

PHYTOPHTHORA ROOT AND CROWN ROT

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RESEARCH OBJECTIVES:

To determine the incidence, geographical distribution and relative importance of different Phytophthora species in decline and death of walnut trees and to develop control measures to minimize losses caused by Phytophthora root and crown rot in commercial walnut orchards.

APPROACHES AND RESULTS:

Surveys of commercial orchards revealed a wide geographical distribution and a high incidence of root and crown rot affected walnut trees. Root and crown rot in epidemic proportion have been observed in several important walnut-producing areas. In the past, decline and death of walnut trees in California's commercial orchards have usually been attributed to Armillaria (oak root rot fungus) and when this pathogen was not associated with walnut trees then root and crown rot were attributed to "wet feet". However, our surveys of orchards with a large number of declining or dying walnut trees revealed that Armillaria fungus was associated with a few trees in a small number of surveyed orchards and that root and crown rot occur often in some orchards on well-drained soils that are not subject to "wet feet". Therefore, we initiated research to determine the causes of walnut root and crown rot.

Our research revealed that several Phytophthora species are commonly associated with declining and dead walnut trees in California's commercial orchards. We repeatedly isolated from decayed roots or dead bark from the crowns of dying or dead walnut trees the following Phytophthora spp: Phytophthora cactorum, Phytophthora cinnamomi, Phytophthora citricola, Phytophthora megasperma, Phytophthora cryptogea and 5 other unidentified Phytophthora species. We often isolated more than one different Phytophthora spp. from the same orchard and occasionally we isolated more than one Phytophthora spp. from the same individual walnut tree. Our pathogenicity tests revealed that all Phytophthora spp. isolated from walnut orchard trees are implicated in root and/or crown rot and decline or death of trees in commercial walnut orchards.

Our research showed that Phytophthora root and crown rot are much more often implicated in decline and death of walnuts in California's commercial orchards than has been previously known. In addition, our research also revealed for the first time that in addition to P. cactorum, which was reported previously to infect walnuts, nine other different Phytophthora species are also causing decline and death of walnut trees in California.

We also learned that the severity of the disease is dependent on the Phytophthora species, on the frequency and the length of the soil saturation with water, on the relative resistance of rootstock and temperature of soil occurring during the periods of excessive soil moisture in the orchards.

Our field observations and research under greenhouse conditions revealed that Phytophthora citricola and Phytophthora cinnamomi are the most destructive to walnuts among 10 Phytophthora species present in California's orchards. We also learned that in general the severity and incidence of root and crown rot are the greatest on sites which are subject to repeated and prolonged soil saturation due to excessive rainfall, poor soil drainage and/or over irrigation. Thus careful soil water management and improved soil drainage are helpful in minimizing losses due to Phytophthora root and crown rot.

Since resistant rootstocks offer the most economically feasible and environmentally acceptable control of soil-borne diseases and since very little is known about resistance of different walnut rootstocks to different Phytophthora species, we are evaluating the relative resistance of Black, Paradox, and English walnut seedlings for their resistance to different Phytophthora species. Our field observations and repeated experiments in the greenhouse revealed that Paradox is significantly more resistant than Northern California black rootstock to P. cactorum. Furthermore, contrary to the previous reports by others that English seedling rootstock is resistant to P. cactorum, our research showed that English seedlings are as highly susceptible as Northern California black rootstock to P. cactorum. Thus, the use of Paradox rootstocks is advisable in orchards with history of or threaten to become infected with P. cactorum crown rot. In addition Paradox is also significantly more resistant than either J. hindsii or English rootstock to P. megasperma and an unidentified Phytophthora species.

Our tests also revealed that Paradox is somewhat more resistant to P. cinnamomi, P. citricola, and P. cryptogea than either Northern California black or English seedlings. However, the difference in resistance between Black and Paradox rootstocks to these Phytophthora species was not as pronounced as the difference in resistance between Black or English and Paradox to P. cactorum. In a test we compared relative resistance of three different selections of Paradox to P. cactorum, P. citricola, P. cinnamomi and P. cryptogea. This test revealed that all tree selections of Paradox were significantly more resistant to P. cactorum than Black rootstock. Our results further revealed marked difference in relative resistance among Paradox selections to P. cinnamomi, P. citricola and P. cryptogea. In another experiment we are investigating the relative resistance J. hindsii, J. rupestris, J. sieboldiana var cordiformis, J. regia 'Hartley', J. regia 'Carpathian', and J. nigra to P. citricola, P. cinnamomi, P. cactorum, P. megasperma, P. cryptogea, and Phytophthora sp. Although this experiment is still in progress, the preliminary results are suggesting the following: that J. nigra appears to be more resistant than any other Juglans species in this test to all 6 Phytophthora species and that J. regia and J. hindsii are the most susceptible. Juglans sieboldiana appears to be highly susceptible only to P. citricola and P. cryptogea whereas P. rupestris appears to be highly susceptible only to P. citricola and P. cinnamomi. These results indicate a marked difference in resistance of different Juglans species to individual Phytophthora species and that breeding and selection of walnut rootstock for resistance to Phytophthora crown and root rot may be feasible.