Morphometrical variability in *Helicotylenchus* Steiner, 1945. 2 : Influence of the host on *H. dihystera* (Cobb, 1893) Sher, 1961

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SUMMARY

Effect of the host on some morphometric characters was studied in progenies of single *Helicotylenchus dihystera* females. When a strain was cultivated on ten different host-plants, significant differences were found in all but a few studied characters. When related strains were cultivated on different cultivars of the same plant, about half the studied characters also varied significantly.

RÉSUMÉ

Variabilité morphométrique chez Helicotylenchus *Steiner, 1945*
2: Influence de l'hôte sur H. dihystera *(Cobb, 1893) Sher, 1961*

L'action de l'hôte sur quelques données morphométriques a été étudiée dans la descendance de femelles isolées d'*Helicotylenchus dihystera*. Quand une telle souche est élevée sur dix plantes différentes, des différences significatives apparaissent dans presque tous les critères étudiés. Quand des souches apparentées sont élevées sur des cultivars différents de la même plante, environ la moitié des caractères étudiés varient significativement.

Most criteria currently used in taxonomy of the species of *Helicotylenchus* were shown to be highly variable in a strain originating from a single female and cultivated on rice in one pot, i.e. with minimum variations concerning environmental factors (Fortuner, 1979).

However, natural populations are submitted in the field to the influence of a variable environment. Host, soil, meteorological conditions, and so on, vary from field to field and in the same field from year to year. These environmental factors can most probably induce an additionnal variability in some of the taxonomic criteria. The variability induced by the host was studied in the present work.

Material and methods

The following strains, each originating from a single female of *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961, were successively used :

— *Strain 1* was the strain studied in Fortuner (1979) which describes its origin (a rice field in Senegal) and mode of obtention.

— *Strain 2* was obtained in the same manner as strain 1 from another female originating from the same field sampled two years later (1975). This strain was cultivated at Dakar on rice cv. I-Kong-Pao.

— Strain 2 was then transported to Ivory Coast and cultivated at the ORSTOM Center of Adiopodoumé on rice, cv. Moroberekan. In 1977, a single female was selected from strain 2 and inoculated on a new pot of rice (same cultivar) to create *strain 2 bis.*

Thus all strains are related by their common geographical origin but strains 2 and 2 bis share a closer relationship as the former gave birth to the latter. These strains were used for the following studies :

COMPARISON BETWEEN SPECIMENS CULTIVATED ON DIFFERENT HOST-PLANTS

Ten different plants (Tab. 1) were cultivated in five pots each at Adiopodoumé. Several hundred specimens from strain 2 bis were inoculated in 1978 to every pot. Six months later the nematodes were extracted from the pots. The individuals from the same host plant will be termed as a "population" in the present paper.

Twenty specimens from each population were selected and processed in the same manner as in Fortuner (1979). Lengths of body, stylet, anterior part of stylet, oesophagus (from anterior end to oesophago-intestinal junction and to base of glands), tail ; distance from head to vulva and from dorsal gland opening to stylet knobs ; anal and vulval body diameters ; number of tail annules (ventral) and position of inner incisures fusion and of phasmids ; were measured. Observations were also made on presence of males, fasciculi, labial disc ; habitus, position of spermatheca, and hemizonid ; size of median oesophageal bulb, lip annulation and shape of anterior end, stylet knobs and tail.

COMPARISON BETWEEN SPECIMENS REARED ON DIFFERENT CULTIVARS OF THE SAME PLANT

Twenty females from strain 2 (from rice cv. I-Kong-Pao) were compared to twenty other females from related strain 2 bis (from rice cv. Moroberekan). The same measurements and observations as previously were effected.

