Host Range of *Dematophora necatrix*, the Cause of White Root Rot Disease in Fruit Trees

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ABSTRACT

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The host range of *Dematophora necatrix* was studied in the greenhouse and field. The fungus attacked and killed deciduous trees (apple, pear, plum, almond), olive trees, citrus rootstocks (*Citrus aurantium, Troyer citrange*), grape rootstocks (Richter-110, Salt Creek), avocado, mango, macadamia, field crops (cotton, alfalfa, bean), and weeds (*Prosopis farcta, Amaranthus gracilis*). However, *Passiflora edulis* and all rootstocks of mango, grape, and citrus (except *T. citrange*) were not killed in the field tests, and persimmon and pecan trees grew in infested soil for more than 4 yr without showing symptoms of the disease.

The white root rot disease caused by the fungus *Dematophora necatrix* Hartig is destructive to many fruit trees, especially apple, and other plants (1,2,4–6). The symptoms are rotting of roots covered with white mycelium and yellowing of leaves, followed by leaf drop and wilting and death of the tree (3,5–8). *D. necatrix* attacks about 170 species of plants in 63 genera and 30 families of other plants and algae (4).

We tested the host range of *D. necatrix* and report plants that were resistant to the fungus in the field and greenhouse.

MATERIALS AND METHODS

D. necatrix was isolated from infected roots of an apple tree, and artificial inoculum was prepared by inoculating wheat grains with the fungus. The grains were soaked in water for 12 hr, autoclaved at 120 C for 30 min at an atmospheric pressure of 1.3, and inoculated with an agar disk, 4 mm diameter, taken from the margin of 7-day-old culture. After flasks were incubated at 25 C for 14 days, the grains were used as inoculum.

Plants tested for determination of the host range of *D. necatrix* were *Malus sylvestris* (apple), *Prunus armeniaca* (apricot), *Prunus persica* (peach), *Prunus amygdalus* (almond), *Punica granatum* (pomegranate, cultivars Shemi and Rosh Pered), *Olea europaea* (olive), *Citrus aurantium* (sour orange), *Troyer citrange, Citrus macrophylla, Poncirus trifoliata*, various grape rootstocks (*Vitis berlandieri* × *Chasselas* [41-B], *Vitis berlandieri* × *V. rupestris* [110-R or Richter, 140 Rug or Ruggeri, 1103 P or Paulsen]), SO_4 (sel. Oppenheim), *Vitis solonis* × *Othello* (1613, Salt Creek), *Coffea arabica, Persea americana* (avocado), *Macadamia* sp., *Mangifera indica* (4-9 and 13-1 rootstocks), *Passiflora edulis*, and *Eriobotrya japonica* (loquat). Plants were from 2 to 4 yr old.

Further experiments were done in a greenhouse maintained at 24 ± 2 C (day) and 16 ± 2 C (night). The soil was a heavy clay with pH 7.4.

For field experiments, various plants were planted on 5 July 1977 in naturally infested soil where apple trees killed by the fungus had been removed. Exactly the same sites were used, to prevent escapes.

RESULTS

Artificial inoculation in the greenhouse. Plants were placed in pots containing 30 g of infected wheat grain per 1,200 g of heavy soil. The fungus attacked and killed all deciduous trees after about 2 wk (Table 1) and attacked pomegranate (Rosh Pered) and olive trees later (Fig. 1). In an earlier greenhouse experiment, the fungus killed apple rootstocks M-109, Crab-C, and Italian Dosin after about 3 wk. Citrus rootstocks were less susceptible than were deciduous and olive trees. The

Table 1. Effect of artificial inoculation[a] with *Dematophora necatrix*

Plants	Treatment: Soil control[b]	Treatment: Soil with inoculum	Inoculated trees (no.)	Days until death (avg.)[c]
Deciduous trees and olive				
Apricot	–[d]	+	5	15
Peach	–	+	5	16
Almond	–	+	5	15
Pomegranate (Shemi)	–	+	3	18
Pomegranate (Rosh Pered)	–	+	3	25
Olive	–	+	3	28
Citrus rootstocks				
Troyer citrange	–	+	4	71
Poncirus trifoliata	–	+	4	210
Citrus macrophilla	–	+	4	70
Citrus aurantium	–	+	4	41
Grape rootstocks				
41-B	–	+	3	24
Paulsen	–	+	3	36
Salt Creek	–	+	3	56
1613	–	+	3	40
SO_4	–	+	3	36
Ruggeri	–	+	3	25
Richter-110	–	+	3	29
Tropical and subtropical plants				
Coffee	–	+	5	16
Loquat	–	+	3	28
Passiflora edulis	–	–	3	...
Macadamia	–	+	3	45
Avocado	–	+	5	24
Mango 4-9	–	+	3	46
Mango 13-1	–	+	3	29

[a] 30 g of infected wheat grains per 1,200 g of heavy soil.
[b] Number of replicates in the control was three trees.
[c] None of the *Passiflora edulis* plants died; 100% of all other plants tested died.
[d] – = healthy plants; + = death of plants.

