

Root-Lesion Nematode Injury

trials under way to determine resistant or tolerant rootstocks for fruit and nut trees

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The root-lesion—or meadow—nematode has been found widely scattered in California by United States Department of Agriculture and Experiment Station workers. In 1941 it was found associated with die-back of bearing sweet cherry trees in Riverside County. About the same time it was found on walnut trees showing poor vigor in Ventury County. Since then it has been identified on walnuts in several southern California counties and also in the San Joaquin, Sacramento, and Santa Clara valleys and Sierra Nevada foothills. Fig and olive roots have been reported frequently infested with this nematode. Apple, almond, peach, pear, plum, and quince roots have been reported infested.

It is now apparent that the root-lesion nematode is doing serious damage to commercial English—Persian—walnut and sweet cherry orchards in several districts in California. Less is known of the extent of the damage caused by this nematode to other species of fruits and nuts, although some cases of low tree vigor have been observed associated with a high population of the nematode and characteristic symptoms.

Mature walnut and sweet cherry trees severely attacked by the root-lesion nematode are observed to make weak, sparse growth, followed by dying back of twigs or branches at the ends of main limbs.

Examination of roots of such trees shows that many of the small fibrous roots have been killed. The scarcity of live feeder roots is very noticeable. In some species of rootstock—such as Northern California Black Walnut *Juglans hindsii*—large lesions or cankers are easily found on roots ranging from about one quarter inch up to six inches or more in diameter. These lesions vary in diameter from about one eighth inch to two inches or more and often develop deep cracks in the killed bark parallel to the axis of the root.

The lesions gradually grow deeper and often completely kill the bark within their margins. They have distinct but expanding margins, enlarging laterally around the roots of young trees faster than longitudinally, and sometimes completely girdling and killing roots.

New roots grow out above the girdled area and the tree is able to maintain a weakened root system.

In some districts small trees used as replants in old orchards or planted on land where old trees have been removed recently seem especially subject to severe attack by the root-lesion nematode. Presumably this is because of a high population of the nematode which has built up on roots of the old trees. In such cases injury to feeder roots of young trees seems similar to injury on old trees but in addition large lesions are often formed on the young trees just below the crown, sometimes girdling a main root.

Lesions have been found on roots of walnut, olive, fig, and cherry trees.

Tests of Juglandaceae

In a mature English walnut orchard in Ventura County—on Northern California Black rootstock—some of the trees

were showing very low vigor and the presence of the lesion nematode had been determined. In April, 1943, four of the weakest trees were pulled and five or six one-year-old seedling trees of several species of Juglandaceae were planted in a circle about five feet in diameter at each former tree location. Early in 1944 four other groups were planted in similar tree locations and in 1945 another group was added. They were given the normal care received by old trees in the orchard.

The seedlings, with the exception of wingnuts—*Pterocarya stenoptera*—made very poor growth. Root specimen examinations showed lesion nematodes present in large numbers. In February 1948, the trees were measured, pulled by tractor and examined at once. Lesions and severe root damage were found on all excepting the wingnuts.

Franquette walnut branch showing typical die-back and weak growth associated with severe root-lesion nematode injury.



Results indicate outstanding vigor of wingnut and either resistance or tolerance of this species, with no lesions found despite a high population of the nematode in the surrounding soil. Some of the seedlings of each *Juglans* species tested were seriously injured.

In an English walnut orchard—in Santa Clara County—approximately 30 years old, mostly on Northern California Black Walnut—*Juglans hindsii*—rootstock, many trees are in very low vigor and dying back.

There are a few trees on Paradox hybrid root—presumably *J. hindsii* crossed with *J. regia*—which show outstanding vigor. On examination, *J. hindsii* roots were found to have numerous lesions and many small rootlets had been killed. Nematologists found root-lesion nematodes present on specimens submitted. No lesions on Paradox hybrid roots were found, and small live rootlets were numerous.

Three one-year-old interplants of Paradox seedlings were examined in May 1948, and no lesions were found while three one-year-old interplants of *J. hindsii* all had lesions on their main roots.

Test Nurseries

Test nurseries were established in Riverside County in 1945 and in Yolo County in 1948, in which were planted specimens of most of the common rootstocks used for deciduous fruit trees, nuts, olives and grapes. In addition there

Ventura County Plot

Trees Measured, Pulled and Examined in February, 1948

| Species | Age of trees | No. of trees | Average height (feet) | Av. circumference (inches) | Severity of injury to root system (1-5)* |
|---------------------------------------|--------------|--------------|-----------------------|----------------------------|--|
| <i>Juglans regia</i> | 5 | 4 | 6.6 | 6.2 | 3 |
| <i>Juglans hindsii</i> | 5 | 4 | 6.1 | 5.4 | 3 |
| <i>Juglans hindsii</i> | 3 | 1 | 3.5 | 3.2 | 5 |
| <i>Juglans nigra</i> | 5 | 4 | 8.8 | 6.6 | 3.5 |
| <i>Juglans nigra</i> | 4 | 4 | 4.2 | 3.5 | 4 |
| <i>Juglans californica</i> | 4 | 4 | 5.8 | 3.9 | 4.3 |
| <i>Juglans honorei</i> | 5 | 4 | 4.8 | 4.3 | 4 |
| <i>Juglans</i> sp. (Mexican black) | 4 | 4 | 3.3 | 3.5 | 4 |
| <i>Juglans sieboldiana</i> | 4 | 4 | 5.2 | 5.1 | 3 |
| <i>Juglans major</i> | 4 | 4 | 4.7 | 4.1 | 4.3 |
| <i>Juglans rupestris</i> | 4 | 2 | 6.0 | 3.7 | 4 |
| <i>Juglans cinerea</i> | (xx) | 4 | | | |
| <i>Pterocarya stenoptera</i> | 3 | 6 | 13.6 | 7.8 | 1 (xxx) |

* Estimates based on number, size and penetration of lesions on main roots and proportions of root system destroyed. The relative resistance (or tolerance) is graded numerically as follows: (1) no appreciable injury, (2) slight injury, (3) moderate injury, (4) severe injury, (5) very severe injury.
(xx) All died after second year but cause not definitely determined.
(xxx) Some *P. pratensis* found in root tips.

were included some species and varieties of walnut, cherry, plum, apricot and peach not now used as rootstocks.

In the Riverside plot wingnuts have shown outstanding vigor as compared with walnut species.

A few Paradox—*J. hindsii* crossed with

J. regia— hybrid rootstocks can be found in many of the English walnut orchards in California, as they occur naturally in many lots of nursery seedlings of *J. hindsii*. In these investigations so far they have been at least as satisfactory as *J. hindsii* although their relative resistance to oak root fungus—*Armillaria mellea*—has not been fully determined. In some cases their greater vigor has been a decided advantage.

The question of use of one or more species of wingnut—*Pterocarya*—as rootstocks for English walnut has been given some attention.

There is one ten-year-old English walnut tree on *Pterocarya stenoptera* in the U. S. D. A. Plant Introduction Garden near Chico, making excellent growth. There are two nursery budded trees in the experimental orchard at Davis with tops in their fourth growing season and three orchard budded trees with tops in their third season. Thorough testing of this combination will require many years.

Preliminary tests of 12 species and hybrids of Juglandaceae, have indicated that Paradox walnut hybrids—*Juglans*—and wingnuts—*Pterocarya*—have either a high degree of resistance to, or marked tolerance of, the lesion nematode in the situations where tested.

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Left. Payne walnut on Paradox rootstock in good condition. Right. Payne walnut on *Juglans hindsii* rootstock declining. Trees are 30 years old.

