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CARYO-PHENOTYPE RELATIONSHIPS IN *DITYLENCHUS DIPSACI*

by
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The relationship between polyploidy and body size in *Ditylenchus dipsaci* (Kuehn) Filipjev was studied by Sturhan (1970) who found that German populations of the nematode had a chromosome number 2n = 24, but populations originated from *Vicia faba* and *Plantago maritima*, which had a longer body size, had also a chromosome number 2n = 54. He postulated that these larger sized populations could belong to the giant race of *D. dipsaci* reported from Algeria by Debray and Maupas (1896).

The basic aploid number of 12 was confirmed for populations from southern Italy (Grimaldi De Zio *et al.*, 1975). However, studying chromosome number of populations of *D. dipsaci* from various geographical origins it was noticed that different caryotypes occurred within this species (Grimaldi De Zio *et al.*, 1980).

Aim of this study was to determine chromosome numbers in various populations of *D. dipsaci* to investigate any possible influence of the caryotype on the phenotype, and to observe when the biometrics could be affected by some factors such as sex, host and geographical origin.

Materials and Methods

Fifteen populations of *D. dipsaci* were selected: five collected from onion (*Allium cepa* L.) fields of Barletta (Bari) and Margherita di Savoia (Foggia), two from broad beans (*Vicia faba* L.) at Marghe-

rita di Savoia and Scanzano (Matera), and two from strawberry (*Fragaria vesca* L.) at Scanzano and Policoro (Matera), in southern Italy; the other populations had been obtained: four from broad beans in Gozo (one of the Maltese islands), one from onion at Wageningen (The Netherlands), and one from broad beans near Coimbra (Portugal).

Nematodes were always extracted from plant tissues. Groups of 20 specimens of either sex were chosen at random for caryological and biometric studies.

Chromosome counts were made on dissected male and female gonads, stained in acetic orcein, propionic orcein and Feulgen.

Measurements were taken on individuals killed in hot 5% formalin fixed in the same and mounted *in toto* in glycerin by the Seinhorst's (1962) rapid method.

Data were statistically analysed and regression lines between factors were calculated.

Results

The caryological studies have indicated the occurrence of four different caryotypes: 12 chromosomes in the Portughese population (Fig. 1a); 24 in all the Italian, the Dutch and the Gozo populations from Ta-Hamet (Fig. 1b); 54 (48 + 6 added chromosomes) for the two populations from Munxar and Zebug in Gozo (Fig. 1c), and 60 (48 + 12 added) for the Ramla population in Gozo (Fig. 1d).

The biometrics of the Portughese population ($2n = 12$) was not studied because of scarcity of material.

For the other populations it appeared clear that the specimens belonging to the tetraploid (54 and 60 chromosomes) had generally a longer body (Fig. 2) and consequently a longer distance excretory pore-anterior extremity and vulva-anterior extremity (Fig. 3) compared to the diploid populations (24 chromosomes).

Significant differences were also found for the tail length, the oesophagus length, the stylet length and the distance of the nerve ring from the anterior extremity while less marked were the differences of the body diameter in various parts of the body.

The morphometric relations between characters used to calculate ratios in nematode taxonomy (Geraert, 1968) were not significant except for the ratio total body length/distance anterior extremity

