

## Relative Susceptibility of Succulent and Woody Tissue of Magness Pear to Infection by *Erwinia amylovora*

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### ABSTRACT

Severe fire blight developed in the main trunk of eleven 5- to 6-year-old Magness pear trees with no visible symptoms elsewhere in the tree. In most infected trees, fire blight was first observed during fall and early winter. The earliest symptom was usually premature foliage coloration on a branch that originated at or near a trunk infection. The disease spread rapidly upward through the central leader and scaffold limbs, resulting in death of the

trees. Artificial inoculation of succulent shoots of other 4-year-old Magness trees resulted in few light infections. However, injection of bacteria under the bark of 2-year-old branches of these trees killed three of four inoculated trees. It appears that the woody tissue of this variety is more susceptible to fire blight than its succulent shoots. *Phytopathology* 60:593-595.

Fire blight of pear and apple, caused by *Erwinia amylovora* (Burr.) Winsl., usually consists of blighted twigs or branches that give the tree a scorched appearance. The blight bacteria usually move downward through the branches into the scaffold limbs and the trunk, where characteristic cankers are formed (7). Sometimes trunk cankers are produced through infected suckers and water sprouts (1, 5, 9). However, natural infection in the tree trunk, without visible blight elsewhere in the tree, is rare. When water-soaking and oozing were observed on the main trunk of a Magness pear (*Pyrus communis* L.) tree, studies of this unusual blight symptom were initiated. Results of these studies are reported here.

**MATERIALS AND METHODS.**—The following trees were used for observations of natural fire-blight infections at Beltsville, Maryland: (i) the original Magness seedling planted in 1941; (ii) three budded Magness trees planted in 1953; (iii) 17 Magness trees, budded to Bartlett seedling rootstock, planted in 1962; (iv) 144 Magness trees, interplanted with Moonglow and Bartlett, planted in 1963.

Also, in early December 1968, we surveyed the extent of blight in other experimental plantings or commercial orchards of the Magness cultivar in Maryland. The following number of 5- to 6-year-old trees were examined in three locations of the State: 100 at the experimental farm of the University of Maryland near College Park, Maryland; 220 in two orchards near Thurmont, Maryland; and 250 near Stewartstown, Pennsylvania.

Isolations from infected trunks were made from bark and wood samples removed with a sterile No. 6 cork borer. The tree tissue was placed in a test tube containing 10 ml of nutrient yeast dextrose broth (NYDB) and incubated for 3-4 hr with occasional stirring. Dilutions were prepared by adding 1.0-ml aliquots from the broth to 9.0-ml blanks of sterile demineralized water. Triplicate sets of plates were prepared from the original broth and  $10^{-2}$  and  $10^{-4}$  dilution blanks. Platings were made by pipetting 0.1-ml aliquots onto nutrient yeast dextrose agar (NYDA) plates and spreading the sample over the surface with a previously flamed sterile glass rod.

In early July 1968, four 4-year-old Magness trees in a nursery planting were artificially inoculated under optimum weather conditions for blight development. Four trees each of Bartlett and Old Home of similar age were used for comparison. Succulent shoot tips were inoculated with a 22-gauge hypodermic needle, and 2-year-old woody branches were injected beneath the bark after wounding. The inoculum consisted of a 0.25 ml aqueous cell suspension ( $30 \times 10^7$  cells/ml) of a virulent strain of *E. amylovora*. Blight measurements were made 10 and 20 days after inoculation of the tissues and, in addition, 80 days after inoculation of the older branches.

**RESULTS.—Blight observations.**—No natural fire blight occurred in the original Magness seedling tree for 20 years, although several thousand sister seedlings were severely blighted. Blight in this tree was observed for the first time in July 1961, and a count revealed 134 blighted shoots with deepest blight penetration extending 1.8 m. This tree continued to grow in spite of unpruned blight infections, and lives today.

In the summer of 1959, following a severe hailstorm, the first blight observation was made in the three budded Magness trees planted in 1953. The tree was next to a severely blighted seedling tree, but blight did not extend beyond 1-year-old woody tissue. In August 1961, fire blight reappeared after a hailstorm. In descending order from the tree nearest the severely blighted seedling, the number of blighted twigs and deepest blight penetration on these three Magness trees was 21 (135 cm), 11 (118 cm), and 5 (88 cm), respectively.

Prior to 1 August 1968, the only blight symptoms observed among the 17 Magness trees planted in 1962 were two oozing fruit on one tree. During the first week of August, oozing was noticed on the main trunk of this tree about 10 cm below a deep wound caused by the weight of a heavy scaffold limb (Fig. 1-A). The foliage on this branch was prematurely colored. About 8 weeks later, the entire trunk appeared water-soaked. Fire blight had moved upward into several scaffold branches, as well as into the central leader (Fig. 1-B). Subsequently, trunk infection was observed in several additional Magness trees in the same orchard. By



**Fig. 1.** Severe fire blight in the trunk of the Magness pear. **A)** Row of 16 6-year-old trees with tree in foreground showing severe trunk infection (arrow); insert shows large canker in the main trunk of this tree, below a deep limb wound (pointer) through which the bacterium possibly gained entry. **B)** Profuse ooze production from entire central leader and some scaffold limbs on reverse side of same tree.

