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RESPONSE OF « TROYER » CITRANGE SEEDLINGS INFESTED  
WITH *TYLENCHULUS SEMIPENETRANS* COBB  
IN THREE DIFFERENT SOILS

by

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The effect of several plant parasitic nematodes on their host may be greatly influenced by physical and chemical characteristics of the soil. The citrus race of burrowing nematode *Radopholus similis* (Cobb) Thorne was favoured by a coarse-textured soil, whereas *Pratylenchus coffeae* (Zimmermann) Filipjev-Schuurmans Stekh. was favoured by a fine textured soil (O'Bannon *et al.*, 1976; Tomerlin and O'Bannon, 1973). Also, damage to crops infested by *Meloidogyne* species is usually greater in sandy soils than in fine-textured soils (Sasser and Taylor, 1978). The citrus nematode *Tylenchulus semipenetrans* Cobb tolerates many soil types (Cohn, 1972), but the population densities of this nematode increased more rapidly in a fine-textured soil or in soils high in organic matter than in coarse sands (O'Bannon, 1971, 1976).

The purpose of this study was to evaluate the influence that three Sicilian soil types may have on the population dynamics of *T. semipenetrans* and on the nematode damage induced on « Troyer » citrange [*Citrus sinensis* (L.) Osb. x *Poncirus trifoliata* (L.) Raf.] seedlings, and subsequent effect of the nematodes on the seedlings in a glasshouse test, in Sicily, in 1976-1978.

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<sup>(1)</sup> With the technical assistance of Mr. W. Ranieri.

## MATERIALS AND METHODS

Three soils, a volcanic sand, coastal loam and calcareous sandy clay loam (U.S. Department Agriculture, 1951) were used in this experiment. Each soil had previously been steam sterilized and stored in containers for 40 days. Physical and chemical properties of the soils are shown in table I.

Table I - *Chemical and physical characteristics of the Sicilian soils used in this study.*

| Soil types                 | pH   | CaCO <sub>3</sub><br>(%) | Clay<br>(<0.002 mm)<br>(%) | Silt<br>(0.002-0.5 mm)<br>(%) | Sand<br>(0.5-2 mm)<br>(%) | Organic<br>matter<br>% |
|----------------------------|------|--------------------------|----------------------------|-------------------------------|---------------------------|------------------------|
| Calcareous sandy clay loam | 8.12 | 60.70                    | 36                         | 18                            | 46                        | 2.17                   |
| Coastal loam               | 7.60 | 8.23                     | 14                         | 34                            | 52                        | 0.83                   |
| Volcanic sand              | 8.35 | 2.10                     | 8                          | 12                            | 80                        | 2.79                   |

Sixty one month old « Troyer » citrange seedlings, grown in plastic containers in a mixture of equal parts of sand and peat, were artificially inoculated with about 28 non sterilized second stage juveniles and males of *T. semipenetrans* per ml of soil and maintained at 20-25°C on a glasshouse bench. Another container free of nematodes was maintained as a control. The nematode inoculum was obtained by incubating moist feeder roots of sour orange (*C. aurantium* L.) on 53 µm sieves in Petri dishes. Six months after inoculation, root samples of seedlings were incubated and found infested with about 200 active juveniles per g of feeder roots. Seedlings infested with citrus nematode or free of nematodes were transplanted individually into 18 cm clay pots, each containing one of the three soils. Each soil type was replicated ten times and the pots were randomized on a glasshouse bench. The seedlings were grown for up to 2 years at 20-28°C under routine cultural conditions. Twelve, 18 and 24 months after transplanting 2 g root samples from each pot were collected for nematode population counts. Root samples were cut into segments, washed gently in tap water and incubated in half litre jars in the dark at 22-24°C (Young, 1954). Active juveniles and males were counted after 2 and 4 days, and recorded as numbers of nematodes per g of fresh root. At the time of taking the root samples, the tops of the plants were measured, and then dried in an oven at 60°C to record

the dry weights. At harvest, top and root oven-dry weights of seedlings were obtained.