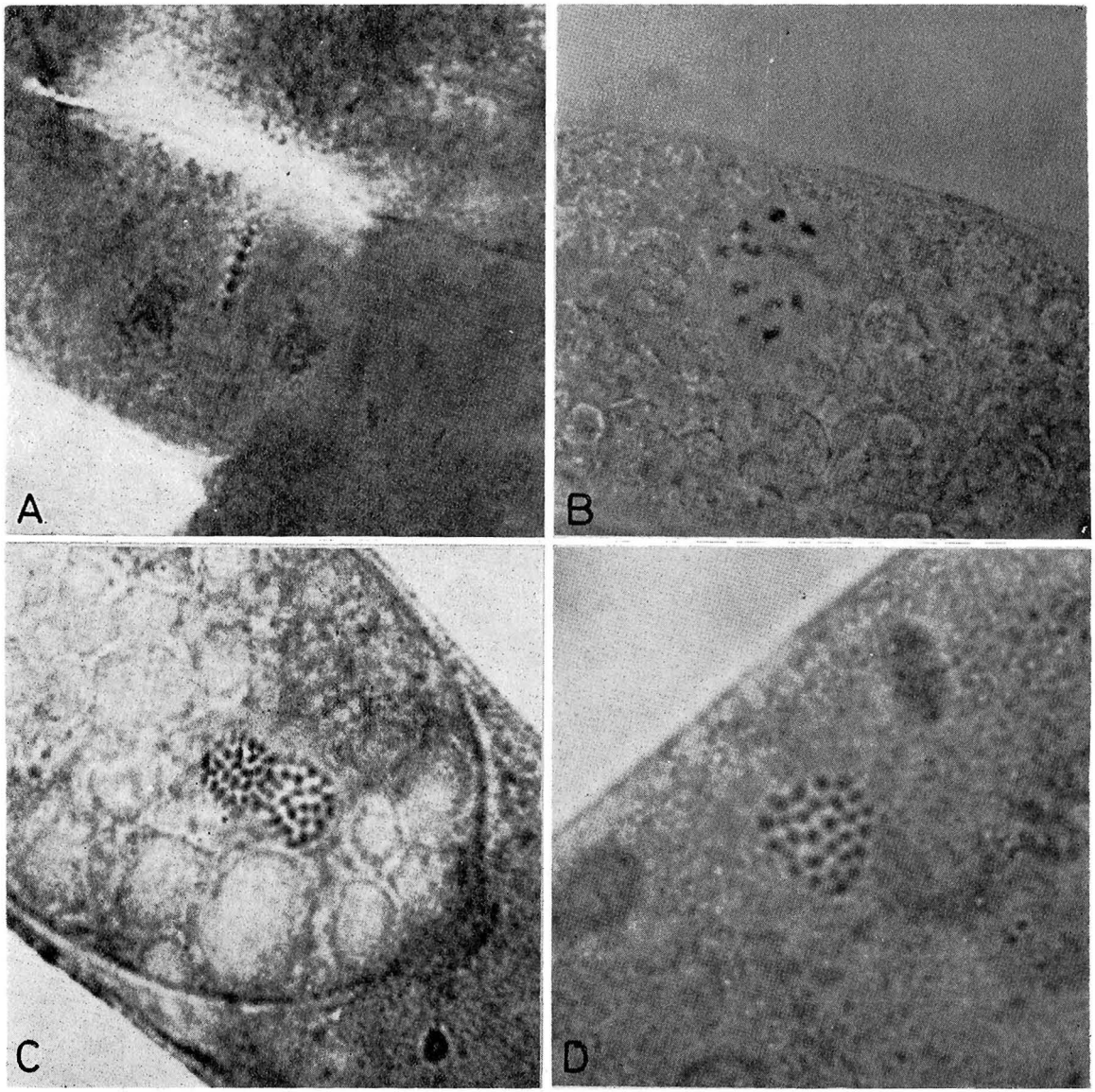

Fig. 1 - Different caryotypes in *Ditylenchus dipsaci* from Portugal; A, aploid (n = 6) in a spermatocyte; B, diploid (2n = 24) in an oocyte from Italy; C, tetraploid (4n = 54) in an oocyte from Gozo; D, tetraploid (4n = 60) in an oocyte from Malta (1cm = 2.9μm).