January 1969, fire blight had spread to distances from 1.5-3.0 m from the original sites of infection.

In the orchard of 5-year-old Magness, Moonglow, and Bartlett trees, first symptoms of fire blight were observed in one Bartlett tree during late summer of 1967. During July 1968, seven additional Bartlett trees exhibited blight symptoms. By 25 October, four blighted Magness trees were noted. In all four trees, premature fall coloration was noted in at least one limb. Trunk infections were discovered at the base of these limbs, and by 1 November infections had spread 1.3-2.4 m into the central leader and scaffold limbs of the trees. By early fall 1969, all infected Magness trees were dead.

Typical cultures of *E. amylovora* were obtained from all eleven infected Magness trees when small pieces of infected bark tissue were plated on NYDA media. Pathogenicity was demonstrated by injecting the cultures by hypodermic needle into succulent shoots of Bartlett trees in the greenhouse. No apparent difference in pathogenicity was observed between these isolates and those recovered from blighted Bartlett trees. This confirms previous unpublished data of cross-inoculation tests with isolates from both these pear cultivars.

*Tree inoculations.*—Three weeks after artificial inoculation of succulent shoots of 4-year-old Magness trees in the nursery, fire blight had spread a maximum distance of 6 cm in three of the trees (Table 1). Inocu-

TABLE 1. Axial penetration of fire-blight infection in succulent shoots and in 2-year-old branches of four trees each of three cultivars of *Pyrus communis*, following artificial inoculation under field conditions

Pear cultivar	Succulent shoots			Two-year-old branches		
	Blighted	Blight penetration		Blighted	Blight penetration	
		Maximum	Average		Maximum	Average
	No.	cm	cm	No.	cm	cm
Magness	3	6	3	3	70	28
Old Home	1	5	1	0	0	0
Bartlett	4	53	45	3	138	80

lations of 2-year-old branches appeared negative at first, but 80 days after inoculation, visible fire-blight infection had penetrated a maximum distance of 70 cm in three of the trees (6). In comparison, fire blight spread rapidly soon after inoculation through both shoots and older branches in all four Bartlett trees. In one Old Home tree, blight spread 5 cm in the young shoot, but no infection occurred in the shoots of the other three trees. No infection was evident in 2-year-old branches of the Old Home trees. A second inoculation in other shoots and branches of the same trees of these cultivars gave nearly identical results.

DISCUSSION.—As far as we know, this is the first record of severe natural fire-blight infection in the trunk of a resistant pear cultivar without visible blight symptoms elsewhere in the tree. In 1967, we observed severe fire blight in three Magness orchards in north central Arkansas (8). Tree growth in these orchards was stimulated for early production. In July 1967, following a severe hailstorm, many blight infections started in 2- to 3-year-old branches. Fire blight then spread rapidly into the central leaders of the trees, killing 23% of 727 Magness trees in two of the orchards.

In the Magness trees at Beltsville, we postulate that the fire-blight bacterium entered through wounds in the trunk or through bark constrictions caused by wire labels. We found no visible wounds or other points of entry on three of eight infected Magness trees, however. Thus, the possibility remains that the fire-blight bacteria were present, in or on the trees or rootstocks as a natural resident, requiring only optimum conditions to become active and infectious. Recently we have demonstrated this possibility in apparently healthy pear and apple tissue in the greenhouse (2).

The survey of 570 Magness pear trees throughout Maryland revealed no blight symptoms in any of the orchards. This lack of blight infection could be attributed to the apparent absence of the disease in fruit orchards surrounding the trees covered in the survey. No evidence of hail damage was noticed in these orchards.

Even though fire blight in the trunks of Magness trees was usually observed in the fall, we believe that

infection took place much earlier. After entry, conceivably the bacterium moved into the vascular system. In detailed histological studies, Rosen (4) demonstrated the presence of fire-blight bacteria in the phloem and xylem vessels of apple and pear. The delayed expression of trunk-blight symptoms suggests that the bacteria multiplied slowly. When sufficient numbers of cells were produced, the tissues broke down and visible symptoms appeared.

It seems obvious from the inoculation studies that the older wood of the Magness cultivar is more susceptible than are the young, succulent shoots. In 1925, Reimer (3) was the first to report this phenomenon in pear cultivars Douglas, Orel, and Surprise following inoculation. He also stated that these cultivars showed a high degree of resistance under natural conditions in the Mississippi Valley. Young shoots of Magness and of these three cultivars may possess some resistance factor which may be absent, undeveloped, or inoperative in the older wood.

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