

Resistance in Apple to Four Bark Canker Fungi

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ABSTRACT

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Resistance to the pathogens *Nectria galligena*, *Pezicula malicorticis*, *Phytophthora cactorum*, and *Stereum purpureum* has been identified in apple, *Malus pumila*. Two cultivars, Vista Bella and NY 58553-1, are resistant to all four pathogens, whereas Discovery and Empire are resistant to three of them. Although the resistance to these bark canker fungi will not provide complete protection, use of these and similarly resistant cultivars could lessen the reliance on chemical control measures.

Bark canker fungi cause extensive damage to apple, *Malus pumila* Mill., in areas with low winter or fluctuating late fall and early spring temperatures. In Poland, four species of these canker fungi are economically important pathogens of apple. *Nectria galligena* Bres. causes the European canker disease (7) and is a common pathogen in the northern sections of most apple-growing regions of the world. *Pezicula malicorticis* (Jacks.) Nannk., more commonly known as its

anamorph designation, *Gloeosporium perennans* Zeller & Childs, causes apple anthracnose and also causes a storage rot (5). *Phytophthora cactorum* (L. & C.) Schroet. was identified by Baines (3) as the causative agent for the collar rot disease whose etiology under Polish conditions was reported (A. Bielenin, unpublished data). Silver leaf, caused by *Stereum purpureum* (Pers.) Fries, causes papery bark disease (8) on apple as well as the foliar symptoms.

Diseases caused by these fungi reduce productivity of apple orchards in Poland. The difficulty of obtaining effective chemicals to control them has stimulated interest in host resistance to these pathogens in cultivars suited for Polish conditions. Availability of cultivars possessing adequate levels of resistance to

these fungi could expand the production of apples in Poland.

MATERIALS AND METHODS

Twelve cultivars of apple were evaluated for their resistance to *N. galligena*, *Pezicula malicorticis*, *Phytophthora cactorum*, and *S. purpureum*. These included five potentially important apple cultivars: Discovery, Empire, Jerseymac, Melrose, and Vista Bella. Other cultivars were selections resistant to *Venturia inaequalis* (Cke.) Wint. (apple scab). Three of these—Priam, Prima, and Priscilla—had been tested earlier (4) for resistance to bark canker fungi. The remaining four cultivars included Macfree, a cultivar from Canada resistant to *V. inaequalis* (6), and three numbered selections from the New York disease-resistant apple breeding program (1).

Ten-tree replicates of each cultivar were inoculated with each fungus at two or three agricultural experiment stations in Poland. These stations were the Pomological Research Institutes located at Dabrowice and Skierniewice in central Poland and Albigowa in south central Poland. All four fungi were evaluated in Dabrowice and Skierniewice, but only

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Phytophthora cactorum and *S. purpureum* were tested at Albigowa. Inoculations were made by inserting a section measuring 4 × 8 mm of malt agar culture containing the fungus beneath a flap measuring 5 × 10 mm of bark cut on three sides, then wrapping the flap back in place with polyethylene tape. *P. cactorum* was inoculated on the trunks of 2-yr-old trees about 2 cm from the soil line; the other fungi were placed under bark flaps about 5 cm from the soil line.

Inoculations were made in April and/or November during 1978–1980. Controls consisted of sterile malt agar placed under the bark, none of which developed into lesions. Length of the lesion resulting from the inoculations with *P. cactorum* was measured 3 mo after the insertion of the inoculum under the bark, whereas lesions developing from the inoculations with the other fungi were measured 6 mo after inoculation.

RESULTS

Pezicula malicorticis. Discovery,

Empire, NY 55140-9, NY 58553-1, and Vista Bella showed the greatest degree of resistance to *P. malicorticis* (Table 1). Melrose was the most susceptible cultivar. This was shown in both Dabrowice and Skierniewice, where lesions more than 127 mm long developed 6 mo after inoculation. Jersey mac, Macfree, NY 55158-2, Prima, and Priscilla were also susceptible to *P. malicorticis*, although lesions were less than 100 mm long.

Nectria galligena. Discovery, Empire, NY 58553-1, and Vista Bella were resistant to *N. galligena* as indicated by lesion lengths from 10 to 45 mm (Table 1). Jersey mac, Prima, Priscilla, and NY 58553-1, however, were very susceptible to *N. galligena*, with lesions up to 166 mm long 6 mo after inoculation. Macfree, Melrose, and Priam, with lesions from 34 to 86 mm long, were highly susceptible to *N. galligena*.

Phytophthora cactorum. Empire, NY 58553-1, Prima, and Vista Bella were quite resistant to *P. cactorum* at three

locations (Table 2). Depending upon cultivar, location, and time of inoculation, cultivars Discovery, Macfree, NY 55158-2, and Priscilla with lesions up to 136 mm long were the most susceptible cultivars to *P. cactorum* in this study. Aside from cultivar Melrose, which had resistance to *P. cactorum* in two tests, the other cultivars were intermediate in reaction.

