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POPULATION CHANGES OF *XIPHINEMA INDEX* IN RELATION TO HOST PLANT, SOIL TYPE AND TEMPERATURE IN SOUTHERN ITALY

by
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Field and laboratory investigations have indicated ,that several environmental factors, including temperature, soil moisture and soil texture, can influence the development of *Xiphinema index* Thorne *et* Allen (Radewald and Raski, 1962; Amici, 1967; Cohn and Mordechai, 1969, 1970; Cotten *et al.*, 1970; Prota and Garau, 1973; Weischer, 1975; Prota *et al.*, 1977; Coiro and Lamberti, 1978; Harris, 1979). The life cycle has been variously reported as two to 14 months, depending mainly on soil temperature and the seasonal growth of the host plants. In field studies a discrete annual cycle could not be identified and all life stages of the nematode were present throughout the year, which appears to be characteristic of most *Xiphinema* species (Flegg, 1966, 1968; Reudel, 1971; Harris, 1979). Laboratory studies by Brown and Coiro (1985) gave a more precise indication of the reproductive capacity and longevity of *X. index* in relation to host plant. They established that females could survive on fig (*Ficus carica* L.) for up to 64 weeks at 22°C, with a reproductive span of up to 56 weeks during which time each female produced about 130 progeny.

The experiment reported here attempted to bridge investigations in the laboratory and events in the field. It examined the effect of host and soil type on the population development of *X. index* in two temperature regimes over a period of two years.

Materials and Methods

Clay pots, 16 cm diameter, were filled with three types of soil, all steam sterilized: a sandy soil from Margherita di Savoia, Foggia (sand); a light

alluvial loam from Metaponto, Matera (loam); and a soil with 30% clay from Policoro, Matera (clay). Rooted cuttings of grapevine (*Vitis vinifera* L. cv. Regina) or fig were planted in the pots, each of which was then inoculated with 100 non-gravid *X. index* females, from a population obtained from the rhizosphere of fig trees, near Bari.

Half of the pots were distributed at random in a glasshouse at 24-25°C and RH 60-65%. The other pots were kept in a screenhouse and were subject to the seasonal and daily variations of the local mediterranean climate. The experiment was started in June (Year 1) and the pots were first sampled for nematode populations in the following September, and subsequently at three-monthly intervals for the next 18 months.

On each sampling occasion, 4 pots were randomly selected from each treatment; the soil from each pot was thoroughly mixed and nematodes were extracted from a 500 ml aliquot by wet sieving. The different life stages of the nematode were identified and counted. Females were identified as old, young, or young with eggs. Young females (without eggs) were subjectively differentiated by the clearly defined oocytes in the gonads, whereas in old females the gonads were empty and the uterus had a somewhat transparent appearance.

Results and Discussion

When the nematode populations were first sampled in September, following inoculation with 100 females per pot in June, they had already increased to large numbers. Figure 1 represents the mean of populations in sand and loam soils as the numbers of nematodes in the two soil types did not differ significantly whether on fig or grapevine, or in the glasshouse or the screenhouse (Fig. 3).

In the glasshouse, population densities continued to increase until the end of Year 2 to a peak of about 200 nematodes/ml soil and then they declined. Coiro *et al.* (1985) also found that populations of *X. index* build up to similar high densities after 9 months on susceptible grapevine rootstocks and Cohn and Mordechai (1970) observed that populations decreased after reaching a high peak.

In the screenhouse, there was a marked decrease in nematode numbers between September and December (Year 1) on both grapevine and fig (Fig. 1) and in all three soil types (Fig. 3). This seems to be a phenomenon associated with that particular environment as it was not apparent in the glasshouse and thus was possibly due to the effect of low winter

