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THE LIFE CYCLE AND REPRODUCTIVE POTENTIAL OF INDIVIDUAL *TRICHODORUS SPARSUS* (NEMATODA) ON S. LUCIE CHERRY

by
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Summary. In a laboratory study, individual female *Trichodorus sparsus* from a northern Italy population had a longevity of *c* 22 wk on S. Lucie cherry plant. The reproductive span of the nematode was only *c* 16 wk and estimated mean total reproductive capacity was 215-225. It was calculated that development from egg to adult took 40-42 days. This species appears to have adopted a "K" survival strategy as for all tylenchs, longidorids and trichodorids. However, the relationship between cumulative total progeny production and observation times (weeks) for this species fits closely (r = 0.971) a logarithmic curve.

Trichodorus sparsus Szczygiel is a common species in northern Italy and is widely distributed in woods, vineyards and orchards (Roca and Lamberti, 1984; Coiro *et al.*, 1989, 1992). The biology and ecology of this nematode remain relatively unexplored and its capacity as a virus-vector has not been demonstrated. The aim of the present work was to study the overall length of the life cycle of the species. The nematodes used in this trial were from a population of *T. sparsus*, originating from the rhizosphere of a cherry tree growing in a vineyard near Verona, northern Italy.

Materials and methods

A culture of *T. sparsus* was maintained on S. Lucie cherry (*Prunus mahaleb* L.) in a green-house. Specimens were extracted from soil by decanting and sieving (Brown and Boag, 1988) and recovered from final extraction in Baermann funnels after four hours. Groups of one female and two males were hand-picked and inoculated to each of 12 plastic pots (25 ml) without drainage holes, containing about 10 ml of heat sterilized wet, white sand. A single newly germinated S. Lucie cherry seedling was then planted and a further amount of sand added to almost fill the pot. The pots were placed in a growth chamber operating at a 12 h day length and 27 ± 1 °C. Three and 7 days later, the sand in each pot was carefully and gently moved to allow direct observation of the plant roots with a stereoscopic microscope. Root systems of the host plants were re-examined after 14, 21 and 28 days. On each occasion care was taken to minimize disturbance to the nematodes. The nematodes in each pot were recovered at 4, 8, 12, 16, 20 and 22 weeks after adding individual females and males to the pots.

On each occasion males, females and juveniles were counted and their developmental stage was estimated by eye into four size grades using a dissecting microscope. The original female, when recovered, was returned always with two males to a new pot, containing a fresh S. Lucie cherry seedling. The experiment was terminated at week 22, when no females, males or progeny were recovered from the remaing pots in which an individual female had been placed at week 20.

Results

Three days after inoculation the nematodes were observed to be aggregated around the elongation zone and at beginning of the root hair zone. The stele of attacked cherry roots was characteristically deformed in the feeding zone.

At this time there was some superficial yellowing of the root and at 7 days there was extensive brown necrosis and root tips were rounded. Injury usually occurred around the entire circumference of the root. Eggs were first observed in the uteri of females 2 wk after commencing the experiment and by week 4 juveniles were recovered. A period of intense reproduction was recorded between weeks 4 to 8 and 8 to 12. Between weeks 12 to 16 reproduction was only 25% as intense as previously (Table I). At 4 wk a mean of 55 juveniles (49-65) were recovered from 12 females, many of which were gravid with a mean of 3.6 (1-4) eggs in the uterus. The developmental stages recovered were J1 (4%), J2 (28%), J3 (32%) and J4 (36%)

