

# Citrus-Root Nematode

effects on young lemon and orange trees studied in inoculation tests under controlled conditions

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**The citrus-root nematode—*Tylenchulus semipenetrans***—appears to affect the growth of young citrus trees in four ways: it may injure the bark of the roots; remove plant nutrients during feeding; impair the normal growth and functioning of the roots; and possibly inject a toxic material into the tree. Recently, investigations were undertaken to determine the effects of the nematode on young lemon and orange trees growing under controlled conditions, and to establish the causal relationship of the nematode to the frequent failure of young citrus trees to grow satisfactorily when planted on old citrus soils.

## Trees Tested in Pots

The lemon and orange trees used for the experiments were grown in containers. In each experiment four to seven trees were inoculated by placing larvae of the citrus nematode in the soil near the tree

roots, and a like number of trees were retained uninoculated for controls. Nematodes used for inoculation were obtained by placing infested roots in water. In a short time the water usually contained large numbers of larvae—the young nematodes. The larvae were freed from extraneous material and concentrated before using.

To be reasonably certain that the inoculum did not contain substances injurious to the growth of orange trees in addition to the nematodes, young sour and sweet orange seedlings—growing in 1- and 2½-gallon pots—were watered with 200 times or more the amount of solution that was transferred with the larvae in making the inoculations. No effect on the growth of the treated trees was observed.

The results of the study were obtained from 10 experiments involving four lots of sour orange seedlings, three of sweet orange seedlings, one of Campbell Valen-

cia trees on sour orange roots, one of Campbell Valencia on sweet orange roots, and one of Frost Eureka lemon on sour orange roots. The trees were grown for nine to 19 months, then their size and the degree of nematode infestation of their roots were determined.

## Fresh Weight Compared

The average fresh weight of the tops from the infested orange trees was from 10% to 50% below that of the noninfested trees in eight of the experiments conducted in a greenhouse. In one experiment with trees of Valencia orange on sweet orange root the diameter of the trunk was used for the criterion of tree size. In this case the infested trees were 35% smaller than the noninfested trees after growing outdoors for 18 months.

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Two noninfested—left—and two nematode-infested trees—right—of Campbell Valencia orange on standard sour orange root. The top growth of the infested trees weighed one half as much as that of the noninfested trees. The trees grew for nine months in five-gallon cans.

**Noninfested tree—left—and nematode-infested tree—right—of Campbell Valencia orange on Koethen sweet orange root. The infested tree was approximately one half the size of the control tree, the leaves were a normal green color. Both trees had grown for 18 months in large concrete tiles filled with soil and submerged in the ground.**



## NEMATODE

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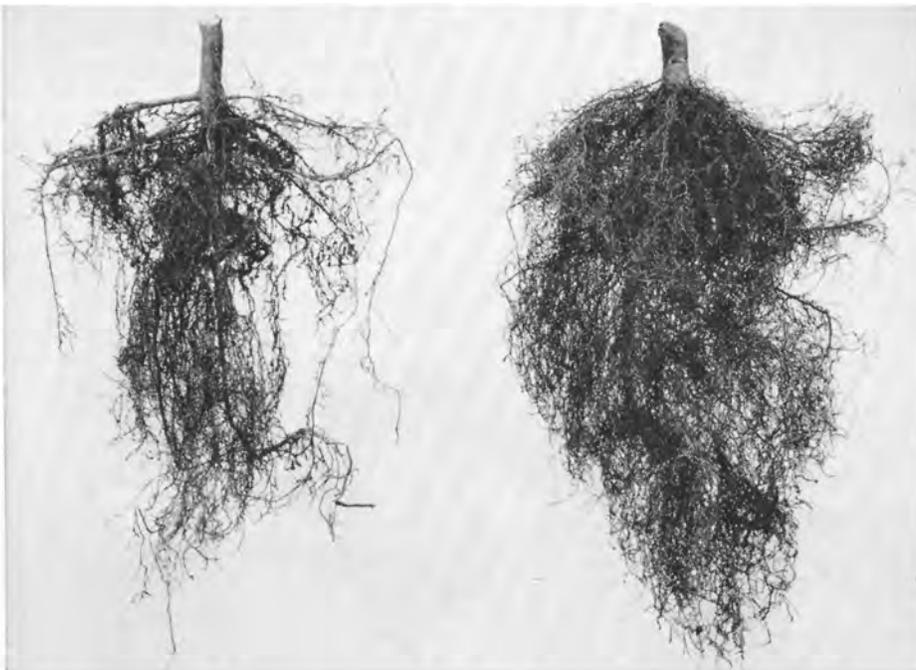
Lemon trees were affected similarly by the nematode. A group of eight Frost—nucellar—Eureka trees on sour orange root in five-gallon pots were 43.4% smaller than similar but noninfested trees after growing for 10 months in a greenhouse.

