Dieback of Carrot Roots Caused by Pythium debaryanum

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We wish to thank O. Vaartaja for identifying the species of fungi isolated during this study.

ABSTRACT

Pythium debaryanum was consistently associated with a root die-back disease of carrots grown in muck soil in the field. Laboratory tests proved this fungus to be pathogenic to carrot. In a field survey, the loss of crop due to *Pythium* root die-back was estimated to be approximately 35%. A similar survey showed that nematodes were not involved. Phytopathology 61:586-587.

During the past 6 to 8 years, carrot growers in the lower Fraser Valley of British Columbia have been plagued with a carrot disease of unknown etiology in muck soils. Symptoms first appear after the two-leaf seedling stage, as a root tip necrosis giving the roots a rusty appearance. This is followed by excessive proliferation of secondary rootlets and branching. One week or 2 later, wilting or stunting of the top growth may be evident, occasionally accompanied by yellowing of the lower foliage. Usually the plants resume growth, but the yield is greatly reduced and the percentage of hairy-rooted and rough carrots is high.

A nematode survey of problem fields revealed several species of stylet-bearing nematodes, but no correlation was evident relating a particular species to the dieback problem.

In an attempt to reproduce the disease, soil from problem and nonproblem areas was brought into the laboratory and seeded to Gold Pak carrot. Seed were surface-sterilized by first wetting in 1% alcohol, then soaking in 10% commercial bleach solution for 25 min. They were rinsed 3 times in sterile distilled water before planting. Fifty cc of test soil were placed in a sterile plastic petri dish; surface-sterilized seed were distributed over the soil surface and covered with moist filter paper. The petri plate cover was replaced and the dish was stored in the dark at room temperature to await germination.

Examination of the root tissues of 2-week-old carrot seedlings grown in problem soils revealed the presence of fungal mycelium and oospores in areas of tissue breakdown. Field-grown carrots from problem areas contained similar mycelium and oospores. This condition was not seen in carrots grown in soils from nonproblem areas.

The fungus was isolated by placing surface-sterilized root pieces on lima bean agar and potato-dextrose agar and was identified as *Pythium debaryanum* Hesse.

Small cubes of agar with the isolated fungus were used to inoculate sterile water agar plates. Two days later, surface-sterilized carrot seeds were added and incubated in the dark at room temperature. The fungus had a damping-off effect on the seedlings, and did not produce the same symptoms observed in soil-grown carrots. This test indicated that under conditions optimum for the fungus, seedlings may be killed outright. Such conditions may occasionally occur in the field and thereby reduce stands.

Typical field symptoms were obtained by infesting single, sterilized, filter paper discs in petri dishes with the fungus isolate grown in liquid culture. Infesting the filter paper 2 days after seeding permitted 96% germination after 5 days, and allowed invasion and development of the fungus within the roots. The fungus reisolated from infected roots in both the agar and filter paper tests proved to be the same as the original isolate.

A survey was undertaken during the 1969 growing season to determine the extent of root die-back in carrots associated with *Pythium*. Carrot samples taken from 50 fields were categorized according to the appearance or absence of oospores in secondary roots. No discoloration of secondary roots was evident in carrots from 6 fields (4.2 acres). There was discoloration but no oospores from 25 fields (65.9 acres), and discoloration and oospores from 19 fields (49.1 acres). In 6 fields totalling 20 acres, the die-back of secondary roots was sufficient to cause obvious foliar dwarfing and yellowing of the top growth. In each case, oospores were easily observed in both completely and partially rooted lateral roots. In these severely affected fields, marketable yields were reduced by 50 to 90%. About 6 acres were not worth harvesting. Average loss due to *Pythium* root dieback in the 50 surveyed fields was estimated to be approximately 35%.

Beginning in January 1969, and continuing monthly thereafter, soil samples were taken from problem and nonproblem areas, placed in petri dishes, and seeded to carrot in the manner described above. Tests were conducted in the laboratory at room temperature. Eight days after seeding, slides of seedling roots were made and microscopically examined. *Pythium debaryanum* was present in problem soils and able to infect carrot seedlings under laboratory conditions throughout the year. During July, however, when the field soil was relatively dry, it took almost twice as long for the fungus to invade and damage the roots. It was also noted that a bioassay of field problem soil stored in closed plastic bags in the laboratory at room temperature for 6 to 8 months showed the fungus to be viable and able to infect carrot seedlings.

This report constitutes the first known demonstration of the pathogenicity of *P. debaryanum* to young carrots. Ward (5) reported successful cultivation of *P. debaryanum* on young buds of carrot. Middleton (2) listed carrot as a host but not associated with a disease. *Pythium debaryanum* and *P. ultimum* cause rubbery slate rot of stored carrots and damping-off of seedlings (3). Thus, *P. debaryanum* attacks carrot seedlings,

causing damping-off; young plants, causing stunting and root deformation; or mature carrots, causing a storage rot.

Attacks on the roots of crops in intermediate stages of growth are usually referred to as root rots (4). The symptoms we describe in this paper are not manifested as a true rot. The outright killing of the root tips, sometimes before they are 1 mm in length, stimulates production of other roots, resulting in deformation of the primary root and an excess of fine roots.

While the "rusting" or "browning" of secondary roots is a consistent symptom, browning resulting from melanin formation (1) in carrot roots is common, and may be caused by anything which damages epidermal cells. For this reason, we think that "rusty root" is not a good common name for this disease, and propose instead, "*Pythium* carrot root dieback".

LITERATURE CITED

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