

## PHYTOPHTHORA SYRINGAE FRUIT ROT OF APPLES IN NOVA SCOTIA<sup>1</sup>

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### Abstract

The fungus *Phytophthora syringae* Klebahn caused a fruit rot of stored 'McIntosh' and 'Red Delicious' apples in Nova Scotia in 1968. Nine strains of each of the two cultivars were all susceptible to the fungus. Infection appeared to occur when harvested apples were left in the orchard in boxes through a rainy period.

### Introduction

In December 1968 a decay of stored 'McIntosh' and 'Red Delicious' apples was brought to the writers' attention. The decay has since proved to have been caused by the fungus *Phytophthora syringae* Klebahn. As far as the authors are aware, this fungus has not previously been reported in North America as a cause of decay of apple fruit in storage or on trees. In Europe *P. syringae* has been recorded as the cause of a collar rot of apple trees, a rot of fruit on the trees and a decay of apple fruit in storage (1, 2, 4, 5, 6, 7, 8, 9, 10). In North America it has caused a stem canker of nursery stock of heeled-in crab apple trees (11). The fungus isolated in Nova Scotia was sent to Dr. C. J. Hickman, London, Ontario, and Dr. D. L. McIntosh, Summerland, British Columbia, for confirmation of its identity. Both believed it to be *P. syringae*. The specimen has been filed in the National Mycology Herbarium, Plant Research Institute, Ottawa, Ont., as DAOM 127886.

### Symptoms

The symptoms on the decayed portion of the apple fruit were very similar to those described by Ogilvie (5). On the cultivar McIntosh (Figs. 1 and 2) the decayed areas were light brown and on 'Red Delicious', dark brown. The margin was indefinite resembling a bruise, the rotted area was firm, and there were no superficial wounds. Often the entire fruit was decayed. The interior of the rotted tissue was elastic or stringy when teased with a scalpel, and the vessels throughout the flesh were a darker brown, giving a striated appearance. The fungus was not evident on the exterior of the fruit.

### Experimental

The apples rotted by *P. syringae* (Fig. 3) were from a 10-year-old orchard located at the Canada

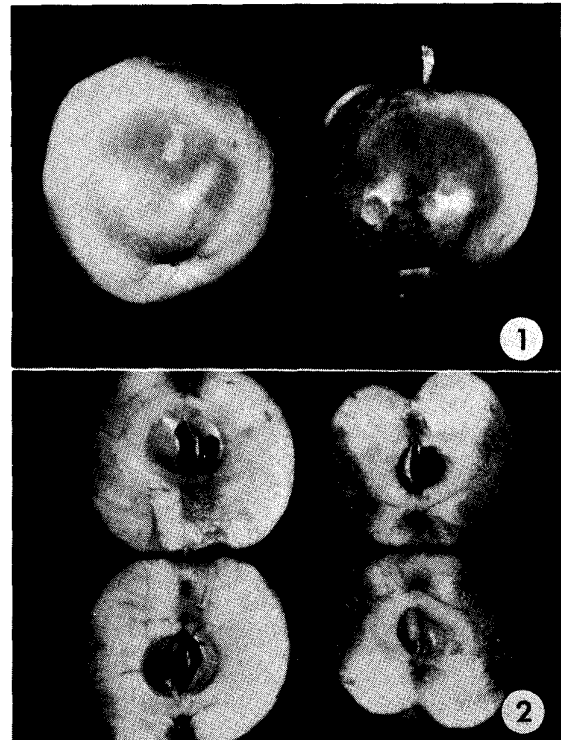


Figure 1. *Phytophthora syringae* rot of 'McIntosh' apple.

Figure 2. Cross section of 'McIntosh' apples rotted by *Phytophthora syringae*.

Department of Agriculture Research Station, Kentville, N.S., in which the Rogers, Hamilton, N. J. 2, A 11 Red, Generation Removed, Blackmac, Farley, W. L. Hamilton and Geneva strains of the cultivar McIntosh; and the Starking, Turner, Bridgeham, Tucker, Richard, Shotwell, Red King, Royal Red, and Vance strains of 'Red Delicious' are being evaluated. The planting consisted of columns of 'McIntosh' and 'Red Delicious' alternating in a 9 × 9 latin

