

Root-lesion Nematode on Walnut

replants of California black walnut and unselected Paradox hybrid responded to preplanting soil fumigation in trials

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Infestations of root-lesion nematodes—*Pratylenchus vulnus*—occur in all important walnut growing areas in California and high population densities cause a disease of economic importance. The disease is characterized by stunting, die-back, and chlorosis in the tops of the trees; by yield reduction; and by root symptoms consisting of black lesions, longitudinal cracking, and even death of entire roots. The disease has been induced experimentally by adding a suspension of the root-lesion nematodes to California black walnut seedlings.

The present lack of sufficiently resistant rootstock material makes alternative control measures necessary. Reduction of nematode populations before planting susceptible rootstocks, or reduction of existing populations around living rootstocks by chemical treatment are two alternatives being investigated.

The most reliable nematocidal chemicals available today are volatile liquid halogenated hydrocarbons, used as soil fumigants. Most of these chemicals are very toxic to living trees, but one—1,2-dibromo-3-chloropropane—has been applied around living walnuts at nematocidal dosages without noticeable injury.

Pressure-chisel machine applications of three nematocides, Shell DD—1,3-dichloropropene, 1,2-dichloropropane; Dowfume W85—1,2-dibromoethane; and Shell Nemagon—1,2-dibromo-3-chloropropane—were made on entire planting sites in two walnut orchards in San Joaquin County and one orchard in Ventura County. Mature trees, showing poor growth and reduced yields because of root-lesion disease, had been pulled from the orchards shortly before treatments were made. Fumigants were applied to an 8" depth. Soil moisture, temperature, and preparation were favorable, but many roots from the recently pulled diseased trees remained in the soil.

The two San Joaquin County orchards were on sandy silt loams with moisture equivalents of 9.3% and 14.0%. Two replicates of three different preplanting fumigation treatments were made in each orchard on the same date. A California black—*Juglans hindsii*—seedling and an unselected Paradox hybrid—*J. hindsii* crossed with *J. regia*—seedling were planted at each site, in March 1954, two months after soil fumigation. In 1954 and in 1955 growth of California blacks and Paradox hybrids was strikingly better at all treated sites than at untreated sites, where growth of neither was satisfactory. Because both Paradox hybrids and California blacks were planted at each site, and because the

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Growth of Walnut Replants and Soil Nematode Density Following Several Preplanting Fumigation Treatments in Two San Joaquin County Orchards

Fumigant	Dosage/A	1954		1955	
		Terminal growth (in.)	<i>P. vulnus</i> /pt. soil	Trunk circ. (inches)	<i>P. vulnus</i> /pt. soil ^a
Dowfume W85	15 gals.	82	9	6.7	238
Shell DD	60 gals.	85	28	6.5	437
Shell Nemagon	10 gals. ^b	58	57	6.5	86
Untreated control		19	342	2.4	618
Least significant difference (19:1)		36	190	1.7	399
Least significant difference (99:1)		49	266	2.3	580

^a *P. vulnus* was recovered by funnel extraction from a composite of four cores of soil taken with a soil tube to a four-foot depth at the drip line of each tree.

^b This material is sold in several strength formulations. Dosage given in these tables is the dosage of the active ingredient, 1,2-dibromo-3-chloropropane.

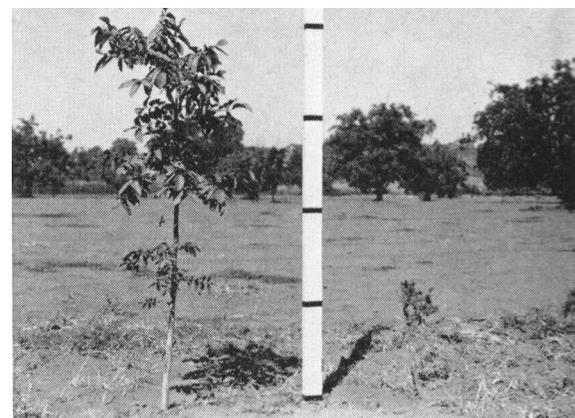
Walnut Growth in 1956 and 1957 After:

(1) Preplanting treatment plus DBCP retreatment, (2) preplanting treatment only, and (3) no treatment.

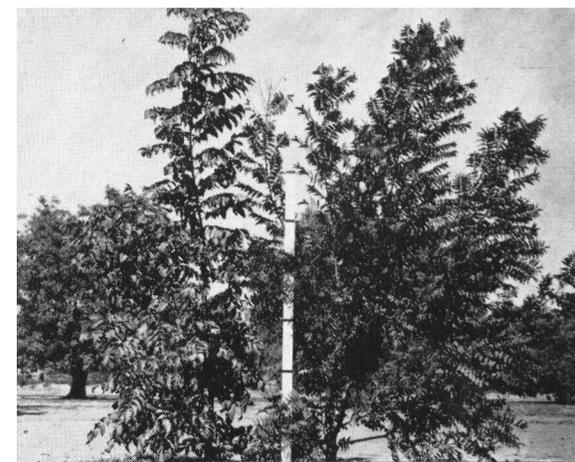
Treatment	increase in circumference (inches)	
	1956	1957
(1) Preplanting treatment plus Nemagon retreatment	4.4	4.1
(2) Preplanting treatment	4.1	2.5
(3) Untreated control	1.6	1.3
Least significant difference (19:1)	1.5	0.9
Least significant difference (99:1)	2.0	1.3

Walnut growth and soil nematode density following several preplanting fumigation treatments in Ventura County

Fumigant	Dosage/A	1956 increase in circumference in in.	<i>P. vulnus</i> /pt. soil
Dowfume W85	20 gals.	1.9	580
Shell DD	75 gals.	4.9	893
Shell Nemagon	10 gals.	2.2	19
Untreated control		0.4	1282
Least significant difference (19:1)		1.6	1891
Least significant difference (99:1)		2.2	



Young walnut trees two years after preplanting soil fumigation in a San Joaquin County walnut orchard. Top—untreated control. Left of 6' marker—Paradox hybrid, right—California Black. Bottom—Dowfume W85, 15 gals./acre, typical of growth in all treatments.



