

**Protection of Apple and Pear Fruit
Tissue Against Fireblight with
Nonpathogenic Bacteria**

J. A. Wrather, J. Kuć, and E. B. Williams

Graduate Research Assistant and Professors, respectively, Departments of Biochemistry and Botany and Plant Pathology, Purdue University, West Lafayette, Indiana 47907.

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ABSTRACT

Pear and apple fruit were protected against fireblight by avirulent *Erwinia amylovora*, *Pseudomonas tabaci* and a yellow bacterium isolated from a fireblight canker. Avirulent *E. amylovora* did not protect the fruit against a 0-hr challenge, but did protect the fruit against a 24-hr challenge. *Pseudomonas tabaci* and the yellow bacterium protected apple fruit against a 0-hr and 24-hr challenge and protected pear fruit against a 24-hr challenge.

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Additional key words: *Erwinia amylovora*, induced protection.

The inducing of protection against bacterial infection in plants has been demonstrated by various workers. Crosse (1) partially protected cherry leaves from *Pseudomonas mors-prunorum* by treating the leaves with epiphytic bacteria normally found on cherry leaves. Lovrekovich & Farkas (4) protected tobacco leaves from wildfire by treating the leaves with heat-killed *Pseudomonas tabaci* (Wolf & Foster) Stevens. McIntyre (*personal communication*) was able to protect green and etiolated 'Bartlett' pear stem tissue from fireblight by previous inoculation with *P. tabaci*, avirulent *Erwinia amylovora* (Burr.) Winslow et al., and a yellow bacterium isolated from a fireblight canker. Similar results were reported earlier by Goodman (3), using the same three types of bacteria. Our investigation was conducted to develop a quicker and more efficient system to use in studying factors conditioning protection against fireblight in pear.

In our experiments a virulent strain, W-8-V, of *E. amylovora* and an isolate, G-Y-1, of a yellow bacterium collected from a fireblight canker, were grown on Emerson agar (5). Avirulent isolates NP-24 (from R. N. Goodman) and HKA-1 (from H. Keil) of *E. amylovora* were grown on potato-dextrose agar. Isolate Pt-G-1 of *P. tabaci* (from R. N. Goodman) was grown on nutrient agar. All cultures were grown at 28

C. Bacterial suspensions were prepared from 24-hr cultures by washing the bacteria from the agar surface with 0.1 M potassium phosphate buffer, pH 6.8 (2). The resulting bacterial suspension was centrifuged at 20,000 *g* for 20 min at 4 C. The pellet was resuspended in potassium phosphate buffer and adjusted to 10⁸ cells/ml. The concentration was determined by measuring the absorbance of the bacterial suspension at 525 nm.

'Anjou' pear fruits bought from a local supermarket were stored at 4 C. Immature 'Jonathan' and 'Red Delicious' apple and Bartlett pear fruits 1-2 inches in diam were picked and stored at 4 C until used. Fruits free from visible infection symptoms or surface defects were surface-sterilized by submersion in 1% sodium hypochlorite for 15 min, rinsed with sterile deionized water, sliced, and inoculated. Slicing and inoculation were carried out under a hood previously fogged with hyamine solution and 1% NaClO. The slices (0.5-cm thick) were inoculated at 28 C in large sterile petri dishes, 150 mm X 20 mm, containing a sterile filter paper and 20 ml of sterile deionized water.

Six slices of pear fruit were used per treatment with five replications, and 10 slices of apple fruit were used per treatment with at least two replications. Some slices were nontreated, and others were covered on their upper surface with 0.5 ml of the buffer suspension of either the avirulent *E. amylovora*, *P. tabaci*, the yellow bacterium, or

phosphate buffer alone. One-half ml of a suspension of virulent *E. amylovora* was spread on the surface of each slice immediately after treatment or 24 hr later. These inoculations are referred to as 0-hr and 24-hr challenges. The experiment was terminated 7 days after the 24-hr challenge.

Slices of mature Anjou pear fruit infected with *E. amylovora* were water-soaked and had deposits of bacterial ooze on the surface within 24 hr after inoculation. Slices of immature Jonathan, Red Delicious and Bartlett fruit infected with *E. amylovora* had deposits of bacterial ooze on the surface within 48 hr after inoculation. Pear and apple slices inoculated with *P. tabaci*, the avirulent *E. amylovora*, and the yellow bacterium did not exhibit disease symptoms.

Slices of mature Anjou pear fruits were protected from fireblight by *P. tabaci* and avirulent isolates of *E. amylovora* (Table 1). *P. tabaci* protected against the 0-hr and 24-hr challenge of *E. amylovora*; whereas, avirulent isolates of *E. amylovora* did not protect against the 0-hr challenge, but protected against the 24-hr challenge. Slices of immature Jonathan, Red Delicious and Bartlett fruit were protected from fireblight by *P. tabaci*, the yellow bacterium, and an avirulent isolate of *E. amylovora*. Bartlett slices were not protected against the 0-hr challenge but were protected against the 24-hr challenge. *Pseudomonas tabaci* and the yellow bacterium protected the apple fruit against a 0-hr and 24-hr challenge, and the avirulent *E. amylovora* protected the apple fruit against a 24-hr challenge.

McIntyre (*personal communication*) demonstrated that etiolated Bartlett seedlings and nonetiolated grafted Bartlett clones protected against fireblight by previous inoculation of *P. tabaci*, the yellow bacterium, or an avirulent isolate of *E. amylovora*. This report indicates that these bacteria also protected pear and apple fruit from fireblight. Protection could be due to an *in vivo* antagonism between the bacteria used for protection and virulent *E. amylovora*, or to a resistance mechanism induced in the fruit by the bacteria used for protection.

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TABLE 1. Protection of apple and pear fruit slices against *Erwinia amylovora* by prior inoculation with *Pseudomonas tabaci*, avirulent *E. amylovora* and a yellow bacterium isolated from a fireblight canker

Treatment ^a	Challenge after (hr)	Host response ^b	
		Apple ^c	Pear ^c
Buffer only		NS	NS
Noninoculated only		NS	NS
<i>P. tabaci</i>		NS	NS
Avirulent <i>E. amylovora</i>		NS	NS
Yellow bacterium		NS	NS
Buffer	0	S	S
Buffer	24	S	S
Noninoculated	0	S	S
Noninoculated	24	S	S
<i>P. tabaci</i>	0	NS	S
<i>P. tabaci</i>	24	NS	NS
Avirulent <i>E. amylovora</i>	0	NS	S
Avirulent <i>E. amylovora</i>	24	NS	NS
Yellow bacterium	0	NS	NS
Yellow bacterium	24	NS	NS

^a Zero-hr challenge, and 24-hr challenge with *E. amylovora* following treatment.

^b Response determined 24-48 hr after challenge. NS = no visible symptoms of fireblight; S = visible symptoms and signs of fireblight.

^c Varieties in each group acted similarly. Apples included 'Red Delicious' and 'Jonathan'; pears included 'Bartlett' and 'Anjou'.