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citrus rootstock *Poncirus trifoliata* had the highest tolerance to the disease and died after 7 mo; the other citrus rootstocks died earlier. The fungus attacked all grape rootstocks, but the Salt Creek and 1613 rootstocks were less susceptible. The fungus attacked and killed all tropical and subtropical plants (except *Passiflora edulis*). Coffee, loquat, and avocado plants were also highly susceptible. The mango rootstocks exhibited varying susceptibilities; 4-9 was more tolerant than 13-1. *D. necatrix* by artificial inoculation also killed cotton (Pima S-4), bean (Brittle wax), cucumber (Bet Alfa), barley (Devir), sorghum, alfalfa, potato, and carnation.

Natural infection. Various species were planted in the field with naturally infested soil. The outstanding point noted in the results (Table 2) was the delay in plant mortality in the field, compared with mortality from artificial infection in the greenhouse (Table 1). Olive, avocado, and macadamia were very susceptible in the field, but pomegranate (Shemi and Rosh Pered), loquat, and *T. citrange* were less susceptible. Mango and grape rootstocks were not attacked by the fungus and apparently are more resistant than the other test plants.

Passiflora edulis also showed resistance to *Dematophora*. *Passiflora edulis* was grown in infested soil, as were macadamia and olive trees to which the fungus proved fatal (Fig. 2).

Other plants killed by the fungus were apples, pears, almonds, plums on Myrobalan rootstock, *Prosopis farcta, Amaranthus gracilis, Conyza bonariensis*, and cotton (Pima S-4). Pecan and persimmon trees that were planted in the infested soil in the apple orchard at Ein Zurim (by Y. Golan) in 1974 are showing high resistance to *D. necatrix*.

The fungus was reisolated from each plant tested in the greenhouse and field, thus confirming mortality caused by *D. necatrix*.

DISCUSSION

Our results indicate that *D. necatrix* attacks and kills various hosts including fruit trees, horticultural and field crops, and even weeds. These observations are in agreement with the conclusions of Khan (4), Thomas et al (8), and others. Most of the hosts inoculated artificially were killed by the fungus within a short time, compared with those that were grown in the field in infested soil. These differences result from the high level and kind of inoculum used (wheat grains, which are very suitable for development of *Dematophora*). The optimal greenhouse conditions further encouraged disease severity. In spite of artificial inoculation intensity, the susceptibility of plants differs considerably. The deciduous trees were the most susceptible and citrus rootstocks the least (Table 1). These results are similar to those of Khan (4).

Under field conditions, all rootstocks of grape, mango, citrus (except *T. citrange*), and *Passiflora edulis* were not attacked by the fungus, although they have been growing for more than 2 yr in infested soil. In contrast, susceptible plants such as macadamia, olive, and loquat were killed after several months (Table 2). Khan (4) also reported on the resistance of various grape rootstocks grown under field conditions 16 yr; among them were 1613 and Salt Creek rootstocks, which we found less susceptible in our field and greenhouse experiments (Tables 1 and 2). Only *Passiflora edulis* plants showed resistance to *D. necatrix* after natural and artificial inoculations. The fact that *Passiflora* plants are still growing very well in the same infested pits in the orchard where olive and macadamia plants were killed after 5 and 3 mo, respectively, supports

Fig. 1. Pomegranate variety Shemi, killed by *Dematophora necatrix* in artificially infested soil (right) and the healthy control plant (left).

