Nematol. medit. (1985), *13*: 7-13.

Scottish Crop Research Institute, Invergowrie, Dundee, Scotland

THE EFFECT, AFTER FOUR YEARS, OF A CHANGE IN BIOTOPE ON THE MORPHOMETRICS OF POPULATIONS OF *XIPHINEMA DIVERSICAUDATUM* (NEMATODA: DORYLAIMOIDEA)

by
D. J. F. BROWN

The published morphometrics of different populations of *Xiphinema diversicaudatum* (Micoletzky) Thorne are very variable. Such variability may result from operator error, measuring system error, different methods of killing, fixing and mounting specimens or may be natural variation resulting from populations having adapted to survive in different biotopes (Brown, 1981; Brown and Taylor, 1981; Brown and Topham, 1984 and 1985).

Cultures of *X. diversicaudatum* from natural biotopes from different countries and continents were collected at the SCRI and maintained as breeding populations using a standardised method (Brown and Topham, 1984). Nematodes from these cultures were measured upon receipt at SCRI and, after four years, specimens from seven populations were remeasured to assess the effect of a change in biotope on their size and morphology. The results from these studies are presented and discussed here.

Materials and Methods

The original host plant species and geographical location of seven populations of *X. diversicaudatum* used in the study were *Ribes nigrum* L., Kostinbrod, Bulgaria; *Rosa* sp., Var, France; *Rubus idaeus* L., Lombardia, Italy; *Triticum spelta* L., Holzieken, Switzerland; *Prunus armeniaca* L., Alexandra, New Zealand; *Fragaria* x *ana-*

nassa Duch., Rygge, Norway, and *Prunus persica* L., San Diego, the United States of America. Each of these populations came from field sites, an exception being the French population which originated from a glasshouse. Upon receipt of the cultures at the SCRI ten female and five male specimens were extracted from each by using the method of McElroy *et al.* (1977), heat killed and fixed in triethanolamine/formalin (Courtney *et al.*, 1955; Seinhorst, 1966), and processed to glycerol using a slow replacement method. The remaining nematodes were placed in 30 cm diam. plastic pots each with a plant of *R. idaeus* cv. Malling Jewel, *F.* x *ananassa* Duch. cv. Cambridge Favourite and *Rosa* sp. and used to establish a breeding population. These populations were maintained in a heated glasshouse (18° C) with natural daylight.

After four years a further ten female and five male specimens were extracted and processed to glycerol by the same methods used previously. Using a Reichart Diapan microscope, with drawing arm attached, and with 6.3 fold eyepieces and 2.5, 4, 10, 63 and 100 fold objectives the length of body (L); length from anterior end to oesophageal-intestinal junction; length of tail; lengths of the odontostyle and odontophore; width at the anus and greatest width were measured for each nematode. With the female specimens the length from the anterior end to the vulva and with male specimens the length of body occupied by the testes were also measured. The results subsequently were analysed statistically using the GENSTAT computer package (Alvey *et al.*, 1982).

Results

The morphometric means obtained from specimens from the glasshouse populations were compared with the values obtained from the specimens taken from the original populations (Tables I and II). The mean L value for females was significantly larger for the Bulgarian glasshouse than the Bulgarian original population. Similarly, the mean L for females for the Italian and the Swiss glasshouse populations were significantly smaller than the mean L values obtained for the corresponding original populations. However, although the mean L values for males showed the same significant trend as the mean L values for females in the Bulgarian populations

Table I - *Morphometrics of female* X. diversicaudatum *(n = 10) from seven field populations and from specimens from the same populations but obtained four years after the populations were placed in a heated glasshouse.*

Population		L	ANTERIOR		TAIL	WIDTH		ODONTO	
			vulva	o/i junc		great	anus	style	phore
		(mm)	(mm)	(µm)	(µm)	(µm)	(µm)	(µm)	(µm)
Bulgaria	original	*4.30**	1.86	467.2	53.2	*55.5*	41.1	*120.4*	*74.9*
	glasshouse	*4.64*	2.01	492.5	55.7	*59.8*	42.2	*132.6*	*82.9*
France	original	4.30	1.84	459.1	*50.9*	*54.1*	38.6	124.2	*75.0*
	glasshouse	4.07	1.77	448.2	*55.5*	*58.1*	40.4	127.4	*78.8*
Italy	original	*4.24*	1.83	469.6	*44.6*	56.3	41.8	125.4	*74.3*
	glasshouse	*3.91*	1.70	451.3	*49.6*	57.4	43.5	127.5	*79.4*
New Zealand	original	4.53	1.95	502.8	49.3	*52.5*	*39.4*	*129.6*	*77.9*
	glasshouse	4.37	1.85	482.9	53.5	*63.7*	*45.4*	*134.8*	*82.6*
Norway	original	4.70	1.90	487.2	*48.2*	*56.2*	*42.7*	*129.3*	*77.7*
	glasshouse	4.51	1.88	500.7	*53.2*	*64.4*	*47.5*	*137.2*	*82.6*
Switzerland	original	*4.96*	2.07	518.8	49.1	64.9	45.9	136.1	*81.1*
	glasshouse	*4.52*	1.94	496.7	52.4	65.7	47.4	136.3	*87.5*
USA	original	4.58	1.84	464.9	*48.0*	*55.2*	*39.9*	*125.8*	*78.8*
	glasshouse	4.39	1.82	490.4	*55.1*	*61.3*	*45.4*	*134.5*	*85.2*
	LSD 5%	0.31	0.20	26.1	4.3	3.2	2.1	4.8	3.7