Results

QUANTITATIVE CRITERIA

Comparison between specimens cultivated on different host-plants

For every measured character the differences observed between means in the ten populations were tested by a F test (Tab. 2). When the F test proved that one at least of the differences was statistically significant, the means for the ten populations were arranged by increasing values and the smallest significant difference computed at 1% level (Fig. 1). Validity of ratios (a, b, b′, c, c′, V, m and o) was tested by

Table 1

List of host-plants used in the present study

Strain	*Population*	*Plant*
2		Rice, cv. I-Kong - Pao
2 bis	a	Rice, cv. Moroberekan
	b	Sugar-cane, cv. B-54142
	c	Maize, cv. C.J.B.
	d	Sorghum, cv. CE 90
	e	Tomato, cv. Heinz 1370
	f	Pepper, cv. Early California Wonder
	g	Cotton, cv. 1422, C 71-72
	h	Groundnut, cv. Florrunner
	i	*Pueraria phaseoloides* (Roxb.) Benth.
	j	*Stylosanthes gracilis* H.B.K.

Table 2

Significance of differences between means of some criteria measured in populations from ten different host-plants (n = 20 ♀)

Criteria	*F*	*Significance (at 1% level)*	*Lowest Significant Difference (at 1% level)*
Stylet length (µm)	22.12	+	0.50
Anterior part of stylet (µm)	5.66	+	0.30
Total length (µm)	22.01	+	38.26
Oesophagus length (to valve) µm	15.07	+	3.78
Head to vulva distance (µm)	22.8	+	22.46
Anal diameter (µm)	11.78	+	0.69
Vulval diameter (µm)	6.65	+	1.55
Oesophagus length (to posterior end of glands) (µm)	13.26	+	4.26
Tail length (µm)	9.42	+	1.20
Number of tail annules	6.33	+	1.36
Dist. D. gland opening to knobs (µm)	16.9	+	1.12
Phasmids position (annules from anus)	0.04	—	
Incisure fusion (in % of incisures length on tail)	1.93	—	
Distance from anteror end to hemizonid (µm)	15.4	+	3.64
a	4.07	+	2.03
c	1.81	—	
V	3.03	+	1.18

t tests (Roggen & Asselberg, 1971). Only a, c and V were statistically justified in every one of the ten populations. These three ratios were included in Table 2 and Figure 1.

Table 2 shows that only three characters present no significant differences among the ten studied populations: position of phasmids and of inner incisure fusion and ratio c.

In Figure 1, it is evident that individuals belonging to the populations on tomato (e) and pepper (f) are noticeably larger than the others, that populations on sugar-cane (b) and sorghum (d) are intermediate, while in the remaining six populations, individuals are smaller in almost every character but V-value.

Comparisons between specimens reared on different cultivars of the same host-plant

Table 3 presents comparisons between specimens from related strains 2 and 2 bis reared on two different rice cultivars. The significance of the observed differences between means is tested by a t test made on independant variables.

The statistical validity of the ratios was tested as previously. Only a, c, c′, and V were found to be justified and could be calculated. These ratios are also presented on Table 3.

It can be seen from Table 3 that, under two different cultivars of the same host-plant, eight characters (length of anterior part of stylet and of oesophagus, head to vulva distance, anal diameter, position of phasmids and of inner incisure fusion, and ratios c and c′) remained constant while the values of the ten other characters studied were significantly different.

The difference in cultivars may not be the only factor inducing variability as environmental conditions (temperature, light, soil, and so on) were different at Dakar and at Adiopodoumé.

Qualitative criteria

When the nature of the host varied, the criteria found to be constant among the progeny of a single female cultivated in one pot (Fortuner, 1979) remained constant here too : parthenogenesis, spiral body shape, offset spermatheca, hemispherical lips, medium sized œsophageal bulb, hemizonid anterior to excretory pore and to oesophago-intestinal junction and absence of fasciculi ("canals").

Shape of stylet knobs and lip annulation were as variable as previously noted.