Stereum purpureum. Discovery, NY 55140-9, NY 58553-1, and Vista Bella were moderately resistant to *S. purpureum* (Table 2). Cultivars Macfree, Melrose, and Prima were moderately resistant to *S. purpureum* only in Dabrowice and Skierniewice but were susceptible to this pathogen in Albigowa.

DISCUSSION

In this study, we have demonstrated that resistance to four bark fungi exists in certain cultivars. The degree of observed resistance, however, would not fully protect them against damage caused by these fungi. Nevertheless, the observed resistance to these bark canker fungi could be used in conjunction with presently used chemical control measures to help reduce the amount of chemicals needed for control or could reduce the number of applications.

Two cultivars, Vista Bella and NY 58553-1, possessed some resistance to all four pathogens; Discovery was resistant to *N. galligena*, *Pezicula malicorticis*, and *S. purpureum*, and Empire was resistant to *Phytophthora cactorum*, *Pezicula malicorticis*, and *N. galligena*. In addition, NY 58553-1 is resistant to the apple scab fungus. Resistance to several fungal pathogens can thus be combined into a single cultivar, as proposed by Aldwinckle and Lamb (2).

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Table 1. Reaction of 12 cultivars of apple to inoculation with *Nectria galligena* and *Pezicula malicorticis* at two locations in Poland, 1978–1979

Cultivar	Length of canker (mm) ²				
	<i>Nectria galligena</i>			<i>Pezicula malicorticis</i>	
	Dabrowice		Skierniewice	Dabrowice	Skierniewice
	April 1979	Nov. 1979	Nov. 1978	Nov. 1979	Nov. 1978
Discovery	16 c	46 d	23 c	38 d	42 cd
Empire	26 bc	42 d	36 bc	40 d	36 d
Jersey mac	46 ab	80 b	75 a	70 bc	54 c
Macfree	48 ab	81 b	49 b	79 bc	39 d
Melrose	52 a	75 b	44 b	133 a	128 a
NY 55140-9	30 b	64 c	40 b	40 d	42 cd
NY 55158-2	44 ab	92 a	75 a	79 bc	38 c
NY 58553-1	10 c	44 d	20 c	56 cd	30 d
Priam	34 b	86 b	44 b	64 c	68 c
Prima	56 a	109 a	64 a	97 b	95 b
Priscilla	51 a	167 a	62 a	97 b	62 a
Vista Bella	12 c	41 d	26 c	36 d	26 c

²Inoculations were made 6 mo prior to measurements. Each number within a column is the mean of 10 separate determinations, and means followed by the same letter are not significantly different at the 5% level, according to Duncan's multiple range test.

Table 2. Reaction of 12 cultivars of apple to inoculation with *Phytophthora cactorum* and *Stereum purpureum* at three locations in Poland, 1979–1980

Cultivar	Length of cankers (mm) ²							
	<i>Phytophthora cactorum</i>			<i>Stereum purpureum</i>				
	Albigowa	Dabrowice		Skierniewice	Albigowa	Dabrowice		Skierniewice
	April 1980	April 1979	April 1980	April 1980	April 1979	Nov. 1979	April 1980	April 1980
Discovery	102 a	83 a	61 a	31 a	38 d	40 d	31 c	53 d
Empire	21 c	12 d	12 d	18 d	105 a	73 bc	49 c	81 c
Jersey mac	84 b	30 c	40 b	32 c	125 a	92 b	81 b	82 c
Macfree	92 ab	42 c	45 ab	52 bc	87 b	221 a	132 a	139 a
Melrose	29 c	18 d	18 cd	27 cd	108 a	221 a	160 a	106 b
NY 55140-9	136 a	61 a	37 b	60 b	33 d	42 d	20 c	36 d
NY 55158-2	81 b	48 bc	26 c	21 cd	122 a	74 bc	38 c	93 c
NY 58553-1	4 d	6 e	5 e	14 d	34 d	30 d	44 c	43 d
Priam	27 c	17 cd	21 c	30 c	60 c	41 d	31 c	87 c
Prima	19 c	6 e	9 d	16 d	161 a	102 b	88 b	114 b
Priscilla	88 b	58 bc	52 a	93 a	99 ab	93 b	68 bc	50 d
Vista Bella	16 c	10 de	17 cd	16 d	29 d	30 d	22 c	59 d

²Inoculations were made 3 mo prior to measurements for *Phytophthora cactorum* and 6 mo prior to measurements for *Stereum purpureum*. Each number within a column is the mean of 10 separate determinations, and means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

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