* Means in pairs of data in italics are significantly different from one another ($P < 5\%$).

the mean L values for males in the Italian and the Swiss glasshouse populations were significantly larger than those of the original populations respectively. This result, for males in the Italian populations, conflicts with the result obtained with the Italian females. Also, the mean L value for males in the New Zealand glasshouse population was significantly smaller than the mean L value for the original population. The mean anterior end to vulva values obtained from the original and glasshouse populations of the seven cultures of *X. diversicaudatum* were not significantly different within each culture. However, the values for testes were significantly larger in the glasshouse populations of the Bulgarian, Italian and Swiss nematodes and significantly smaller in the French glasshouse population when compared with the values obtained from the corresponding original populations.

Table II - *Morphometrics of male* X. diversicaudatum *(n = 5) from seven field populations and from specimens from the same populations but obtained four years after the populations were placed in a heated glasshouse.*

Population		L	TES-TES	ANT o/i junc	TAIL	WIDTHS great	WIDTHS anus	ODONTO style	ODONTO phore
		(mm)	(mm)	(µm)	(µm)	(µm)	(µm)	(µm)	(µm)
Bulgaria	original	*4.14**	2.49	*453.4*	52.6	*50.4*	41.4	*113.8*	*71.6*
	glasshouse	*4.51*	2.73	*497.2*	54.8	*55.8*	42.8	*134.4*	*80.8*
France	original	4.26	*2.63*	465.0	*53.6*	*49.0*	40.0	123.8	74.2
	glasshouse	3.96	*2.38*	457.6	*59.4*	*53.2*	41.8	126.0	77.6
Italy	original	*3.72*	*2.14*	448.6	46.8	*48.0*	*38.8*	*122.8*	*72.8*
	glasshouse	*4.22*	*2.60*	469.0	50.8	*55.4*	*44.4*	*134.6*	*82.4*
New Zealand	original	*4.81*	2.81	517.8	*50.8*	*50.0*	*42.0*	130.4	80.6
	glasshouse	*4.43*	2.99	505.6	*56.4*	*61.8*	*46.0*	135.0	82.8
Norway	original	4.06	2.49	458.0	*48.2*	*47.8*	*40.2*	*123.2*	*75.2*
	glasshouse	4.41	2.69	477.4	*56.8*	*60.2*	*44.0*	*131.4*	*84.2*
Switzerland	original	4.63	*2.54*	*515.6*	*48.8*	*56.4*	*44.2*	*132.4*	83.4
	glasshouse	4.68	*2.88*	*476.8*	*55.6*	*62.4*	*47.4*	*139.4*	85.4
USA	original	4.54	2.74	479.0	50.2	*50.6*	*41.6*	*123.8*	*76.8*
	glasshouse	4.39	2.78	503.0	54.6	*58.6*	*47.6*	*136.0*	*85.0*
	LSD 5%	0.36	0.24	30.1	5.0	3.6	2.4	5.5	4.3

* Means in pairs of data in italics are significantly different from one another ($P < 5\%$).

Generally the mean values for anterior to oesoph.-intest. junction were not significantly different for each sex within each pair of populations. However, exceptions were the mean values obtained with males from the Bulgarian and Swiss glasshouse populations which were significantly larger and smaller, respectively, than those of the original populations. The mean values for greatest body width, body width at anus and odontostyle and odontophore lengths were significantly different for one and/or the other sex within each pair of populations; being consistently larger for the glasshouse than the original populations. However, body width at anus for males and females from the Bulgarian and French cultures were not significantly different between the glasshouse and the original populations.

Discussion

Brown and Topham (1985) reported that morphometrics from a population of *X. diversicaudatum*, originally from a field site, Inchmartine, Dundee, cultured for four years in a heated glasshouse were significantly smaller than those recorded from specimens from the original field population. The present study confirms that the morphometrics of populations of *X. diversicaudatum* can change significantly within four years when the biotope is altered. It also reveals that morphometrics from *X. diversicaudatum* may be significantly larger in populations which have been cultured in a heated glasshouse when compared with those obtained from the corresponding original field populations.