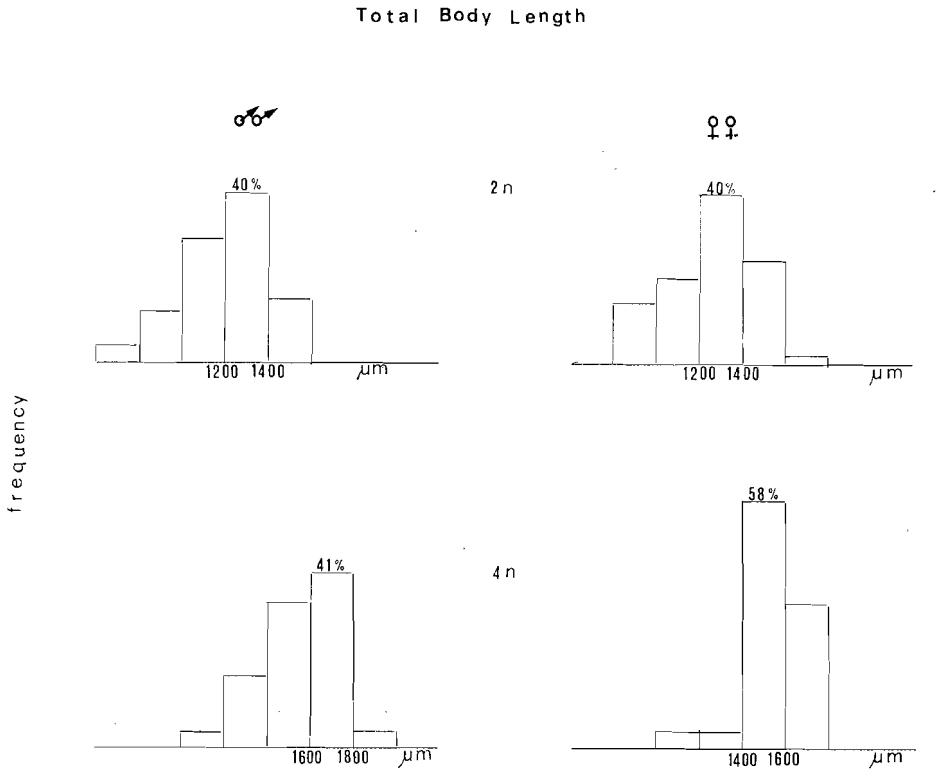

Fig. 2 - Frequency of total body length in diploid and tetraploid populations of *D. dipsaci.*

vulva, which on the Cartesian axes gave two distinct regression lines for the tetraploid and the diploid females (Fig. 4).

At this point it has been thought interesting to check whether the difference in body and other lengths was exclusively due to the caryological factors or was also dependent upon other exogenous factors such as host and geographical origin hence for all the populations examined these lengths of the male specimens always appeared to be shorter than in the females (Table I).

The results of statistical analysis have indicated that for both sexes the host and the geographical origin are cause of variability in the lengths (Table I), within diploid populations, while within the tetraploid populations from Gozo the provenience affected body length only in males.