The roots of the Campbell Valencia seedlings on sour orange roots were freed from soil, dried, and weighed. The roots of the seven infested trees weighed only 60% as much as the roots from the seven noninfested trees.

### Degree of Infestation

The degree of infestation, which was based on the number of mature female nematodes attached to the roots, ranged from slight to severe. The sour orange and sweet orange seedlings showed slight infestations, while the infestations of the Valencias on standard sour roots and on sweet orange were severe. Roots classified as infested severely contained between 50 and 250 mature female nematodes per inch of the small feeder roots. The infestation on the roots of the inoculated trees in these experiments tended to be less severe than on roots of young trees infested naturally in the field. In the field the top two feet of soil, after infested trees have been removed, frequently contain between two and seven million citrus nematode larvae per cubic foot.

**Nematode infested—left—and noninfested—right—root systems of Campbell Valencia orange trees on standard sour orange roots. The infested root weighed 60% as much as that of the noninfested root. Fewer and shorter fibrous roots were produced on the infested than on the noninfested tree. The trees had grown for nine months in five-gallon cans.**



## Results from Inoculation of Young Lemon and Orange Trees in Pots with the Citrus Nematode.

Expt. No.	Type of tree	Treatment	Number of trees	Months grown	Decrease of top fresh wt. from control	Degree of infestation <sup>a</sup>
1	Sour orange seedling	Control	4	12	%	
		Nemas	4	12	25.8	Slight
2	Sour orange seedling	Control	6	12		
		Nemas	6	12	10.4	Slight
3	Sour orange seedling	Control	7	19		
		Nemas	7	19	15.1	Slight
4	Sour orange seedling	Control	7	9		
		Nemas <sup>b</sup>	7	9	36.0	Slight
5	Valencia on standard sour root	Control	7	9		
		Nemas	7	9	50.0	Severe
6	Sweet orange seedling	Control	6	12		
		Nemas	6	12	23.4	Slight
7	Sweet orange seedling	Control	6	12		
		Nemas	6	12	39.6	Slight
8	Sweet orange seedling	Control	6	12		
		Nemas	6	12	24.8	Slight
9	Valencia on sweet orange	Control	5	18		
		Nemas	5	18	35.0 <sup>c</sup>	Severe
10	Frost Eureka lemon on sour orange root	Control	6	10		
		Nemas	6	10	43.3 <sup>d</sup>	

<sup>a</sup> An infestation of 1 to 10 mature female nematodes per centimeter of root was classified as "slight," 11 to 20 nematodes as "moderate," and 21 or more nematodes as "severe."

<sup>b</sup> The nematode larvae were surface disinfected in copper sulfate solution before placing on the trees. This kills any brown rot fungi.

<sup>c</sup> Calculated from trunk circumference measurements.

<sup>d</sup> Calculated from measurement of height of trees.

In some of the experiments a fine mottle developed on the young leaves of the infested trees. This suggested that the nema-

todes had introduced a toxic substance into the trees.

Only citrus nematode-free trees should be planted on noninfested land, to insure the satisfactory growth of the trees and to prevent spread of the nematode.

Growers of nursery trees should take special precautionary measures to produce trees that are free of the citrus nematode. It is suggested that the trees be grown on new land, which is free of the nematode. If only infested land is available it should be fumigated thoroughly.

In recent tests, 500 to 1,000 pounds per acre of a soil fumigant consisting of a mixture of dichloropropane and dichloropropene eradicated the nematode satisfactorily. The lighter dosage is suggested for the porous, sandy soils and the heavier dosage for use on the compact, finer-textured soils. For best results the chemical should be applied at depths of 12 to 15 inches and injected at 12 to 18 inch spacings. To permit escape of the chemicals which are also toxic to trees, plantings should not be made before four months have elapsed.

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