Some of the tail shapes of strain 1 presented in Figure 1 in Fortuner (1979) were observed

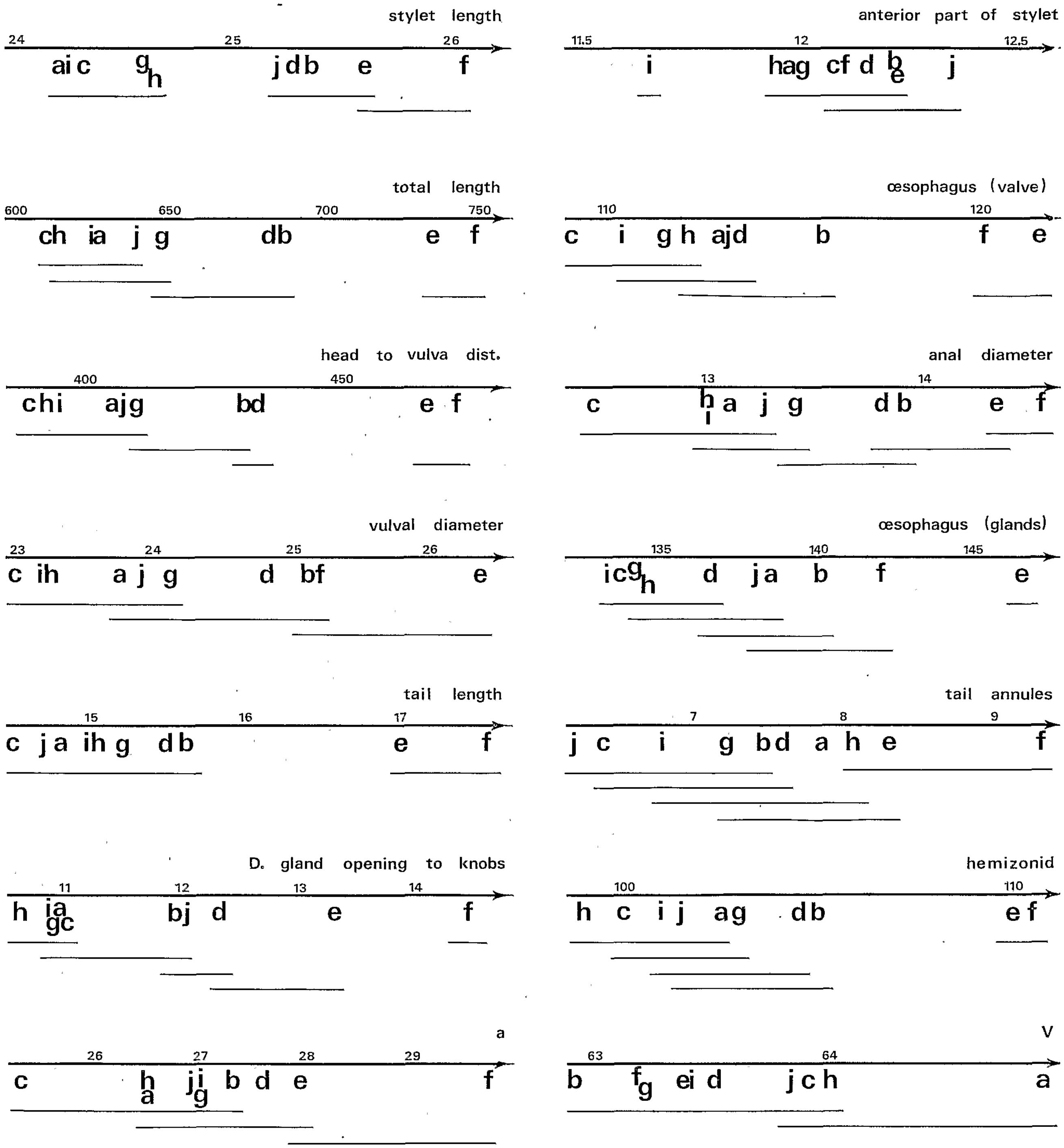

Fig. 1. Means and significant differences between means for 14 measurements of strain 2 bis cultivated on ten hosts : rice (a), sugar-cane (b), maize (c), sorghum (d), tomato (e), pepper (f), cotton (g), groundnut (h), *Pueraria phaseoloides* (i), *Stylosantes gracilis* (j). (μm, n = 20 ♀; bars join means not different at 1 % level).

