The reproductive capacity and longevity of *Xiphinema index* (Nematoda : Dorylaimida) from three populations on selected host plants (1)

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SUMMARY

Under *Ficus carica* host plants, in a laboratory study done at 18°, longevity and the total reproductive capacity of female *Xiphinema index* from populations from Italy and the U.S.A. were the same. The nematodes survived for *c* 64 weeks, had a reproductive span of *c* 56 weeks and produced a total of *c* 150 progeny which was equivalent to an egg being produced every 25 day° above a minimum daily threshold soil temperature of 10°. Under *Lycopersicon esculentum* cv. Moneymaker females from populations from Italy, Israel and the U.S.A. survived for *c* 40 weeks and their reproductive capacity was only 20 % of that under *F. carica*, with 62 or 90 day° required for individual egg production. In a second experiment done in larger pots (250 ml *vs* 25 ml) at 22° Italian female nematodes required 21 and 48 day° for individual egg production under *F. carica* and *Vitis vinifera* host plants.

RÉSUMÉ

Taux de reproduction et longévité de trois populations de Xiphinema index *(Nematoda : Dorylaimida) sur certaines plantes hôtes*

Une étude faite au laboratoire a montré qu'à 18° la longévité et le taux de reproduction, sur *Ficus carica*, de femelles de *Xiphinema index* appartenant à des populations provenant des U.S.A. et d'Italie étaient identiques. Les nématodes survivent environ 64 semaines, ont une période de reproduction de 54 semaines et produisent environ 150 descendants, ce qui correspond à la ponte d'un œuf pour 25 jours/degrés, au-dessus d'un seuil minimum de température journalière de 10°. Sur *Lycopersicon esculentum* cv. Moneymaker les femelles de populations provenant d'Italie, d'Israël et des U.S.A. survivent environ 40 semaines et leur taux de reproduction n'atteint que 20 % de celui observé sur *F. carica*, le nombre de degrés/jours nécessaires à la ponte d'un œuf étant ici de 65 et 90. Lors d'une seconde expérience dans des pots plus grands (250 ml au lieu de 25), à 22°, des femelles provenant d'une population italienne élevées sur *F. carica* et *Vitis vinifera* ont demandé 21 et 48 jours/degrés pour la ponte d'un œuf.

Brown and Coiro (1983) reported the total reproductive capacity and longevity of female *Xiphinema diversicaudatum* (Micoletzky, 1927) Thorne, 1939 from a Scottish population. A similar study was done with female *X. index* Thorne & Allen, 1950 from Israel, Italy and the United States of America. The results from this study are presented here and are compared with those reported for *X. diversicaudatum*. Results from these two studies allow the longevity and total reproductive capacity of a thelytokous species, *X. index*, to be compared with that of an amphimictic species in the same genus, *X. diversicaudatum*. The reproductive capacity of female *X. index* from the Italian population on selected crop plants also was examined and the results are presented here.

Materials and methods

Populations of *X. index* were maintained on *Ficus carica* L. host plants in a glasshouse at the Istituto di Nematologia Agraria and were originally obtained from stock cultures kept under *Vitis vinifera* L. from California, U.S.A. (supplied by Prof. D. J. Raski, U.S.A. via Dr J. J. M. Flegg, U.K.); Bet Dagan, Israel (Prof. E. Cohn) and Bari, Italy.

The plant species used in the study were *Citrus aurantium* L., *F. carica*, *Olea europaea* L., *V. vinifera* and six cultivars of *Lycopersicon esculentum* L., Chico II × Rossol, Haubners Vollendung, Moneymaker, Nematex, Roma and Rossol. In the experiments the

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plants used were two to four weeks old seedlings except for the experiment done in 250 ml pots where *V. vinifera* rooted cuttings were used.

