New Fire Blight and Scab Resistant Pyracanthas

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A *Pyracantha* breeding programme was started in 1982, to obtain resistance to fire blight (*Erwinia amylovora*) and scab (*Spilocaea pyracanthae*), and frost resistance. The ornamental criterion was a heavy long-lasting fruiting period. Cross pollination of different species and cultivars in INRA'S collection produced hybrids tested against scab and fire blight. Best hybrids were then cloned and tested again in a glasshouse. Observations were made on flowering and fruiting abilities. All hybrids have endured two hard winters with temperatures falling down to -15°C without snow protection. Two cultivars were selected and released to trade.

INTRODUCTION

Pyracantha is a favorite landscape and garden shrub because of the brightly coloured berries carried through the winter. They are mainly used as formal hedges or in free forms and more rarely as wall-covering plants.

Pyracantha is a member of the rose family (Rosaceae) and of the subfamily Maloideae which includes *Malus*, *Pyrus*, *Crataegus*, *Sorbus,* and *Cotoneaster*. This subfamily is a specific host of the fire blight bacteria (*Erwinia amylovora*) which was first discovered in the U.S.A. Extensive evaluation of the susceptibility of commercial species and cultivars of several genera has been undertaken in Angers by the Plant Pathology Research Station (Paulin, 1990).

As antibiotics are not allowed to be used to control plant disease in this country, only preventative techniques may be used to control fire blight. Breeding new cultivars resistant, or highly tolerant to fire blight, is an important part of prevention. Programmes have been developed on apple (Lespinasse and Paulin, 1989), pear (Thibault and Paulin, 1984) and *Pyracantha* (Cadic et al., 1989).

The first fire blight resistant cultivars of *Pyracantha* were released by Egolf between 1966 and 1986. Six cultivars have been described: 'Shawnee', 'Mohave', 'Navajo', 'Teton', 'Apache' and 'Pueblo' (Egolf, 1966; 1970; 1978; 1987a; 1987b), but this author is unaware of any information published on the inoculation procedure or the strain of *E. amylovora* used by Egolf to test them. In 1975, a breeding programme was initiated in The Netherlands (Bouma, 1990) but so far no cultivar has been released to the trade.

MATERIALS AND METHODS

Breeding strategy is summarized in Table 1. Crosses between 33 clones in the INRA collection were made in 1982 and 1983 in 126 combinations, including selfing. Young seedlings bearing four or five leaves were then tested against scab in a glasshouse. Scab had been collected on susceptible taxa then cultivated on an artificial medium and induced to produce spores (conidia). These were sprinkled on

leaves and susceptibility was screened. Only young hybrids without scab symptoms were retained for a second screening.

Table 1. Pyracantha breeding strategy.

1982 – 1983	Hybridizations in Angers
1983 – 1984	Glasshouse selection for scab resistance in Angers
1983 – 1984	Selection for fire blight resistance at seedling stage in Dax Field plantation
1985 – 1989	Repeated field inoculations, preselection, and cloning of preselected hybrids
1986 – 1992	Glasshouse tests in Angers. Field plantation for further observations

At this time, fire blight was not yet present around Angers so it was impossible to perform inoculation experiments. Hybrid seedlings were taken to Dax in the southwest of France which is in a fire blight area. Seedlings were top leaf inoculated with infected scissors using a French strain (CFBP 2045) at a concentration of 10^8 living bacteria per ml. Surviving plants were then planted into the field and inoculated again in the following years. Actively growing shoots were tip injected as soon as possible with a new French strain (CFBP 1430) at a concentration of 10^9 living bacteria per ml. Symptoms were scored from 0 to 3, 0 meaning no symptom, 1 meaning necrosis of less than 1/3 of the inoculated shoot; 2 meant 1/3 to 2/3 and 3 meant complete necrosis. Each seedling was inoculated 5 times on more than 30 shoots. Seedlings were selected for further screening on the basis of these scores. Ten rooted cuttings of each selected seedling were containerised and placed in a controlled glasshouse at Angers. Inoculations, at a concentration of 10^9 bacteria, were then repeated using a French strain (CFBP 1430) and an American strain (CUCM 273) of *E. amylovora*. The number of inoculated shoots showing necrosis and the size of necrotic patches were scored. Common cultivars were used as control and only the best seedlings were selected to be field planted for further observations of ornamental qualities.