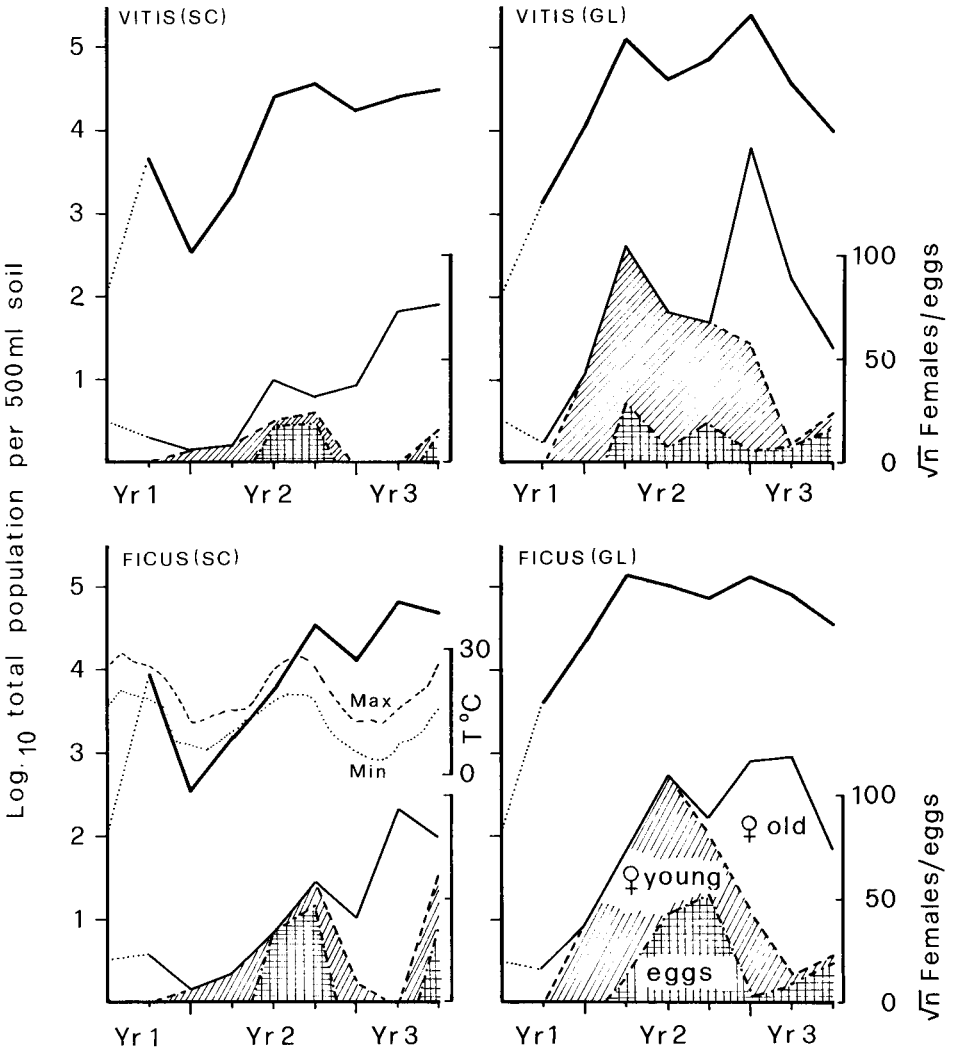

Fig. 1 - The development of populations of *Xiphinema index* on fig (FICUS) and grapevine (VITIS) in the glasshouse (GL) or screenhouse (SC). Mean of populations in sand and loam soil.

temperature on particular life stages, especially in the first six months of the experiment before the population structure had stabilised. At the end of Year 2 there was some indication of a decline in nematode numbers after reaching peak populations, both in the screenhouse and the glasshouse.

In the glasshouse, young females were present throughout the year and egg laying was virtually continuous from the beginning of Year 2, although peaks of production were evident particularly on fig (Fig. 1). As would be expected, populations increased more rapidly than in the screenhouse and more than three generations would be completed with a life cycle of 15 to 16 weeks at 22°C (Brown and Coiro, 1985) or more than four generations with a life cycle of nine weeks (Prota *et al.*, 1977; M. I. Coiro, pers. comm.).

In the screenhouse, egg laying was first observed in May and continued until the September sampling, which coincided with the period when the mean air temperature (minimum/maximum) was 15°C or above (Fig. 1). During this period more eggs were produced on fig than on grapevine, which is consistent with the requirement of 23 day degrees (day°) above a threshold of 10°C for each egg produced on fig and 48 day° on grapevine, as established by Brown and Coiro (1985). Based on these data, in the screenhouse egg production theoretically would extend from late March to November, with a peak in July/August. However, with an assumed threshold of 15°C, egg production would commence in May and continue until September, or early October, which accords with our observations (Fig. 1).

Eggs laid from May to mid-July would develop to young adults between August and October and further contribute to egg production. Those eggs laid after mid-July would develop to various juvenile stages by December, by which time soil temperatures begin to fall below 10°C and further development would be very slow or would cease until a rise in temperature, above 10°C, from about early March.

Assuming a requirement of approximately 1300 day° above 10°C (or 730 day° above 15°C) for the life cycle, as derived from data of Brown and Coiro (1985), in the screenhouse it is estimated that there would be one and a half generations within the year (2000 day° > 10°C; 900 day° > 15°C). If the life cycle takes only about 9 weeks at 22°C, as calculated by Prota *et al.* (1977), there would be just over two generations. A discrete cycle of reproduction is not apparent because of the longevity of the female and the extended period of egg laying, which may continue for up to 56 weeks at 22°C (Brown and Coiro, 1985) and presumably for longer at lower temperatures. Thus, in both the screenhouse and glasshouse, all life stages were present at any time during the year without any particular pattern being apparent (Fig. 2). However, the percentage of first stage juveniles