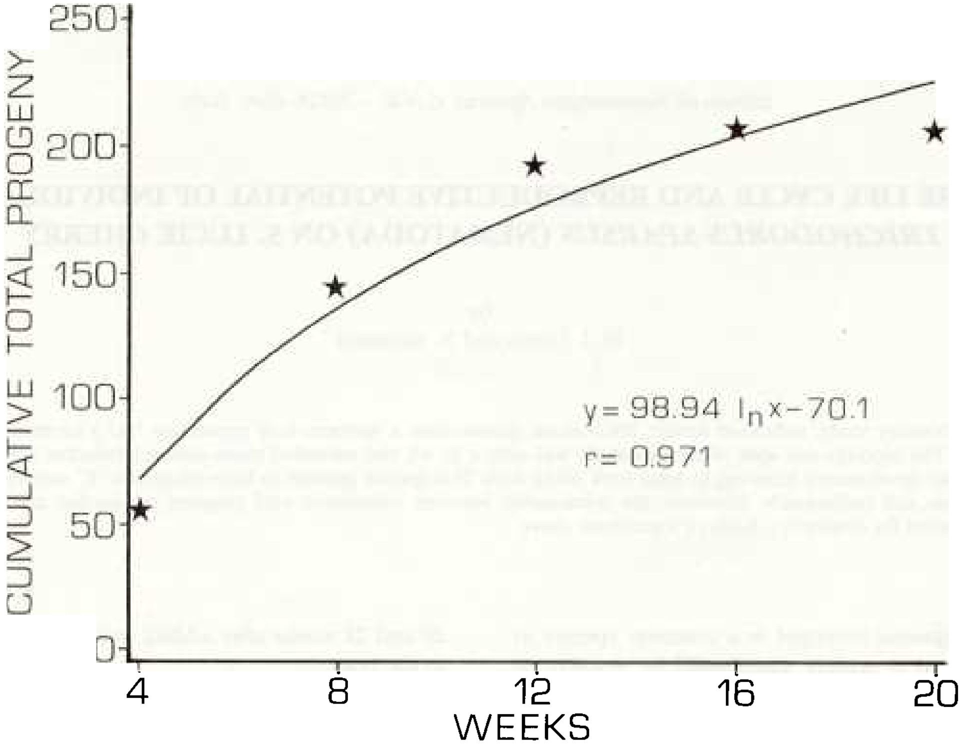

Fig. 1 - Relation between cumulative total progeny production and observation times (weeks) for *Trichodorus sparsus.*

TABLE I - *The reproductive capacity of individual female* Trichodorus sparsus *at 27°C on S. Lucie cherry.*

Nematodes/replicate 1♀ and 2♂♂	Number of juveniles					
	Weeks					Total
Pot n°	4	8	12	16	20*	
1	49	85	45	–**	–	179
2	61	90	42	–	–	193
3	52	93	54	–	–	199
4	50	87	50	7	0	194
5	51	89	43	11	0	194
6	53	86	46	12	0	197
7	57	92	47	16	0	212
8	54	94	49	12	0	209
9	50	95	52	14	0	211
10	63	85	55	13	0	216
11	56	97	49	12	0	214
12	65	97	48	3	0	213
Mean	55	91	48	11	0	205

* No juveniles or females were recovered at 22 wk; ** no females were recovered at 12 wk.

TABLE II *Analysis of population of* T. sparsus *at 4 wk intervals from individual females on S. Lucie cherry at 27 °C*

Week	Mean n° eggs/uteri	Mean n° developmental stages*			
		J1	J2	J3	J4
4	3.58 (1-4)	2	16	18	19
8	2.83 (1-3)	3	22	31	35
12	1.66 (1-2)	2	10	16	20
16	0 (0)	1	2	4	4
20	0 (0)	0	0	0	0

* Mean of 12 replicates; ( ) range of n° eggs observed in the uteri.