## RESULTS AND CONCLUSIONS

In all soils the nematode populations increased in the first year after transplanting infested seedlings. In the second year, populations decreased in the volcanic sand but increased in the other two soils, although a decrease was recorded after 18 months in the calcareous sandy clay loam (Fig. 1). Nematode numbers observed at all sampling dates were significantly ( $P = 0.05$ ) lower in volcanic sand than in coastal loam or calcareous sandy clay loam. At the last sampling date, nematode populations in volcanic soil were less than 1000 nematodes/g of root compared with more than 5000/g of root in the other soils. The growth of « Troyer » citrange seedlings was adversely affected by *T. semipenetrans* in each of the three soil types (Table II). Plant height and dry weights of tops and roots of infested plants were

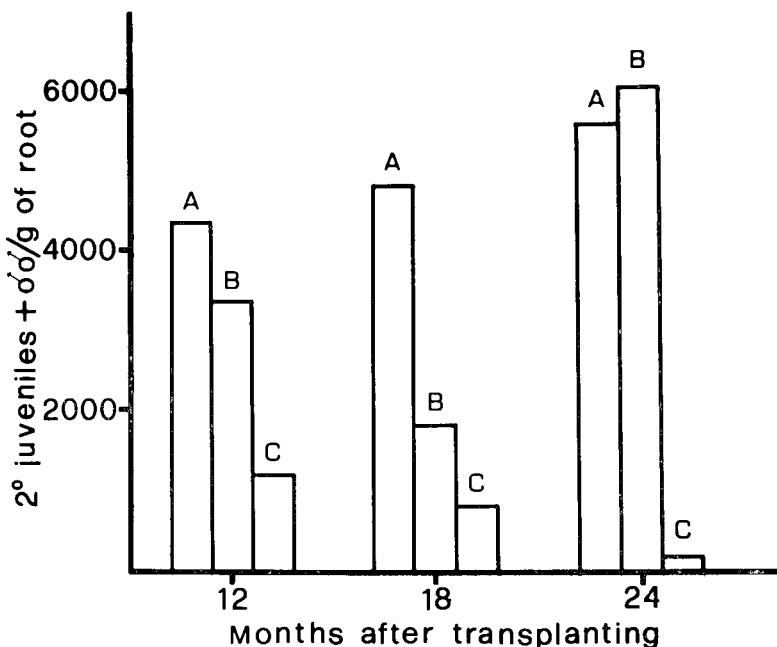


Fig. 1 - *Tylenchulus semipenetrans* populations density detected on « Troyer » citrange seedlings 12, 18 and 24 months after transplanting in a coastal loam (A), calcareous sandy clay loam (B) and volcanic sand (C).

Table II - Effects of *Tylenchulus semipenetrans* on the growth of «Troyer» citrange seedlings in three soils.

| Soil type                                | Height (cm) |          |  | Oven-dry top weight (g) |          |  | Oven-dry root weight (g) |          |  |
|--|-------------|----------|--|-------------------------|----------|--|--------------------------|----------|--|
|  | Control     | Infested | % of reduction with respect to the control | Control                 | Infested | % of reduction with respect to the control | Control                  | Infested | % of reduction with respect to the control |
| Calcareous sandy clay loam <sup>yz</sup> | 259 A       | 215 A    | 17 **                                      | 42 A                    | 33 A     | 21 **                                      | 18 A                     | 15 A     | 17   |
| Coastal loam                             | 234 B       | 216 A    | 8  | 32 B                    | 27 B     | 16   | 12 B                     | 9 B      | 25 *                                       |
| Volcanic sand                            | 189 C       | 151 B    | 20 *                                       | 23 C                    | 16 C     | 30 *                                       | 10 B                     | 7 B      | 30 *                                       |

<sup>y</sup> Means in the columns followed by the same letters are not significantly different ( $P = 0.01$ ) according to Duncan's Multiple Range Test.