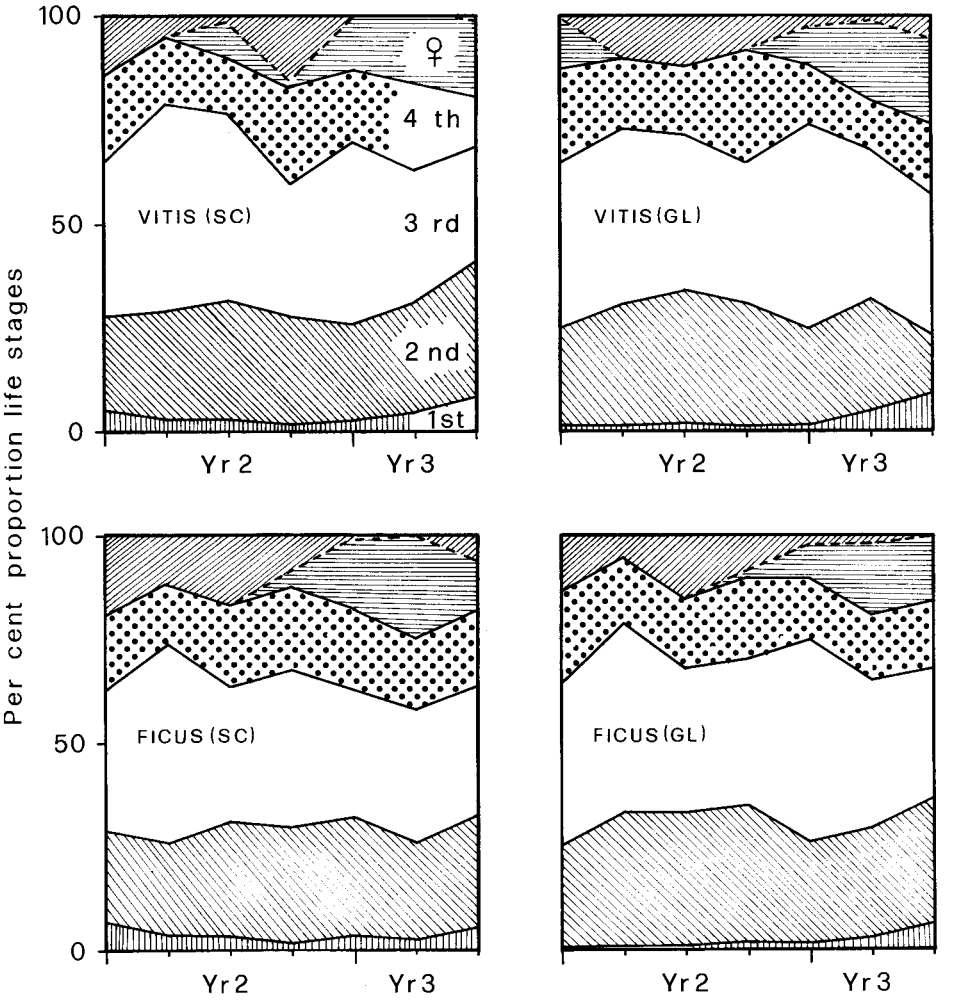

Fig. 2 - Population structure of *Xiphinema index* on fig and grapevine in the glasshouse or screenhouse in the second and third years following inoculation with 100 females per pot in June (Year 1). Mean of populations in sand and loam soils. Females - diagonally hatched, young; horizontally hatched, old.