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same treatments were made in two orchards, it was possible to analyze the interactions of rootstock and treatment, rootstock and orchard, and treatment and orchard. The interaction of rootstock and treatment was not statistically significant, reflecting the fact that growth of both California blacks and Paradox hybrids was improved in like manner by preplanting fumigation. However, the interactions analyses of rootstock and orchard, and treatment and orchard were statistically significant at the 5% level, indicating that growing conditions at the two orchards influenced the response to the treatments, and the relative performance of the rootstocks.

In March, 1956, the California blacks were pulled to allow normal growth of the Paradox hybrids remaining at each site. Roots of most of the California blacks—including those with good top growth at treated sites—showed considerable lesion formation. Moreover, soil samples taken in September, 1955, had shown that root-lesion nematode population density at treated sites had risen in many instances until it did not differ significantly from the population density at untreated control sites.

The response of the Paradox hybrids to preplanting fumigation indicated that they, too, were susceptible to the disease. It seemed doubtful that the remaining Paradox hybrids would continue to grow satisfactorily at the treated sites. Therefore annual Nemagon retreatments around half of the trees on treated sites were begun in March, 1956. The fumigant was injected by handgun at the rate of five gallons per acre over a 10' x 10' area covering the root zone of the tree. This provided Paradox hybrids with essentially three different histories in each of the two orchards: 1—those grown at pretreated sites with annual retreatments begun after two growing seasons, 2—those grown at pretreated sites without further treatment, and 3—those grown without any fumigation treatment. Top growth of all trees except the complete checks continued to be satisfactory at the end of the fourth growing season. During the fourth season, growth of trees receiving annual Nemagon retreatments was significantly greater than growth of trees receiving preplanting treatment only.

In the Ventura County orchard the soil was a clay loam with a moisture equivalent of 26.7%. Test sites were fumigated in December, 1954, and California black walnuts planted in March, 1955. Treatments were arranged in five blocks of single tree replicates. Growth in all treatments was better than growth

in the untreated controls. DD at 75 gallons per acre produced the greatest growth response.

The value of preplanting fumigation for walnuts depends on the duration of benefits. Striking initial growth responses are of no use, unless they presage productive walnut trees. Benefits of preplanting soil fumigation probably will be most prolonged where land to be replanted is left free of trees or vines for several years before fumigation, allowing time for woody, nematode-infected roots to rot. Such roots protect nematodes from soil fumigants.

The better growth of the San Joaquin County trees receiving supplemental Nemagon side dressings suggests the possibility that benefits of preplanting soil fumigation may be prolonged in that manner.

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tons per acre. This is further evidence of the importance of early planting to achieve maximum yields on sugar-beet nematode infested fields. The high population of nematodes surviving the treatments apparently explains the failure to obtain an increase in yield from any of the fumigants.

The significant decrease in yield at the 10 gallons per acre dosage of Nemagon was very likely a result of the stability of the chemical which—under some conditions—may persist in the soil for as long as six months.

In Plot No. 3 another attempt was made to increase control of the nematode in the upper 2" or 3" of the soil by the use of split applications of the fumigants. This required turning the soil by plowing between treatments. Forty-eight hours were allowed to elapse after the first fumigation was applied before the plots were plowed and the second dosage injected.

The nematocides DD and Nemagon were tested—alone and in combination—applied March 21 and 23. Soil moisture content was approximately 15% with a temperature of 50°-53°F. Beets were planted April 16, soil samples taken May 24 and yields recorded November 1.

The results showed no significant effect on the nematode population by the fumigants. There is a significant increase in yield in all of the treatments, but the maximum of 8.4 tons per acre is far

below the minimum necessary for profitable production of beets.

In 1957, additional work was done in Plot 4 to test the effectiveness of row placement of DD. An area treated at the rate of 25 gallons per acre was compared with the same rate per acre injected by one chisel centered in the bed and two chisels per bed spaced 12" apart.

The rate delivered by the single chisel was 83 gallons per acre and 41.5 gallons per acre for each in the two chisel application. The treatments were applied February 14, and beets planted April 10. Soil samples were taken April 26, and the beets were harvested October 2.

The results showed a highly satisfactory reduction in the nematode population, but the yields obtained were not sufficient to justify fumigation. The explanation for this is not evident and further work is planned to determine whether or not these soil treatments can be developed for successful practical use.

Exploratory tests have also been made on the possible use of sodium N-methyl dithiocarbamate—Vapam—as a control for sugar-beet nematode. Vapam is soluble in water and has highly effective nematocidal properties. It can be applied in irrigation water or by overhead sprinklers, but it is difficult to obtain an even distribution of the chemical by either method and—what is more important—the cost of Vapam is prohibitive for this purpose.

It is evident from these results that chemical control of the sugar-beet nematode is not practicable under the conditions of these tests.

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OAT HAY

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two critical times for harvest. Apparently the total nutrients realized from oats are greater at about 18%-20% flowering. Although the yield of dry matter has increased rapidly to this time lignification has not yet adversely influenced utilization. If situations prevent harvesting oat forage at 20% bloom, the forage should be allowed to mature to the dough stage rather than harvested at an in-between milk stage.

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