

Root-lesion Nematodes

resistant rootstocks most promising method of control

M. W. Allen

Nematode injury to the roots of trees and vines frequently is responsible for the appearance of aboveground symptoms of disease. These symptoms are variable since their expression may be influenced by such factors as soil type, soil fertility, irrigation practice, presence of other root parasites, age of the plant, and the severity of the root injury.

Trees or vines suffering from nematode infection usually have one or more of the following top symptoms: reduced size, poor growth, sparse foliage, dieback of small twigs and branches, and reduced yield. If the infection is of long duration and conditions are favorable for the build-up of large numbers of nematodes, the plant may die.

Nematode infestations frequently are characterized by the difficulty that is encountered in establishing young seedlings in sites where infested trees have been pulled. In general it is not possible to establish satisfactory trees or vines of the same or a similar susceptible variety in areas in which the previous trees or vines have suffered from nematode infection. This condition may apply in cases where the previous trees or vines appeared to suffer little if any ill effects from the presence of nematodes. Here the failure of the new plantings may be due to the enormous concentration of nematodes around the small root system of the young seedling.

The nematode species which are most commonly found attacking the roots of trees and vines in California are the root-knot nematode, the citrus nematode, and the root-lesion or meadow nematode. Root-knot nematode infections are easily recognized by the presence of the con-

spicuous galls or knots that are formed on the roots of infected plants. The citrus nematode attacks only the roots of citrus and olive. Injury to the roots by this species is characterized by distortion and loosening of the cortex of the feeder roots. Such roots are killed if the infection is severe.

The root-lesion nematodes are a group containing the species *Pratylenchus pratensis*, *Pratylenchus musicola* and probably other undescribed species of the same genus. These nematodes have been known to occur in California for more than 20 years but their distribution and host plants are not well known. It has been only in recent years that they have become recognized as important parasites of the roots of cultivated plants, particularly of trees and vines.

Root Symptoms

The root injury caused by lesion-nematodes can be roughly divided into two types. Large necrotic lesions are characteristic of infections in the larger roots of cherry, fig, olive and walnut. The injury to the roots of apple, apricot, grape and peach is chiefly confined to the feeder roots and large lesions are rarely present. It is probable that in both types of injury the major damage to the root system results from the infection and killing of the feeder roots. It is frequently difficult to find feeder roots around trees that are severely injured by root-lesion nematodes.

The necrotic lesions which are present on some infested roots are apparently formed as a result of the feeding of large numbers of nematodes. These colonies are probably established from root penetra-

tion by one or only a few nematodes. When the infection is severe the lesions may become so numerous that only islands of healthy root tissue remain. The nematodes do not live in the dead and necrotic tissues but are found along the margins of the lesions feeding upon the adjacent healthy tissue. Such colonies are also formed in small feeder roots but so much root tissue is involved that the entire root is frequently killed.