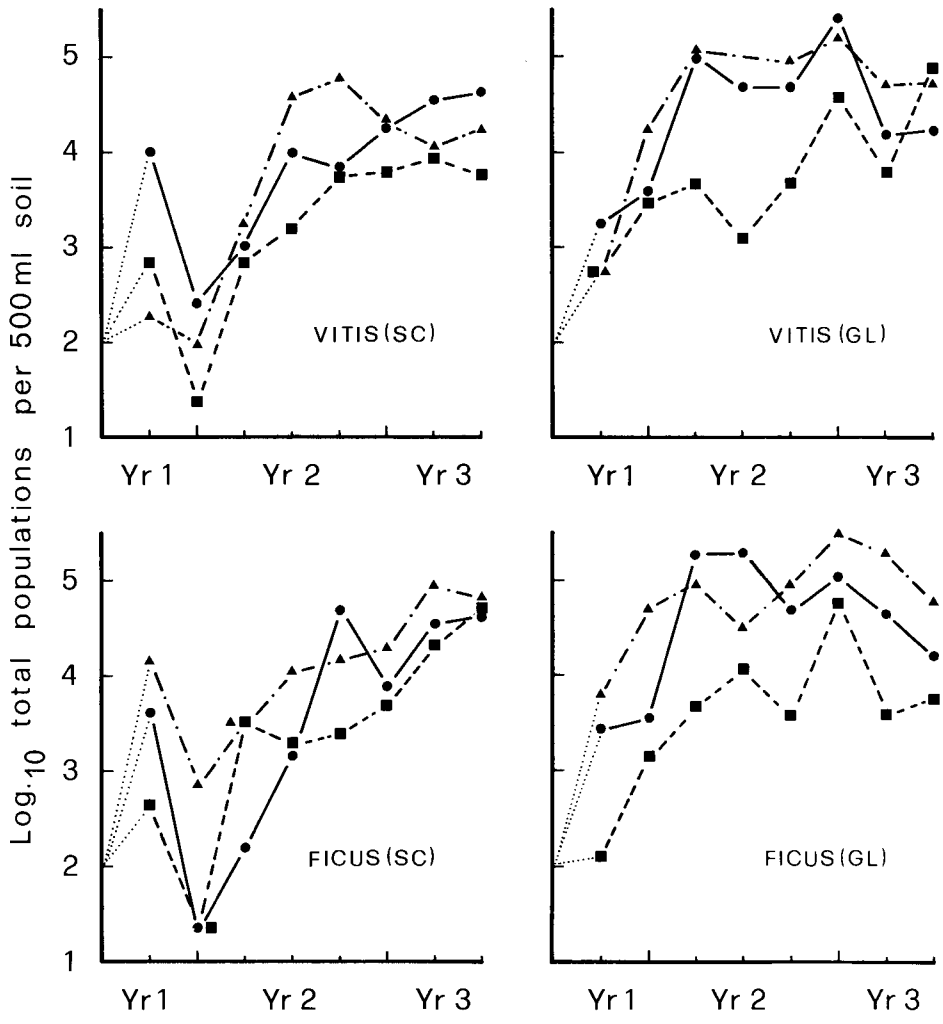

Fig. 3 - Effect of sand (· — ·), loam (▲ — ▲) or clay (■ — ■) soils on the development of populations of *Xiphinema index* on fig or grapevine hosts in the glasshouse or screenhouse.

was generally low on all sampling occasions, which is probably due to their short time of existence, compared with other life stages, rather than an underestimate of their numbers.

Although more eggs were produced on fig than on grapevine (cf. Brown and Coiro, 1985), there were no significant differences between the two hosts in the rate of increase of population density, whether in the glasshouse or the screenhouse (Fig. 1). Also, the population densities were similar in sand and loam, but populations on both fig and grapevine were generally lower and increased more slowly in clay soil (Fig. 3). In the screenhouse, the increase in numbers of *X. index* on grapevine was significantly greater in sand and loam than in clay; on fig, there was a significant difference between loam, but not sand, and clay. In the greenhouse, the rate of increase of *X. index* in sand and loam differed significantly from clay on both hosts.

The results of the experiment confirm that grapevine and fig are good hosts for *X. index* on which populations increase rapidly to high maximum densities. The events in the screenhouse probably reflect those in the field in southern Italy, and indicate that egg laying and rapid multiplication of *X. index* populations occurs from April/May to September/October. From December to February, it would be expected that development of the life stages is slow because of the low soil temperatures, but our results did not show whether this was also a period of high mortality. Peak populations in the screenhouse pots were reached within two years of their inoculation with females, and hence in the field it could be expected that *X. index* would rapidly build up to a peak population within a few years of initial infestation of the soil. Peak populations in the experiment were ca 200 nematodes/g soil but in most circumstances these are not likely to be reached in the field because of other interacting and competing factors.

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SUMMARY

Pots containing sterilized sand, loam or clay soil were planted with fig (*Ficus carica* L.) or grapevine (*Vitis vinifera* L. cv. Regina) and inoculated with female *Xiphinema index* Thorne *et* Allen. Half of the pots were maintained in a glasshouse (24-25°C) and half in a screenhouse

subject to seasonal and daily fluctuations of the local (southern Italy) temperature and were sampled monthly for a period of two years to ascertain nematode population densities in the different treatments. Fig and grapevine were both good hosts for *X. index* and peak populations of about 200 nematodes/ml soil were reached about 15 months after inoculation in the glasshouse, and slightly lower peak populations but after a similar period in the screenhouse. Populations then declined. In the glasshouse, young females were present throughout the year and egg laying was virtually continuous. In the screenhouse, egg laying continued from May until the end of September, coinciding with the period when the mean air temperature was 15°C or above. It is estimated that there were just over two generations completed per year in the screenhouse (field conditions) and about four in the glasshouse. Because of the longevity of the females and the extended period of egg laying, all life stages were present at any time during the year. Population densities were similar in sand and loam, but populations on both fig and grapevine were generally lower and increased more slowly in clay soil.

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