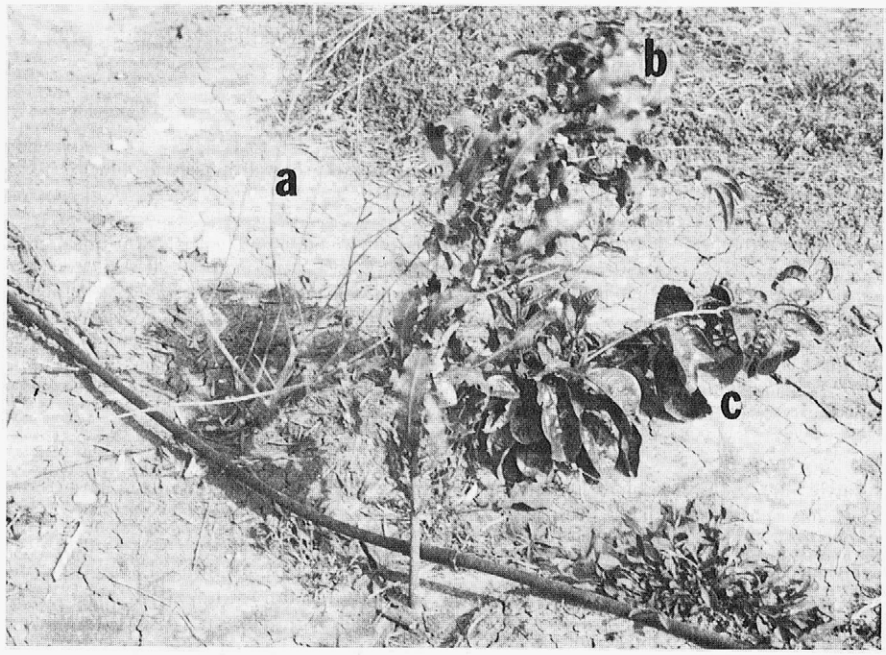

Fig. 2. Olive **(A)** and macadamia **(B)** plants killed by *Dematophora necatrix*; *Passiflora edulis* **(C)** growing well in the naturally infested orchard in Ein Zurim.

Table 2. Natural infection by *Dematophora necatrix* in field conditions[a]

Plants	Trees tested (no.)	Death (%)	Months until death (avg.)
Olive	5	60	5
Pomegranate (Shemi)	3	33	9
Pomegranate (Rosh Pered)	3	33	10
Macadamia	5	100	3
Loquat	3	33	5
Avocado	4	100	10
Grape rootstocks	21	0	...[b]
Mango rootstocks	6	0	...
Troyer citrange	6	16	19
Poncirus trifoliata	6	0	...
Citrus macrophilla	6	0	...
Citrus aurantium	6	0	...
Passiflora edulis	4	0	...

[a] The results in this table are correct until 10 June 1979.
[b] Plants were not attacked by the fungus.

the results of artificial inoculation. Pears, plums, almonds, and, especially, apples have been killed by the fungus in different locations in Israel; Thomas et al (8) and Khan (4) also found these plants to be susceptible in California where the climate is similar to that of Israel. Five trees of each persimmon and pecan (planted by Y. Golan in 1974) that have been growing for 4 yr in infested soil are resistant and do not show any symptoms, whereas susceptible plants (apple, olive, avocado) planted at the same site died within a short time.

The fungus also killed weeds such as *Prosopis farcta, Amaranthus gracilis*, and *Conyza bonariensis*, which suggests that weeds can promote the spread and propagation of inoculum in orchards. Potential host weeds must therefore be examined and possibly controlled concomitantly with the fungus. Because we do not yet have an effective method for controlling the disease, varieties that are susceptible under field conditions in infested soils should not be planted. The solution recommended for problems caused by this dangerous and destructive fungus is to grow resistant plants such as *Passiflora edulis*, pecan, and persimmon.

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LITERATURE CITED

1. BEHDAD, E. 1975. Morphology, distribution, importance and hosts of *Rosellinia necatrix* (Hart.) Berl., the cause of white root rot in Iran. Iran. J. Plant Pathol. 11:13.
2. BUTLER, E. J., and S. G. JONES. 1949. Plant Pathology. Macmillan & Co. Ltd., London. 979 pp.
3. GIBSON, I. A. S. 1977. *Rosellinia necatrix* Prill. Pages 136-137 in: J. Kranz, H. Schmutterer, and W. Koch, eds. The Diseases, Pests and Weeds in Tropical Crops. Verlag Paul Parey, Berlin and Hamburg.
4. KHAN, A. H. 1955. *Dematophora* root rot. Calif. Dep. Agric. Bull. 44:167-170.
5. MADAR, Z. 1978. The white root rot disease in fruit trees caused by the fungus *Dematophora necatrix* Hartig. M.Sc. thesis. The Hebrew University of Jerusalem. 54 pp.
6. NATTRASS, R. M. 1926. The white root rot of fruit trees caused by *Rosellinia necatrix* (Hart.) Berl. Annu. Rep. Agric. Hortic. Res. Stn. Long Ashton, Bristol. pp. 66-72.
7. SZTEJNBERG, A., and Z. MADAR. 1977. The fungus *Dematophora necatrix* causes the white root rot disease of fruit trees in Israel. (Abstr.) Phytoparasitica 5(1):69.
8. THOMAS, H. E., W. STEPHEN, and A. M. NEAL. 1953. The root rots of fruit trees. Pages 702-706 in: H. E. Thomas, W. Stephen, and A. M. Neal, eds. The Yearbook of Agriculture. U.S. Dep. Agric.