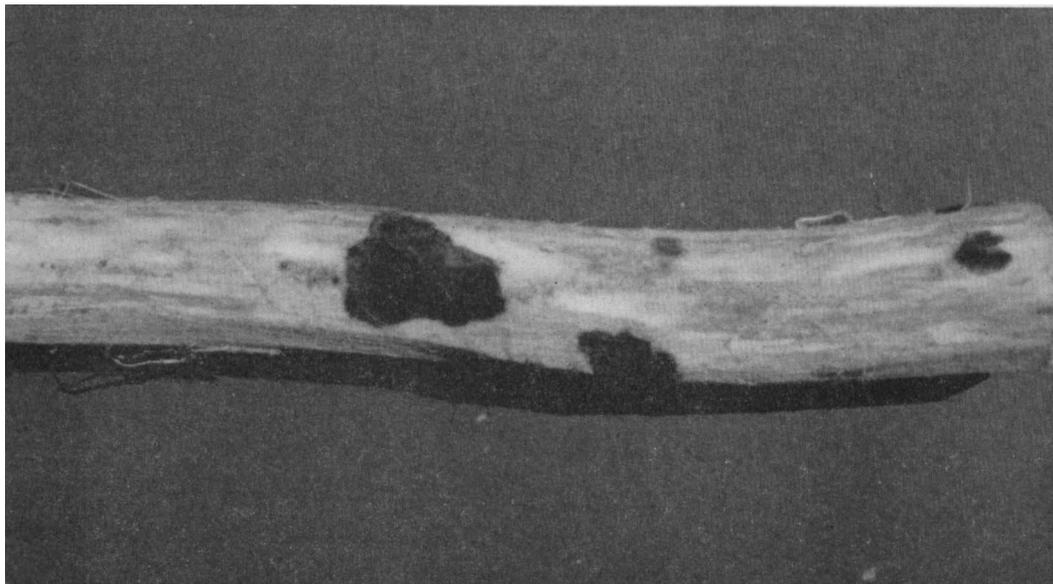
Recognition of Infestation

Root-lesion nematodes differ markedly from the root-knot nematode and the citrus nematode both in appearance and in their life cycle. The adult females of the root-lesion nematodes are slender and wormlike in contrast to kidney-shaped females of the citrus nematode and the pear-shaped females of the root-knot nematode. The adult females of the latter two species are not able to move from the site of the infection while the females of the root-lesion nematodes are able to move freely in the plant tissues and from root to root through the soil. Root-lesion nematodes are thus able to move from dead rootlets and enter nearby roots. Males of the root-lesion nematodes resemble the females in general appearance and are found commonly in both infected roots and in the soil around the roots.

The aboveground symptoms are of little or no value in determining the presence or absence of nematode infections. They are useful merely as indications of trouble. The presence of lesions and dead roots should not be regarded as positive evidence of nematode infestation since they may or may not be caused by root-lesion nematodes. The only safe procedure is the recovery and identification of the parasites from the roots. This may be complicated in some instances by the presence of other nematodes which feed upon the dead tissue of the root. It is therefore necessary to examine the nematodes under a suitable microscope and distinguish between the parasites and the species which are secondary invaders. It is nearly always possible to extract root-lesion nematodes from the soil around the roots of suspected trees providing root-lesion nematodes are present in the roots.

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Lesions caused by root-lesion nematode on northern California black walnut root after peeling off the external bark.



NEMATODES

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However, the parasites must be distinguished from other similar free-living species that are present in the soil.

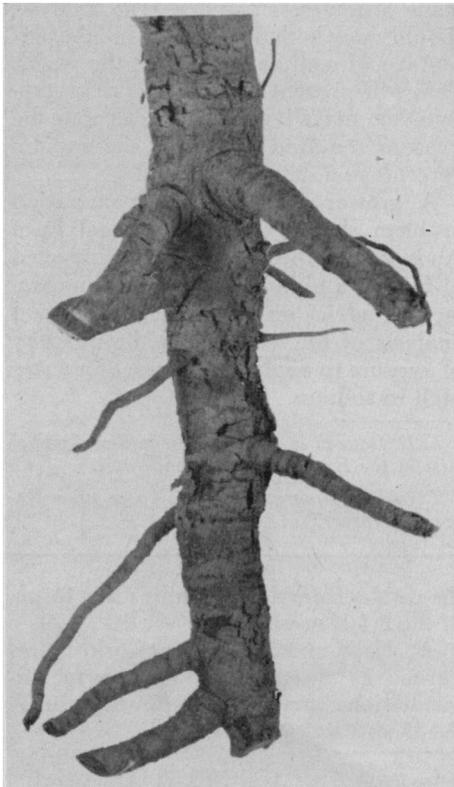
Method of Spread

Root-lesion nematodes can be spread to new localities by the planting of infested seedlings. Since these nematodes are able to penetrate into the roots of many different plants it is possible that they may be carried in the roots of plants that are not actually injured by the infection. They may leave the roots of these plants and later infect susceptible roots if they become available. It is extremely desirable that plants intended for replanting in other localities be grown in soil that is free of root-lesion nematode infestation.

Irrigation water and the movement of soil during cultivation and other cultural practices undoubtedly play an important part in the spread of the nematodes within an infested planting.

