Phytophthora Root Rot of Blueberry in Arkansas

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ABSTRACT

Sterne, R. E. 1982. Phytophthora root rot of blueberry in Arkansas. Plant Disease 66:604-605.

Phytophthora root rot of highbush blueberry, caused by *Phytophthora cinnamomi*, was found for the first time in Arkansas in 1978 in a commercial blueberry planting in Benton County. Subsequently, 28 other infested fields were identified. Isolates of *P. cinnamomi* had characteristic mycelial and reproductive structures and were highly pathogenic to blueberry seedlings. In the field, there did not appear to be varietal differences in disease reaction. Planting blueberries in peat and on poorly drained soil may be increasing the disease potential for root rot.

In 1978, J. N. Moore (Department of Horticulture, University of Arkansas) found a field in Arkansas with Phytophthora root rot of highbush blueberry (*Vaccinium corymbosum* L.) caused by *Phytophthora cinnamomi* Rands (*personal communication*). The field was in Benton County, one of several northwestern counties where blueberry production is concentrated. M. J. Goode (Department of Plant Pathology, University of Arkansas) identified the fungus. Moore mapped the field for plants with symptoms and for dead plants. There were 416 dead plants and 817 with symptoms, out of approximately 11,000 plants in the field. Each year the disease in that field increased until, in 1981, over half of the plants in the field showed severe symptoms. It has been common for the disease to spread rapidly and extensively in blueberry plantings in Arkansas.

Since 1980, I have confirmed Phytophthora root rot in 21 fields, primarily in northwestern Arkansas but including fields in adjoining areas of Missouri and Oklahoma. The pattern of disease in these fields has been some variation of three basic types: a) diseased plants scattered throughout the field; b) diseased plants isolated in one section of a field, generally associated with low, poorly drained areas; or c) diseased plants spread over a section of a field without respect to contour, but generally with a low-lying area somewhere in the diseased sections. In many fields with root rot, there was considerable activity of burrowing animals, primarily moles and voles. This was particularly true of fields where the disease was scattered throughout or where it was in a section regardless of contour. It has not been determined whether *P. cinnamomi* is a typical component of soils in northwestern Arkansas.

Published with approval of director of Arkansas Agricultural Experiment Station.

Accepted for publication 15 December 1981.

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0191-2917/82/07060402/$03.00/0

Cultivar reaction. The most commonly grown highbush cultivars in Arkansas are Bluecrop, Blueray, Collins, and Coville. The disease does not appear to affect any one cultivar more than others. I have isolated *P. cinnamomi* from all the cultivars and have also isolated it from the cultivar Patriot, which has shown resistance to root rot (3). The Patriot plants showed severe symptoms in the field. In a 1-yr-old planting where rabbiteye (*V. ashei* Reade) and highbush cultivars were planted together, 75% of the highbush plants were dying with Phytophthora root rot, whereas there were no aboveground symptoms in the rabbiteye cultivars. This difference in susceptibility between species was observed by Milholland and by Milholland and Galletta in North Carolina (5,6). *P. cinnamomi* also has been isolated from propagation beds in nurseries associated with blueberry plantings where there were infected plants.

Symptoms. The root and aboveground symptoms in highbush blueberry were like those reported from New Jersey (7,9) and North Carolina (2). On the roots, the disease started on the very fine absorbing roots with a brownish black rot and progressed into larger roots. On heavily damaged plants, particularly those in 1- to 3-yr-old plantings, the root system was mostly black from infection. The aboveground symptoms of the disease included chlorosis and reddening of leaves, reduction of leaf size, defoliation, tip dieback of branches, death of canes in a bush, and overall stunting of a bush. In any one field, the symptom pattern on individual plants was similar; ie, the mixture of the components listed above was similar. But in different fields, there was variation in the combination of components as well as in the intensity of particular components of the pattern.

Pathogen culture. Root pieces (0.5–1.0 cm) taken from the advancing edge of the dark portion of a root were surface sterilized by being dipped briefly in 75% ethanol, blotted on a paper towel, and plated on a selective medium, $P_{10}VP$, modified by the addition of 3-hydroxy-5-methylisoxazole (hymexazol) at 50 μg/ml as described by Tsao and Guy (11). The hymexazol effectively inhibited most *Pythium* spp. that were common secondary invaders in diseased roots. However, in old infected roots, some isolates of *Pythium* grew out and made it difficult to find emerging hyphae of *P. cinnamomi*.

Morphology. Representative isolates of *P. cinnamomi* from diseased blueberry roots had mycelial and reproductive structures that were characteristic for the species (12) and were similar to those reported earlier for *P. cinnamomi* isolated from blueberry (10). Sporangia were easily induced by the method of Chen and Zentmyer (1). The isolates were of the A_2 mating type, with oospores produced by pairing blueberry isolates with isolates representing the A_1 mating type (12) for *P. cinnamomi* (*Phytophthora* culture collection, Department of Plant Pathology, University of California, Riverside).

Pathogenicity. Koch's postulates were completed with two isolates (coded Bb20 and Bb31) of *P. cinnamomi* collected from highbush blueberry plantings with heavy losses from root rot. For inoculum, the fungi were grown on a medium prepared by soaking rice hulls for 12 hr in water, placing 250 ml of hulls in 500-ml flasks, and autoclaving on 2 consecutive days. Each flask of rice hulls was incubated with 10 disks of an isolate taken from 1-wk-old cultures on V-8 juice medium. For pathogenicity tests, inoculum of an isolate was mixed at a rate of 1:10 (v/v) with a container medium of sand and peat (1:1, v/v). Nine-month-old seedlings of two cultivars, Collins and Earliblue, were planted one plant per pot in the infested medium placed in 15-cm-diameter clay pots. The pH of the container medium was 4.6, and the height of the soil column in each pot was 10 cm. For each blueberry cultivar, six pots were infested with Bb20, six were infested with Bb31, six were uninfested pots, and six pots had autoclaved rice hulls mixed with sand:peat medium at the rate used for inoculum. All pots were fertilized weekly with a 20-20-20 fertilizer solution (200 μg of nitrogen per milliliter). Within 90 days, both isolates of *P. cinnamomi* had

infected 95–100% of the root system of plants of both cultivars. *P. cinnamomi* was easily isolated from infected roots plated on the $P_{10}VP$ medium plus hymexazol. There was no root damage to either cultivar in the uninfested checks or the checks with autoclaved rice hulls.

Disease enhancement. There are two factors that might be contributing to the success of *P. cinnamomi* as a pathogen of blueberry in Arkansas. One is the medium used when berries are transplanted into the field. Holes are dug and filled with peat, the plants are worked into the peat, and the hole is covered with soil. For container-grown plants, Pythium and Phytophthora root rots frequently develop on plants produced in media containing peat (4,8). Root rot is apparently favored because the peat drains water slowly and does not support competitive microbial activity. If this is the case with transplanted blueberries, peat might be providing a conducive environment for development of root rot.

A second factor is that many of the soils where blueberries are grown in northwestern Arkansas contain high percentages of clay, are relatively shallow with rock layers or compacted clay layers below, and are poorly drained. Such conditions are known to favor *P. cinnamomi* and the diseases it causes (12,13). Considered together, a conducive root environment and poorly drained soil may be increasing the disease potential of *P. cinnamomi* on blueberry.

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