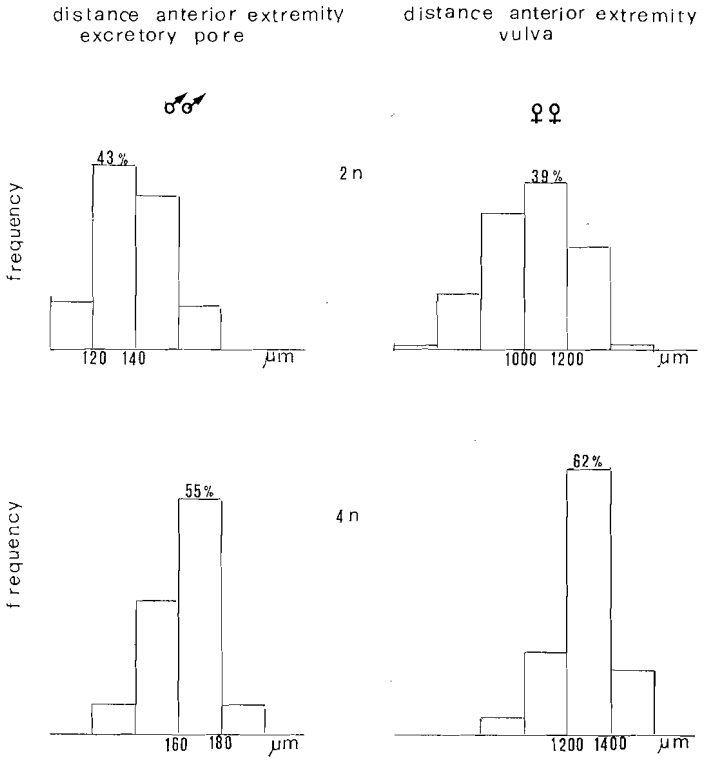

Fig. 3 - Frequency of the distance of the vulva in females and of the excretory pore in males, from the anterior extremity in diploid and tetraploid populations of *D. dipsaci.*

Once ascertained that lengths were affected by caryotype, host and provenience the question arose on the weight of these factors in determining this character. The variance in total body length due to diploids versus tetraploids was therefore compared to the variance due to host and geographical origin obtaining clear evidence (Table I) that the caryotype is a more important factor in determining total body length than exogenous factors, such as host and provenience of the populations.

Conclusions

The results of these investigations indicate the occurrence of at least four caryotypes of the stem nematode *D. dipsaci*: one diploid

