	Feb. 1988	4	0.71 NS	—	—
	Mar. 1988	3	0.92 NS	—	—
	All dates	11	0.67**	0.87	1.78
Vetch	Apr. 1987	4	0.83 NS	—	—
	Feb. 1988	4	0.78 NS	—	—
	All dates	8	0.81*	1.44	1.35
All crops	All dates	52	0.74***	1.38	1.37

Only nonzero points are used in determining regression equations; N = number of nonzero points; r^2 = coefficient of determination for fit to equation $\log_{10} s^2 = \log_{10} a + b \log_{10} \bar{x}$ where s^2 = variance and $\bar{x}$ = mean of three 12-core samples per plot. Asterisks denote significance at $P \leq 0.05$ (*), $P \leq 0.01$ (**), and $P \leq 0.001$ (***). Coefficients significant at $P \leq 0.10$ are unmarked. NS = not significant. Dashes (—) indicate no a and b values calculated for nonsignificant relationships.

could be applicable to the dispersion and sampling of plant-parasitic nematodes in general. However, its utility was limited by the many differences ($P \leq 0.05$) in a and b values within this large data set, which was not unexpected, since several different nematode species were involved.

Evaluating sampling plans: The existence of similarities in a and b values from Taylor's Power Law among some sampling dates and crops suggests that, in certain cases, general sampling plans could be applied to a range of plots varying in host and sampling date. This possibility can be evaluated by comparing precision estimates from sampling plans based on limited, specific data with those based on more general relationships.

Precision estimates derived from various sampling plans for a sample size of n = 3 are shown (Table 5) for data on *B. longicaudatus* from a crop in which parameters of Taylor's Power Law were similar across sampling dates (maize) and one in which parameters differed with sampling date (soybean). For each crop, coefficients of variation, standard error to mean ratios, and confidence intervals are shown for specific plots, derived from $\bar{x}$ and s^2 values for these plots. Also shown are precision estimates obtained from equation 2 using parameters from Taylor's Power Law relationships showing various degrees of generality. For maize, these vary from relationships based on plots sampled at the same time (August 1987) to all maize plots, to plots of all hosts containing *B. longicaudatus,* and finally to the most general relationship derived from all nematode data on all crops.

The 95% confidence intervals around the means are broad, regardless of the specificity or generality of the data set used to obtain them. There seem to be few practical differences between confidence intervals obtained from the various sources. These generalizations are based on the range of data from which the original regression equations were derived, however. A value of 15 *B. longicaudatus*/100 cm³ soil is typical of an infested plot, and sampling plans for maize involving three 12-core samples produced D values of 0.98 when the general *B. longicaudatus* equation was used and 1.26 when the general equation for all nematode data was used (Table 5). If an extreme value is used, such as 100 *B. longicaudatus* per 100 cm³ soil, D values of 0.47 and 0.76 would be obtained from the equations for *B. longicaudatus* and all nematodes, respectively. The difference in D values from the two equations, 0.29, is the same for densities of 15 and 100, but proportionally this difference is greater at the higher density. Thus 95% confidence intervals around $\bar{x}$ = 100 calculated from these two equations (53–147 and 24–176) show a greater difference in breadth than did those calculated around $\bar{x}$ = 15 (0–30 and 0–34).

For all cases, the relatively great widths of the 95% confidence intervals are due to the low number of samples collected. With n = 3, the *t* value in equations 2 and 3 is 4.303 (18) and has a much greater influence than the *t* value of 1.96 or 2 which is often applied for large sample sizes (20). If

TABLE 5. Precision estimates for *Belonolaimus longicaudatus* densities that were derived from data for different sampling plans.

Data used to calculate precision estimates	Coefficient of variation	½ confidence interval to mean ratio (D)	95% confidence interval†	80% confidence interval‡
Maize plots				
Based on $\bar{x}$ = 15.0 *B. longicaudatus*/100 cm^3 soil:				
Single maize plot, Aug. 1987; $\bar{x}$ = 15.0, s^2 = 38.99	41.7	1.03	0–30	8–22
All maize plots, Aug. 1987; a = 1.68, b = 1.38	55.9	1.39	0–36	6–24
All maize plots, both seasons; a = 1.38, b = 1.32	46.8	1.16	0–32	7–23
B. longicaudatus data from all crops; a = 1.26, b = 1.23	39.5	0.98	0–30	8–22
All nematode data from all plots; a = 1.12, b = 1.46	50.9	1.26	0–34	7–23
Soybean plots				
Based on $\bar{x}$ = 13.33 *B. longicaudatus*/100 cm^3 soil:				
Single soybean plot, Oct. 1987; $\bar{x}$ = 13.33, s^2 = 65.31	60.6	1.51	0–38	4–22
All soybean plots, Oct. 1987; a = 1.33, b = 1.53	62.7	1.56	0–38	4–22
All soybean plots, both seasons; a = 1.41, b = 1.17	40.5	1.01	0–30	7–19
B. longicaudatus data from all crops; a = 1.26, b = 1.23	41.4	1.03	0–30	7–19
All nematode data from all plots; a = 1.12, b = 1.46	52.6	1.31	0–35	6–21

For single plots, precision estimates are calculated using the equation $n = (t_{\alpha[n-1]}s/D\bar{x})^2$ with n = 3 and $\bar{x}$, s^2 as indicated. For plans involving multiple plots, parameters a and b from Taylor's Power Law are shown and used in the equation $n = (t_{\alpha[n-1]}/D)^2 a\bar{x}^{(b-2)}$ to calculate precision estimates, with n = 3 and $\bar{x}$ as indicated.

† $t_{.05[3-1]} = 4.303$ (18).

‡ $t_{.20[3-1]} = 1.886$ (18).

the breadth of the 95% confidence interval were a cause for concern, it could be reduced by collecting, extracting, and counting more samples per plot. Perhaps a 95% confidence interval is impractical in nematology, given the great spatial heterogeneity observed in nematode population densities. An 80% confidence interval may be attainable more easily; corresponding 80% confidence intervals are illustrated for comparison (Table 5).

The comparative similarity of precision estimates from various sources suggests that if precision estimates are desired, they could be obtained equally well from a general plan or from data from a specific plot. If a general plan is available and applicable to the situation, it could be used in obtaining a precision estimate. However, there are limits beyond which general relationships of Taylor's Power Law may not apply. Values of a vary greatly with location (1) or plot size (12), but probably would also be affected greatly if the number of cores per sample were changed. In these cases, as well as when sampling plans are unavailable, it is unnecessary to conduct detailed sampling studies to determine a and b values from Taylor's Power Law before precision estimates can be obtained. By collecting multiple samples from any plot, estimates of $\bar{x}$ and s^2 can be obtained and confidence limits to $\bar{x}$ can be set with equation 3. Our results suggest that confidence limits set in this way would be similar to those obtained from sampling plans based on Taylor's Power Law.

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