Quantities of food eaten and whether or not the female nematode was newly moulted or gravid have been reported to result in differences in body length and width but not to affect stylet length (Fisher, 1969; Rhoades and Linford, 1961). None of the *X. diversicaudatum* examined in the present study were gravid. Furthermore, as mean stylet length (odontostyle and odontophore) was generally significantly different between the original and glasshouse specimens it is unlikely that food intake alone accounted for all of the morphometric differences recorded. Individual components of a biotope e.g. soil type, soil temperature, host plant, host plant physiology, etc., have been reported to influence morphometrics of nematodes (Bird, 1966; Bird and Mai, 1968; Fisher, 1965; Martelli *et al.*, 1966; Rhode and Jenkins, 1957). Reports such as these may be misleading as all components of a biotope are interrelated with each directly and indirectly affecting the others. Therefore, any effect recorded in nematode morphometrics is likely to be, at best, only correlated, and not necessarily related, to any particular biotopic component.

It is likely that morphometric differences which developed between the original and glasshouse populations of *X. diversicaudatum* reflect physiological differences. For example, differences in mean lengths of body occupied by the testes in males from the Bulgarian, Italian and Swiss original and corresponding glasshouse populations may be accompanied by differences in the fecundity of these populations. Similarly, differences in the lengths of components of the feeding apparatus e.g. odontostyle, odontophore, may affect food acquisition and the transmission of viruses by the nematodes. Therefore, the results obtained in biological studies may be influenced by the choice

of biotope from which nematode populations are taken and/or methods of culturing the populations.

SUMMARY

Several morphometrics showed significant differences between populations of *Xiphinema diversicaudatum* taken from field locations and from corresponding populations which had been cultured in a heated glasshouse for four years. Generally, larger morphometric values were recorded from those populations which had been cultured in the glasshouse although occasionally some morphometrics were significantly smaller in these populations. Morphometrics from female and male specimens from each population usually followed a similar trend although some exceptions to this were recorded. It is suggested that morphometric differences which develop between the field and corresponding glasshouse populations of *X. diversicaudatum* may reflect corresponding physiological differences. Therefore, the results of biological studies may be influenced by the choice of biotope from which nematode populations, used in such studies, are taken.

LITERATURE CITED

ALVEY N., GALWAY N. and LANE P., 1982 - *An Introduction to GENSTAT*. Academic Press, London. pp. 152.

BIRD G. W., 1966 - Influence of host and geographical origin on populations of *Trichodorus christiei*. *Nematologica, 12*: 88.

BIRD G. W. and MAI W. F., 1968 - Morphometric and allometric variations of *Trichodorus christiei*. *Nematologica, 13*: 617-632.

BROWN D. J. F., 1981 - The effect of operator and measuring system error on the morphometrical variability of one nematode specimen. *Revue Nématol., 4*: 169-171.

BROWN D. J. F. and TAYLOR C. E., 1981 - Variazioni nella trasmissione di virus tra popolazioni di nematodi vettori Longidoridae. Atti Giornate Nematologiche, Società Italiana Nematologia, Firenze, 28-29 novembre 1979, pp. 191-204.

BROWN D. J. F. and TOPHAM P. B., 1984 - A comparison of reported variation in the morphometrics of *Xiphinema diversicaudatum* (Nematoda: Dorylaimida) and the effects of some methods of preparing specimens for examination by optical microscopy. *Nematol. medit., 12*: 169-186.

BROWN D. J. F. and TOPHAM P. B., 1985 - Morphometric variability between populations of *Xiphinema diversicaudatum* (Nematoda: Dorylaimoidea). *Revue Nématol., 8*: (In press).

COURTNEY W. D., POLLEY D. and MILLER V. L., 1955 - TAF, an improved fixative in nematode technique. *Pl. Dis. Reptr, 39*: 570-571.

FISHER J. M., 1965 - Studies on *Paratylenchus nanus*. I. Effects of variation in environment on several morphometric characters of aduls. *Nematologica, 11*: 269-279.

FISHER J. M., 1969 - The relation between stylet and body length in *Aphelenchus avenae* with observations on *Paratylenchus nanus*. *Nematologica, 15*: 353-360.

MARTELLI G. P., COHN E. and DALMASSO A., 1966 - A redescription of *Xiphinema italiae* Meyl, 1953 and its relationship to *Xiphinema arenarium* Luc et Dalmasso, 1963 and *Xiphinema conurum* Siddiqi, 1964. *Nematologica, 12*: 183-194.

MCELROY F. D., BROWN D. J. F. and BOAG B., 1977 - The virus vector and damage potential, morphometrics and distribution of *Paralongidorus maximus*. *J. Nematol., 9*: 122-130.

RHOADES H. L. and LINFORD M. B., 1961 - Biological studies on some members of the genus *Paratylenchus*. *Proc. helminth. Soc. Wash., 28*: 51-59.

RHODE R. A. and JENKINS W. R., 1957 - Effect of temperature on the life cycle of stubby-root nematodes. *Phytopathology, 47*: 29.

SEINHORST J. W., 1966 - Killing nematodes for taxonomic study with hot f.a. 4:1. *Nematologica, 12*: 178.

Accepted for publication on 2 November 1984.