In an experiment done to examine the total reproductive capacity and longevity of individual female *X. index* the methods used were similar to those of Brown and Coiro (1983) and Coiro and Brown (1984). *X. index* from the three populations were extracted and individual fourth stage juveniles (J 4) or pre-adult females were hand-picked into a series of 25 ml plastic pots, without drainage holes. A plant seedling was added to each of the fifteen pots used for each plant species, for each population. The pots were maintained in a temperature controlled cabinet, similar to that of Taylor and Brown (1974), at 18° ± 1° with supplementary lights providing a minimum daylength of 16 h. After eight weeks nematodes were extracted from the pots, the juveniles counted and discarded and the female returned to a clean pot together with a new seedling. This procedure was repeated each eight weeks until the females were not recovered or were considered to have ceased feeding (translucent bodies) and were moving sluggishly.

A second experiment was done to examine the reproductive ability of female *X. index* on several crop plants. Five J 4 or pre-adult females from the Italian population were added to each of ten 250 ml plastic pots, without drainage holes, per plant species. The plants were allowed to grow in the pots in a glasshouse for sixteen weeks at 22°. Upon terminating the experiment the nematodes were extracted from all the soil contained in the pots, identified to developmental stage and counted.

Results

Longevity and total reproductive capacity

Under *F. carica* host plants longevity and the total reproductive capacity of female *X. index* from populations from Italy and the U.S.A. were similar. Juveniles were produced up to between 48 and 56 weeks. At 56 weeks the females remaining generally had translucent bodies and moved sluggishly, and, none were recovered at 64 weeks (Tab. 1). Differences between females in the numbers of juveniles which they produced were similar for both populations and the total mean numbers of juveniles produced had a coefficient of variation of *c.* 7 percent. Under *L. esculentum* cv. Moneymaker females from three populations of *X. index* produced fewer juveniles than under *F. carica* and reproduction ceased between 24 and 32 weeks although the females survived for another eight to sixteen weeks.

Reproductive ability under selected crop plants

Nematodes from the Italian population completed a life cycle (J 4 to J 4) in less than sixteen weeks on *F. carica* and *V. vinifera* host plants at 22°. After sixteen weeks under *O. europaea*, *C. aurantium* and five cultivars of *L. esculentum* only J 1 and J 2 were recovered except under *L. esculentum* cv. Nematex where a few J 3 were recovered (Tab. 2).

The day/degree (day°) requirement, above a daily threshold of 10°, for the production of each egg was calculated for the two experiments (Tab. 3). In the two experiments the Italian female *X. index* required a mean of 21.3 day° and 23.5 day° respectively under *F. carica* host plants to produce an egg. Females from the U.S.A. population required a mean of 26.1 day° under *F. carica* to produce an egg. The similarity of these values contrasts with a mean of 48.3 day° required by Italian *X. index* under *V. vinifera* for each egg produced. Under *L. esculentum* cv. Moneymaker *X. index* from Israel and the U.S.A. required 89.6 and 84.0 day° respectively to produce an egg whereas Italian females required only 61.8 day°.

Table 1

The mean (n = 15) total reproductive capacity of individual female *Xiphinema index*, from three populations, at 18° under *Ficus carica* and *Lycopersicon esculentum* host plants

Population	*Juveniles recovered (cumulative totals) (Weeks)*							
	8	16	24	32	40	48	56	64
				Ficus carica				
Italy	0	16	52	58	83	111	133	133
U.S.A.	9	14	50	63	112	112	120	120
				Lycopersicon esculentum cv. Moneymaker				
Italy	0	9	25	29	29	—		
U.S.A.	0	5	16	16	—	—		
Israel	5	10	19	20	20	—		

Table 2

Mean (n = 10) numbers of adults and juveniles of *Xiphinema index* recovered after 16 wk access to nine plant species

Plant	X. index *juveniles*				
	1	2	3	4	♀
Ficus carica	24	137	78	76	8
Vitis vinifera	23	70	28	18	6
Olea europaea	2	1	0	0	3
Citrus aurantium	6	2	0	0	2
Lycopersicon esculentum					
cv Roma	1	2	0	0	2
cv Rossol	4	9	0	0	3
cv Nematex	0	8	1	0	3
cv Chico II × Rossol	5	6	0	0	2
cv Haubners Vollendung	3	3	0	0	4