RESULTS AND DISCUSSION

Resistance to scab is quite easy to assess. Susceptible plants are quickly covered by a dark olive green mycelium while resistant plants remain free. From 7111 contaminated seedlings, 3273 were judged resistant. This resistance looks quite stable both in Dax or Angers. On resistant plants, conidia spores are unable to germinate or germination and mycelium development are quickly and actively stopped by surrounding tissues.

Resistance to fire blight is unlikely to exist and it would be better to speak of tolerance. Even tolerant cultivars may express symptoms when grown in conditions that favor the disease, or if inoculated with very high concentrations of conidia. By repeating field inoculations and using two strains in the glasshouse we tried to overcome environmental effects to assess the true potential susceptibility.

It was found that highly susceptible clones must not be used in crosses. For instance, all progenies from *P. angustifolia* have had to be discarded after the first test. One of the best parents used was the American selection 'Shawnee' and

especially in combination with the French cultivar 'Mozart' a cultivar of from *P. atalantoides*. Results from a glasshouse inoculation made in March 1989 show that selected hybrids were more effective at resisting the symptoms of fire blight than the commercial cultivars in the INRA collection (Table 2).

The range of susceptibility to fire blight follows a continuous genetic variation and environment drastically modulates plant responses to infection so that it is likely that several genes are involved in fire blight tolerance. Improvement of resistance to fire blight would then be reached by accumulating those genes by performing recurrent crosses between the more resistant hybrids.

Of the 3000 hybrids originally tested against fire blight only 229 appeared to have disease resistance better than existing cultivars.

Table 2. Susceptibility to two strains of fire blight: a comparison of selected genotypes to 45 known cultivars.

	Strain CFBP 1430			Strain CUCM 273			Total both strains		
	Genotype[1]			Genotype			Genotype		
	LIS[2]	LN[3]	%	LIS	LN	%	LIS	LN	%
A	6803	1904	28.0	6707	1902	28.4	13510	3807	28.2
B	9601	4047	42.2	10030	4116	41.0	19631	8163	41.6

[1]A = Selected hybrids population, B = 45 cultivars from collection.
[2]LIS = Length of inoculated shoots in cm.
[3]LN = Length of necrosis in cm.

They all survived the severe frosts of two consecutive winters during which temperature fell to -15°C. Under the same climatic conditions, *P. angustifolia* has been killed, aerial parts of 'Navajo' and *P. crenatoserrata* 'Graberi' were killed, and *P. atalantoides* and relatives were slightly injured (Bertrand et al., 1992).

Up to now, two cultivars have been released to the trade. Both are owned by INRA and SAPHYR, the group of nurserymen who financially supported part of the breeding program.

Pyracantha 'Cadange' SAPHYR® Orange comes from a cross between *P.* 'Shawnee' and *P. atalantoides* 'Mozart' a slow growing heavy flowering and fruiting cultivar. Fruits are orange (RHS 25A to 28A), colouration is early. It is a medium-sized cultivar.

Pyracantha 'Cadrou' SAPHYR® Rouge originates from the same cross. Fruits are red (RHS 46B) turning to orange. As compared to other red-fruited firethorns, this cultivar has smaller leaves and fruits are not hanging down.

Both cultivars have been described (Bertrand et al., 1992). They were put to the trade in 1989. To fill the cultivar range, a yellow fruiting form will be introduced next year. Nurserymen are also selecting hybrids with a stronger growth and perhaps with a more erect habit.

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