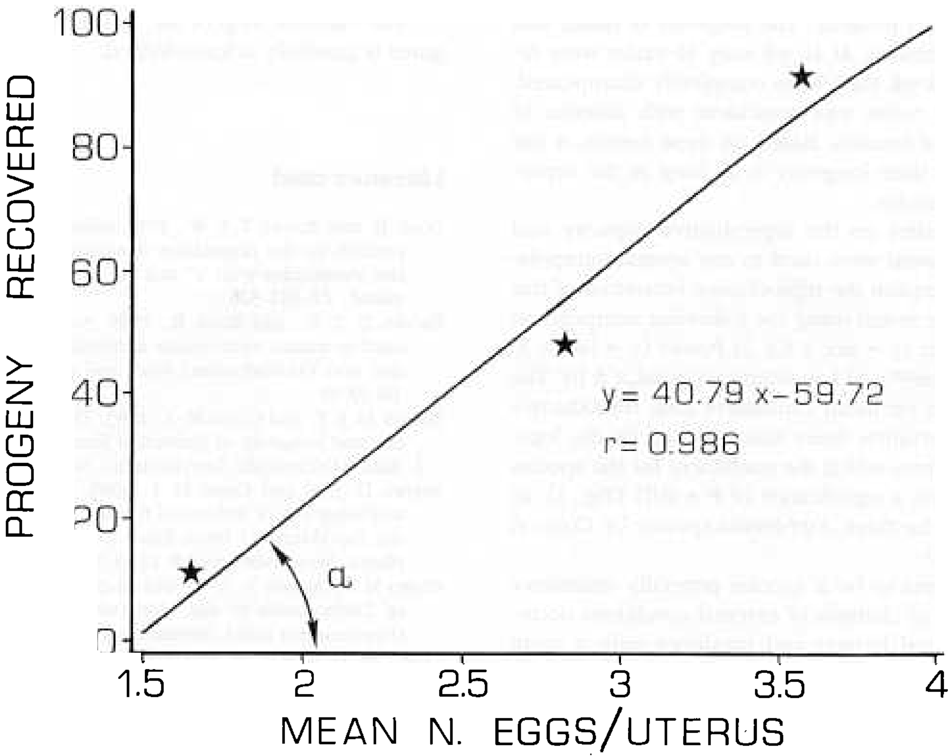

Fig. 2 - Relation between progeny recovered at 4 wk intervals and mean number of eggs noted in the previous observation in the uteri of *T. sparsus.*

(Table II). The fourth stage juveniles inoculated on some new S. Lucie cherry seedlings, reached the adult age in 10-12 days. Therefore, it is estimated that the life cycle of this species is about 40-42 days. From 4 to 8 wk females produced a mean of 91 (85-97) progeny being J1 (3%), J2 (25%), J3 (34%) and J4 (38%). Also, all females were gravid when recovered with a mean of 2.8 (1-3) eggs. From 8 to 12 wk a mean of 48 (42-55) progeny were produced by 12 females, viz. J1 (4%), J2 (21%), J3 (33%) and J4 (42%). Females were still gravid with a mean of 1.7 (1-2) eggs per individual. At 16 wk 3 females were not recovered and the remaining 9 females had produced a mean of 11 (3-16) progeny being J1 (4%), J2 (23%), J3 (31%) and J4 (42%). These females were not gravid but appeared still vital. No progeny were recovered at 20 wk and the 6 females remaining had translucent bodies and appeared relatively inactive. At 22 wk no progeny or live females were recovered (Table I and II).

Discussion

The methods used in this study are similar to those used by Brown and Coiro (1983, 1985) and Coiro *et al.* (1994, in press) with longidorid nematodes. In the present study, it is calculated that development from eggs to adult takes *c* 40-42 days. The longevity of females was slightly more than 20 wk and their reproductive span was *c* 16 wk. A mean total of 205 progeny were produced per female in 16 wk period, although the numbers of progeny recovered from each female were probably incomplete as some losses may have occurred during the extraction procedure and, also, unhatched eggs were not recovered. Assuming losses of 5 to 10% (Coiro, unpublished) the estimated total reproductive capacity of an individual female *T. sparsus* is 215-225 progeny. The longevity of males was less than that of females. At 16 wk only 10 males were recovered and at 20 wk they were completely disappeared. Disappearance of males was coincident with absence of eggs in the uteri of females. Based on these results, it can be estimated that their longevity is as long as the reproductive span of females.

Data from studies on the reproductive capacity and longevity of *T. sparsus* were used to test several interpolation formulae to explain the reproductive behaviour of this species. Data were tested using the following interpolation formulae: 1) Linear ($y = mx \pm b$); 2) Power ($y = bx^m$); 3) Exponential ($y = be^{mx}$); 4) Logarithmic ($y = ml_nx \pm b$). The best fit to the data on mean cumulative total reproductive capacity and observation times was obtained by the logarithmic equation from which the coefficient for the species was $r = 0.971$, with a significance of $P = 0.01$ (Fig. 1), as found previously for three *Xiphinema* species by Coiro *et al.* (1994, in press).

T. sparsus seems to be a species generally insensitive to adverse effects of changes of external conditions occurring in their natural habitat and produces only a small number of eggs per female, thus explaining the absence of strong fluctuations of population density. Therefore, it may be concluded that this species has adopted a "K" strategy for survival, similarly to *T. primitivus* and *Paratrichodorus pachydermus* (Boag and Alphey, 1988).

The relation between progeny recovered at 4 wk intervals and mean number of eggs in the uteri (as observed previously) of *T. sparsus* females may be represented by a linear regression from which it is possible to calculate the egg deposition rate of this species (Fig. 2). The deposition rate is the ratio between the progeny recovered and the mean number of eggs observed in the uteri in the previous period of observation. It corresponds to the "m" value ($m = 40.79$) of the linear equation of regression, that is the tangent of α angle between interpolation stright line and abscissa axis (Fig. 2).

The method used in this study allowed several aspects of the biology of *T. sparsus* to be examined eg.g. longevity, reproductive-cycle and reproductive capacity and could be applied to an examination of the biology of other trichodorid species.

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