<sup>z</sup> Significantly growth reduction of infested plants compared to non inoculated controls at  $P = 5$  (\*) and 1% level (\*\*), respectively.

less ( $P = 0.05$ ) than non-infested controls in volcanic coarse sand. A significant reduction in plant height and top weight ( $P = 0.01$ ) occurred in infested seedlings in the calcareous sandy clay loam compared with its control (Fig. 2). Only root weights of *T. semipenetrans* infested seedlings showed significant reduction ( $P = 0.05$ ) compared with its control in coastal loam.

Both infested and control seedlings in the volcanic coarse sand were significantly smaller ( $P = 0.01$ ) than those grown in the other two soils (Table II). This was due to some adverse soil factor which apparently accentuated nematode damage during the first year, whereas in the other two soils the more favourable pedological factors caused less stress to infested plants. The decrease in nematode population density observed in the volcanic soil during the second year resulted from a greatly deteriorated root system that could support relatively few nematodes. The lower population density detected in this soil during this experiment was similar to the low citrus nematode infestations reported by O'Bannon (1968) in the coarse sand of the Central Florida peninsula or detected in many Italian citrus orchards established on coarse river or volcanic sandy soils. It has been observed in citrus orchards in Florida (O'Bannon, 1971) citrus nematode populations built up rapidly in fine textured or high organic soils, where the conditions for nematode infestations were favourable, with a consequent early deterioration of the infested plant root systems. Conversely, in coarse and well drained soils nematode populations increased more slowly and root damage was less.

The results of this experiment indicate that in the three soils tested, which are representative of Sicilian citriculture, the citrus nematode is able to infest and cause damage to « Troyer » citrange rootstock. The severity of damage caused by the parasite in the volcanic sand appeared to be accentuated by adverse soil factors, possibly nutritional deficiencies resulting from rapid leaching or the absence of endomycorrhizal fungi.

The rootstock « Troyer » citrange, a hybrid derived from the citrus nematode resistant *P. trifoliata* and the susceptible *C. sinensis*, in this test showed the same degree of susceptibility to the Sicilian *T. semipenetrans* population as sour orange. Therefore, the introduction of this rootstock in place of sour orange in citrus orchards should be used only in fumigated soil otherwise it will be subjected to nematode attack and suffer damage.