Control

There is very little information available on the control of root-lesion nematodes. They cannot be controlled in the roots since the available nematicides are toxic to living plants. It is possible to treat planting sites with a nematicide



Northern California black walnut root showing severe damage to young seedling root. The main root shows the external signs of the lesions.

prior to replanting. An area approximately six to eight feet in diameter should be treated at the dosage rate of about 400 pounds an acre preferably with a nematicide containing 1,3, dichloropropene. An interval of at least two weeks should be allowed between treatment and planting. It also is preferable to dig the planting hole two or three days prior to the actual planting. This allows the fumigant to escape from the soil more readily and is a safeguard against possible injury of the plant by the fumigant. Precautions should be taken to avoid introducing untreated soil into the treated area.

Fumigation of the soil enables the young seedling to get well established before it is again subjected to the attack of large numbers of nematodes. Fumigation does not kill all of the nematodes and it is possible that over a period of several years the population will again build up to a point where it will be injurious to the new tree or vine.

The most promising method of control appears to be in the development of resistant or immune rootstocks. The Division of Pomology at Davis is at the present time engaged in the testing of many rootstocks to determine which ones can be successfully grown in the presence of high populations of root-lesion nematodes.

Distribution and Host Plants

The distribution of root-lesion nematodes as it is known at the present time is indicated below. Undoubtedly intensive surveys would greatly increase the known distribution as well as the host plant list. Host plants, and the counties where they are found are: apple in Sonoma; apricot in Madera; avocado in Los Angeles; cherry in Riverside, San Joaquin, Yolo; Croft lily in Humboldt; fig in Merced, Riverside, Tulare; grape in Fresno, Madera, Tulare; guayule in Monterey; olive in Riverside, Tulare, Yolo; peach in Sacramento; plum, on apricot root, in Kern, and walnut, in Butte, Fresno, Kern, Orange, San Bernardino, San Joaquin, Santa Barbara, Santa Clara, Solano, Stanislaus, Tehama and Yolo.

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FLAX

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burns back these weeds, dries both the weed seed and the flax, reducing the possibility of heating in storage and making it possible to harvest by direct combining. This spraying also eliminates the

necessity for windrowing and prevents the loss in flaxseed which usually occurs by shattering due to windrowing. In addition to these benefits, it reduces the amount of dockage and allows fields to be harvested earlier than normal.

The most promising material used in tests in 1947 and 1948 is a highly fortified oil. This consists of two to three pints of a general contact weed killer used to fortify 10 to 15 gallons of general contact weed oil per acre. All applications are made by airplane and the heavier application is used where weeds are heavy and the lighter application where only moderate weed growth is present. Fields containing excessively large thick pigweed and lambsquarter can not be successfully killed back to allow combining. Redweed present only in moderate amounts and scattered can be effectively killed, but where the redweed is heavily clumped and forms a mass, only the tops will be burned and windrowing still will be necessary.

Precaution Necessary

Precaution is necessary in the use of this highly fortified oil since it is injurious to other crops such as alfalfa, citrus, ornamentals and truck crops. Care in application and a minimum of drift is essential.

In 1948 a single field was divided into two equal parts, one half received a preharvest spray and was combined direct; the other half was not sprayed but windrowed before threshing. The yields of the sprayed and unsprayed portions of the field were as follows:

	Preharvest sprayed (direct combined)	Unsprayed (windrowed)
Yield per acre (bu.)	35.9	27.5

The dockage in the sprayed portion of the field was only about half as much as that of the portion of the field which was not sprayed.

Preharvest spraying also speeds up harvesting as a field can be harvested three to six days after spraying.

Since the cost of preharvest spraying is \$7 to \$10 per acre, it is essential to be able to recognize weed conditions that will more than repay the cost of application. Where weeds are not numerous, preharvest spraying usually is not practical and where the weed growth is extremely heavy and consists of very large weeds, spraying is of little benefit and the desired results are not accomplished. It is the intermediate condition between light and excessively heavy weed growth that must be recognized in order to obtain all the benefits from preharvest spraying.

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