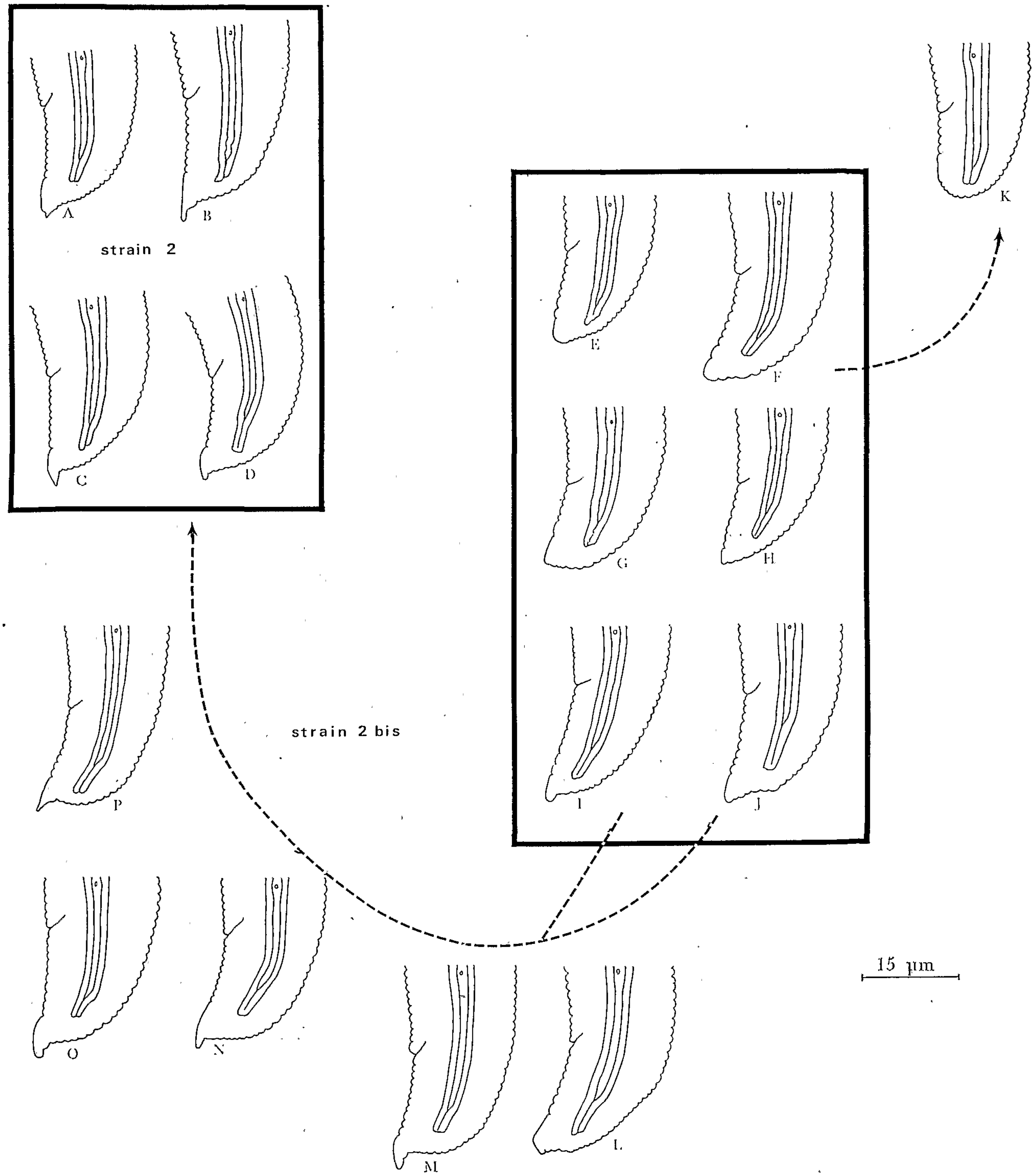

Fig. 2. Variability of tail morphology within strains 2 (A-D) and 2 bis (E-P). A-D : strain 2 on rice, cv. I-Kong-Pao. E-P : strain 2 bis on rice, cv. Moroberekan (E-J), maize (K), tomato (L-M), pepper (N-O), and groundnut (P). E-J : typical shapes seen in every population of strain 2 bis. K-P : a-typical shapes seen only in some populations.

Table 3

Comparison of specimens cultivated on two different rice cultivars
(n = 20 ♀)

Criteria	*Strain 2 cv. I-Kong-Pao*	*Strain 2 bis cv. Moroberekan*	*t*	*Significance (at 1% level)*
Stylet length (μm)	26. ± 0.5	24 ± 0.5	8.91	+
Anterior part of stylet (μm)	11.5 ± 0.5	12 ± 0.5	2.25	—
Total length (μm)	678 ± 22	627 ± 21	3.23	+
Oesophagus length (to valve) μm	117 ± 2	113 ± 2	3.28	+
Head to vulva distance (μm)	430 ± 14	406 ± 11	2.70	—
Anal diameter (μm)	14 ± 0.5	13 ± 0.5	2.66	—
Vulval diameter (μm)	27 ± 1	24 ± 1	4.99	+
Oesophagus length (to posterior end of glands) (μm)	138 ± 3	138 ± 2	0.32	—
Tail length (μm)	16.5 ± 0.5	15 ± 0.5	3.78	+
Number of tail annules	10 ± 1	8 ± 1	3.87	+
Dist. D. gland opening to knobs (μm)	14 ± 0.5	11 ± 0.5	9.70	+
Phasmids position (annules from anus)	8 ± 1	7 ± 1	0.78	—
Inner incisures fusion (in % of incisures length on tail)	33 ± 5	40 ± 4	2.23	—
Distance from anterior end to hemizonid (μm)	109 ± 2	102 ± 2	5.79	+
a	25 ± 0.7	26.5 ± 0.8	2.80	+
c	40.8 ± 1.6	42.6 ± 1.5	1.62	—
c'	1.20 ± 0.06	1.13 ± 0.05	1.92	—
V	63.5 ± 0.6	64.9 ± 0.8	2.78	+

again in strain 2 (Fig. 2 B, D) and strain 2 bis (Fig. 2 G, I, J). Tails from strain 2 (Fig. 2 A-D) has a somewhat sharper terminal process than typical shapes from strain 2 bis (Fig. 2 E-J).

Figure 2 E-J presents various tail shapes observed in rice population of strain 2 bis. Identical shapes were also seen in the nine other populations. Every individual observed in population from *Stylosanthes gracilis* had tail shape similar to Fig. 2 G. In all other populations were also present atypical tail shapes such as rounded tail seen in a specimen in maize population (Fig. 2 K) or tail shapes intermediate between the typical shapes of strain 2 bis and those of strain 2 (Fig. 2 L, M, N, O, P).

Conclusion

Variation in host, whether different plants or different cultivars of the same plant, can affect most measurements used as taxonomic criteria to the extent of creating statistically significant differences between two populations originating from the same strain. This is true even for the criteria which were the most constant when environmental variation was minimum : stylet length and V value (Fortuner, 1979). Morphological characters such as tail shape are also subject to variation. Taxonomists must be aware of such variability and make use of both quantitative and qualitative criteria with more caution than is generally done.

It is not known whether the limit of the variability within *H. dihystera* has been reached in the present study. It is possible that, if some other environmental factors (temperature, soil, etc.) had been taken into account, it may have resulted in an even higher variability of the criteria.

References

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