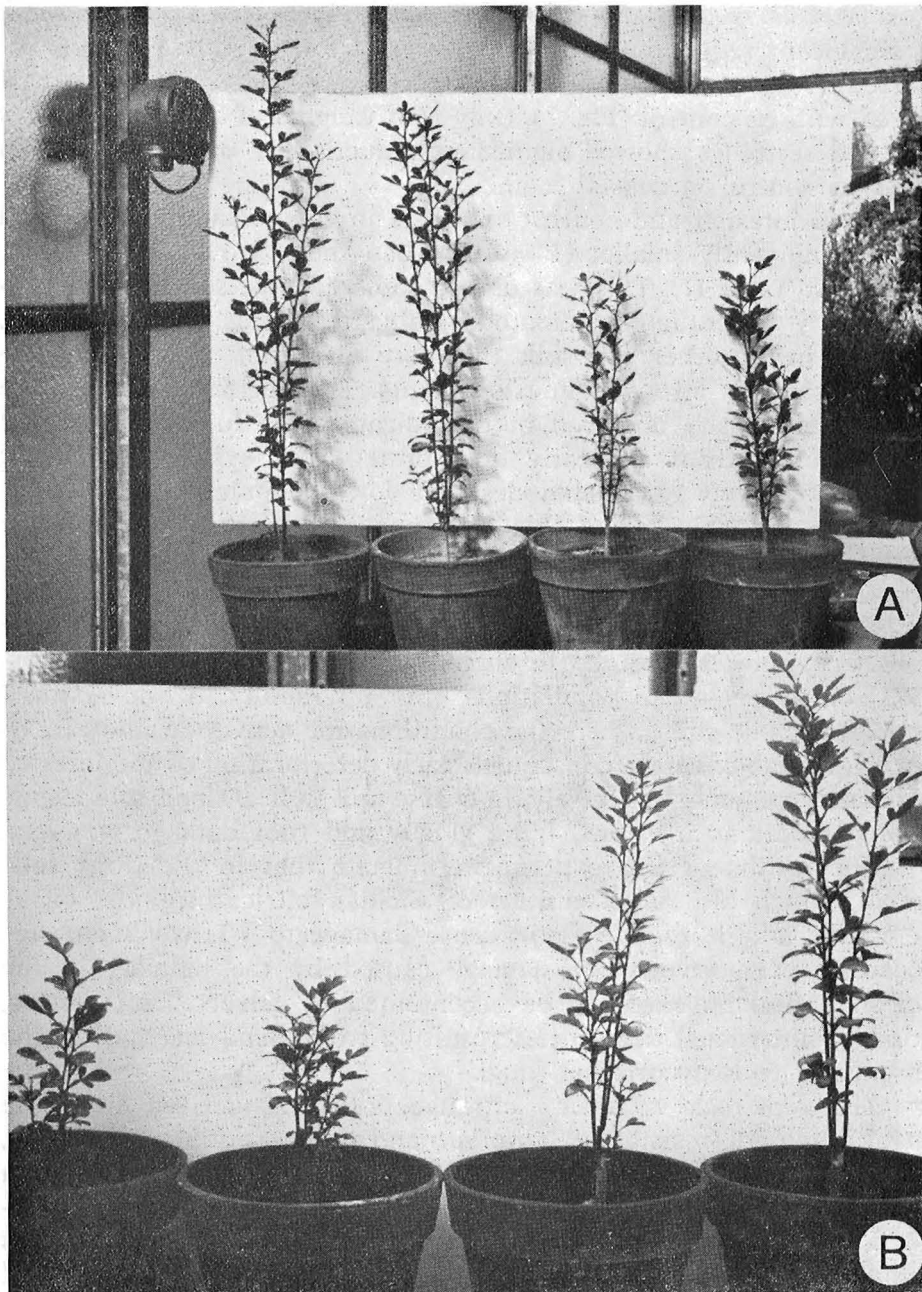


Fig. 2 - Effects of *T. semipenetrans* infestations on the growth of « Troyer » citrange seedlings in a calcareous sandy clay loam (A) and volcanic sand (B). The two plants on the right in A and on the left in B are infested, the other are uninfested.

## S U M M A R Y

*Tylenchulus semipenetrans* infested and nematode free « Troyer » citrange seedlings were grown in two fine textured soils, a calcareous sandy clay loam and coastal loam, and in a coarse textured volcanic soil collected in Sicily. The nematode population densities detected 12, 18 and 24 months after seedling transplant were significantly lower in the coarse volcanic sand than in the two fine textured soils. A significant reduction in plant height, or dry weights of tops or roots of infested seedlings compared to non-inoculated controls occurred in all the three soils but was greatest in the volcanic sand.

## R I A S S U N T O

*Effetto dell'infestazione di Tylenchulus semipenetrans Cobb su semenzali di citrange « Troyer » in tre tipi diversi di terreno.*

Semenzali di citrange « Troyer » sani e infestati da *Tylenchulus semipenetrans* sono stati allevati in un terreno calcareo (sabbioso, argilloso limoso) e in uno limoso costiero, ambedue a tessitura fine, nonché in un terreno sabbioso vulcanico a tessitura grossa, raccolti nelle zone agrumicole più rappresentative della Sicilia. La prova è stata eseguita in vaso e in ambiente controllato alla temperatura di 20-28°C. Le densità delle popolazioni del nematode rilevate 12, 18 e 24 mesi dopo il trapianto dei semenzali sono state significativamente inferiori nel terreno sabbioso vulcanico rispetto agli altri due a tessitura fine. In tutti e tre i terreni è stata osservata una riduzione significativa dell'altezza del germoglio principale e del peso secco della porzione epigea ed ipogea dei semenzali infestati, rispetto a quelli sani. Tale riduzione è risultata decisamente più marcata nel terreno vulcanico a causa della contemporanea presenza di fattori pedologici sfavorevoli.

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