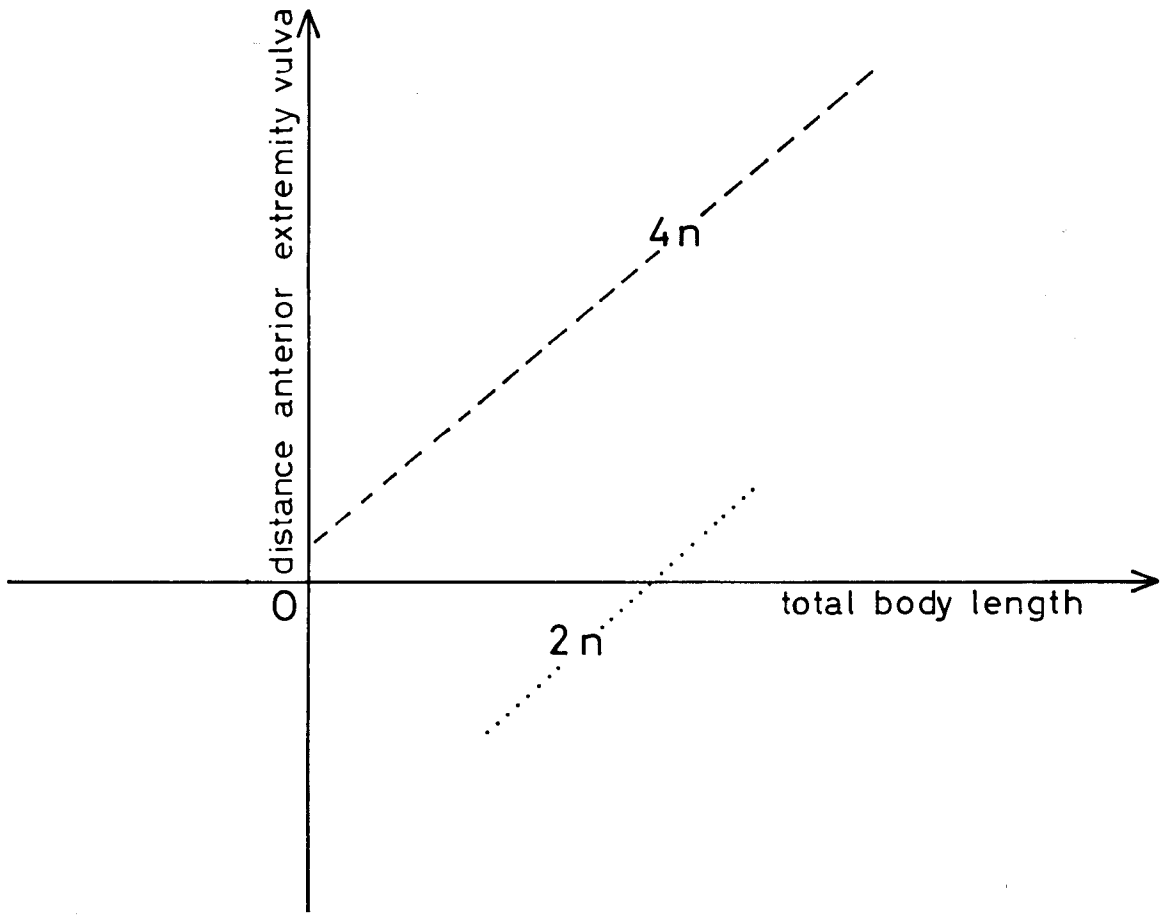

Fig. 4 - The relation between body length and the distance of vulva from the anterior extremity in females of diploid and tetroploid populations of *D. dipsaci*.

Table I. - *Factors affecting total body length in* Ditylenchus dipsaci.

CAUSE OF VARIABILITY	Deviance	Degrees of freedom	Variance	F
Female				
Diploid vs tetraploid	1857786.69	1	1857786.69	8.29 **
Host vs diploid	835612.54	2	417806.27	26.00 **
Geographical origin vs diploid vs host (onion)	1382759.00	5	276551.80	17.02 **
Geographical origin vs diploid vs host (broadbeans)	266304.50	2	133152.25	8.20 **
Geographical origin vs diploid vs host (strawberry)	175124.50	1	175124.50	10.90 **
Geographical origin vs tetraploid vs host (broadbeans)	28627.46	2	14313.73	0.89
Error	1735088.50	108	15918.24	
Total	62813003.19	122		
Male				
Diploid vs tetraploid	2546648.29	1	2546648.29	10.90 **
Host vs diploid	401913.61	2	200956.81	14.40 **
Geographical origin vs diploid vs host (onion)	1653676.62	5	330735.81	23.70 **
Geographical origin vs diploid vs host (broadbeans)	194447.77	2	97223.89	7.00 **
Geographical origin vs diploid vs host (strawberry)	201392.13	1	201392.13	14.40**
Geographical origin vs tetraploid vs host (broadbeans)	360962.75	2	180481.38	12.90 **
Error	16117370.22	116	13942.85	
Total	6976411.39	129		

		Average body length in mm	
		Female	Male
Caryotype			
	Diploid	1.261	1.203
	Tetraploid	1.562	1.539
	Diploid + Tetraploid	1.324	1.278
Host			
	Onion	1.330	1.255
	Broadbeans	1.398	1.347
	Strawberry	1.077	1.101
Geographic origin			
	Italy	1.304	1.254
	The Netherlands	1.010	0.917
	Malta	1.459	1.428

** Significant for P = 0.01.

widespread, 2n = 24, two tetraploids, 4n = 54 and 4n = 60, found in Gozo (Malta) and the first of them also in West Germany (Sturhan, 1970), and a caryotype (n = 6) found in a single population from Portugal.

The main biometrical character that appeared clearly affected by the caryotype and by other exogenous factors as host and geographical origin is the total body length. The caryotype affected also the relationship between total body length and distance anterior extremity-vulva, and seems to have greater influence, compared to the other factors, in determining the lengths.

Apparently none of the populations examined belonged to the giant race as reported by Goodey (1941), which have a total body length ranging between 1.73 to 2.23 mm for female specimens and between 1.51 to 1.93 mm in males.

SUMMARY

Caryological studies carried out on populations of *Ditylenchus dipsaci* (Kuehn) Filipjev collected from various hosts and localities have confirmed the occurrence in this species of at least four caryotypes: 12, 24, 54 and 60 chromosomes. The total body length of both sexes was the only biometrical character clearly affected by the caryotype and by other exogenous factors such as host and geographical origin; however the caryotype appeared to have a greater influence with respect to exogenus factors.

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