Table 3

Number of day°, above a minimum daily threshold of 10° required for the production of eggs by female *Xiphinema index* from different populations and under different plant species

Table 1	
Ficus carica	
Population : Italy	24 day°/egg
U.S.A.	26 day°/egg
Lycopersicum esculentum cv. Moneymaker	
Population : Italy	62 day°/egg
U.S.A.	84 day°/egg
Israel	90 day°/egg
Table 2	
Plant : *Ficus carica*	21 day°/egg
Vitis vinifera	48 day°/egg

Discussion

Techniques used in the present study of longevity and total reproductive capacity were similar to those used by Brown and Coiro (1983) with *X. diversicaudatum* under *Fragaria* × *ananassa* Duch. cv. Cambridge Favourite, and thus, results from both studies can be compared. The longevity of *X. index* on *F. carica* host plants and *X. diversicaudatum* on *F.* × *ananassa* was similar being 60 to 64 weeks and the total reproductive capacities for the two species were generally similar being 140 to 160 and 180 to 200 progeny respectively. Furthermore, *X. diversicaudatum* females produced an egg every 21 day° above a minimum daily threshold of 5° whereas *X. index* females produced an egg every 24-26 day° above a minimum daily threshold of 10°. The higher minimum threshold temperature was chosen for *X. index* as the nematode is associated with the warmer, *Vitis* growing, areas of the world, whereas, *X. diversicaudatum* is a northern European species (Brown, 1983). Female *X. index* from Italy and the U.S.A. had similar longevities and reproductive capacities under *F. carica*. Under *L. esculentum* cv. Moneymaker females from these and the Israel population also had similar longevities and reproductive capacities. However, total reproduction under *L. esculentum* was less than 20 % of that under *F. carica* and the nematodes developed less rapidly than under *F. carica*. Furthermore, longevity of the original J 4 under *L. esculentum* was much reduced compared with *F. carica*, 32 to 40 weeks and 56 to 64 weeks respectively.

The day° requirement for individual egg production by Italian nematodes under *F. carica* was similar in experiments with small (25 ml) and large (250 ml) pots (24 day° and 21 day° respectively). In the larger pots a mean of 48 day° was required by the Italian nematodes to produce an egg under *V. vinifera*, and, only a few J 1 and J 2 were produced under several other commercial crops and root stocks. It appears therefore that *F. carica* is a better host than *V. vinifera* for *X. index* and that *O. europaea*, *C. aurantium* and four commercially grown *L. esculentum* cultivars and cv. Haubners Vollendung are comparatively poor hosts for the nematode. These data are supported from field observations in southern Italy where *X. index* is frequently identified as large populations under *Ficus* and *Vitis* spp. but only occasionally associated with *O. europaea* and *C. aurantium*, and then only as relatively small populations. Futhermore, results from this study agree with those of Coiro and Brown (1984) who reported that *L. esculentum* cv. Moneymaker was a better host for *X. index* from Italy than was cv. Haubners Vollendung. The four commercially grown *L. esculentum* cultivars also were poor hosts therefore in general *L. esculentum* is probably a poor host for *X. index* from Italy.

The present study reveals that the longevity and reproductive capacity of *X. index*, a thelytokous species, is similar to that of *X. diversicaudatum*, an amphimictic species (Brown & Coiro, 1983). It seems probable that the results obtained in these two studies can be extrapolated for use with other *Xiphinema* species. The minimum temperature for reproduction required by a *Xiphinema* species may be used with the day° requirement for longevity and egg production as recorded for *X. index* and *X. diversicaudatum*. These data and the local daily mean soil temperature may be used to predict the life cycle and reproduction of the species and therefore allows for the planning of a cropping system which may prevent the nematode from completing its life cycle, or, for better determining the timing of chemical applications for controlling nematodes.

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