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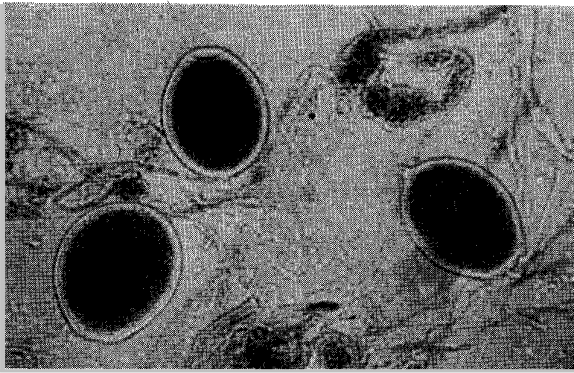


Figure 3. Sporangia of *Phytophthora syringae* (X600), DAOM 127886

'square with the rows and trees 20 feet apart. In 1967 an experiment in which Alar (succinic acid 2,2-dimethyl hydrazide, 85%; Uniroyal (1966) Ltd., Elmira, Ont.) was applied on different dates was superimposed on the original design. In 1968 Alar was not applied. A sample of 100 apples from each tree was stored in a bushpicking box at 1C. In January 1969 these samples were examined for rot and the causal organism of each rotted area determined by isolation on potato dextrose agar (PDA).

In the cultivars McIntosh and Red Delicious, an average of 4.7% and 6.3%, respectively, of the apples were rotted by *P. syringae*. In both cultivars there were some samples that had no rot, whereas the maximum percentages of rotted fruit per sample were 12 and 34 for 'McIntosh' and 'Red Delicious', respectively. There was no evidence that *P. syringae* spread from apple to apple in storage. There was no indication that the previous Alar treatments had any effect on the intensity of rotting, and the data do not suggest that the strains varied in their susceptibility to *P. syringae*.

In the cultivar McIntosh the apples decayed by *P. syringae* were fairly evenly distributed throughout the orchard, but with 'Red Delicious' the average percentages of decayed apples were 7.1, 7.6, 11.4, 11.1, 7.9, 11.3, 0, 0.2, and 0.1 from rows 1 to 9, respectively. The apples from rows 1 to 6 of 'Red Delicious' were picked on October 19 and remained in the orchard in bushelboxes until October 23. Rows 7 to 9 were picked on October 22 and stored on October 23. Rainfall on October 20-21 was 4.6 inches. Similar harvest data are not available for 'McIntosh', except that picking began on October 3 and 1.54 inches of rain fell on October 4.

Similar symptoms were readily reproduced in 'Red Delicious' apples when they were inoculated below the peel with inoculum from an agar culture of *P. syringae* or from a decayed apple. Twenty-four apples were inoculated, using culture inoculum and an additional 24, with inoculum from a decayed apple.

Twelve of the inoculated apples of each set were placed in a plastic bag and incubated at 20C, and 12 were similarly incubated at 1C. After 11 days at 20C the average diameters of the rotted areas on the apples inoculated from culture and from decayed apple tissue were 4.8 and 4.9 cm, respectively. At this time the apples at 1C showed no evidence of decay, but after 36 days the average diameters of the rotted areas were 4.9 and 4.5 cm, respectively. Isolations on PDA showed all rots to be caused by *P. syringae*.

At about monthly intervals during the growing season of 1969, soil samples were collected from under the canopy of 'McIntosh' and 'Red Delicious' trees and were saturated with water in shallow pans. Green apples or pears were placed on the wet surface as recommended by Klotz and DeWolfe (3) but none of the fruit became rotted by *P. syringae*.

## Discussion

The literature suggests that outbreaks of fruit rot of apples caused by *P. syringae* are very sporadic. No explanation can be given for its sudden appearance in Nova Scotia. Inoculum for fruit infections by *Phytophthora* spp. is generally considered to come from the soil (10), and our results with the cultivar Red Delicious suggest this. Apples picked and left in the orchard in bushel boxes during a rainy period were heavily infected, whereas the disease was very rare on apples picked after the rain. This shows that most of the infection occurred after picking and suggests that the inoculum reached the fruit in water and soil particles splashed from the ground. Where the disease occurred, there was a large variation among trees in the number of decayed apples. The samples taken for storage may have been from apples subjected to different amounts of splashing from the ground. The apples may have been from boxes stacked at different heights on sod or on the 10-foot strip down each row where ground vegetation had been removed with herbicides.

According to Wormald (10) no attempts have been made to control *Phytophthora* apple fruit rots. The results here show the danger of leaving picked fruit in the orchard over wet periods where *P. syringae* is present.

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