A New Scab-resistant Apple: 'Ariane'

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Abstract. 'Ariane' is a new apple cultivar carrying the *V_f* gene of resistance to *Venturia inaequalis*. It was derived from a cross made in 1979 at INRA in Angers, France between two advanced selections. The seed parent was a hybrid between the *V_f* cultivars 'Florina' and 'Prima' and the pollen parent was derived from an open pollination of 'Golden Delicious'. 'Ariane' matures during the same period as 'Golden Delicious'. 'Ariane' fruit has blushed bright red skin, with 75% of the fruit surface colored. It is medium sized. The flesh is firm and crisp; it has excellent flavor and eating quality with a high level of sugar and acid. Storage ability is long. Trees have to be thinned intensively, chemically and manually, to get good size fruit. 'Ariane' shows low susceptibility to powdery mildew and fire blight. 'Ariane' has been selected by the SARL (Ltd) NOVADI and the S.A.S. POMALIA to be developed as the first cultivar of a "Les Naturianes" series. Since 2002, about 95,000 trees of 'Ariane' have been planted in France.

'Ariane' is a new scab-resistant cultivar released from the apple breeding program of INRA Angers. 'Ariane' is a long storage cultivar, is very attractive and has excellent flavor. It carries the *V_f* gene for scab resistance from *Malus floribunda* and is resistant to the most common races of *Venturia inaequalis* (Cke.) Wint.

The apple breeding program started in 1960 at INRA Angers. Four scab-resistant dessert apple cultivars have already been released: 'Priam' was released in 1974 in cooperation with PRI (Purdue University, Rutgers University, and the University of Illinois) (Decourtye et al., 1974), 'Querina-Florina' in 1977 (Lespinasse et al., 1985), 'Baujade' in 1991 (Lespinasse et al., 1992) and 'Initial' in 1999 (Laurens et al., 2000). Two scab-resistant cultivars released for juice production have been widely planted in France: 'Judeline' and 'Judaine' (Boré, 1994 a, 1994b).

Origin

'Ariane' resulted from a cross made in 1979 by Y. Lespinasse between two hybrids from the apple breeding program at Angers: the seed parent resulted from a cross between 'Florina' and 'Prima', two cultivars with the *V_f* gene inherited from *Malus floribunda* clone 821

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(Fig. 1). The pollen parent is a very attractive bright-red apple.

'Ariane' has followed the selection process developed at INRA Angers (Laurens, 1996). The cross produced 366 seeds which were sown in the glasshouse in winter 1980. In total, 313 plantlets were sprayed with a scab mixture comprised mainly of race 1 of *Venturia inaequalis* (L. Parisi, personal communication), obtained from scabbed leaves collected in INRA's orchards. In total, 233 scab-resistant seedlings were selected from this first screening. This amount of resistant seedlings (75%) was high as we expect a 50 resistant : 50 susceptible ratio from a resistant × susceptible cross. This could be due to a low level of scab infection in this particular test. The seedlings free from infection were planted in a nursery in June

1980. In December 1981, each seedling was assessed for powdery mildew susceptibility, *Nectria* canker under natural infection conditions and also scored for burrknot production. The 135 most susceptible individuals were discarded and in April 1982, the 92 remaining individuals were planted on their own roots in the orchard. In total, 29% of these trees showed scab symptoms in the field, much higher than the 5% susceptible plants normally present in the field after an INRA scab screening. That confirms that many individuals escaped infection in the greenhouse tests.

In 1984 first bloom occurred in this progeny, with 15.6% of the trees flowering. Fruit assessment started in 1985 using 20 fruit descriptors. In 1988, the original tree of 'Ariane' was selected by Y. Lespinasse and A. Fouillet and tested, under the clone number X6407, in the national varietal testing stage A and stage B trials coordinated by INRA and Ctifl (Centre Interprofessionnel des Fruit et Légumes) on different sites in France (Laurens, 1996). It was then released in France for advanced experiments in large scale trials by experimental stations (national level 2 trials), growers and nurserymen.

Description

Flowering and harvest time. Flowering occurs a few days—2 to 6—depending on the site and the year—before 'Golden Delicious'. Harvest maturity is the same as 'Golden Delicious' (middle of September in Angers). Fruit mature homogeneously within the tree, so that only two pickings are required. 'Ariane' is not susceptible to preharvest drop.

Fruit. Fruit of 'Ariane' is 75% to 100% blushed bright-red on a yellow background: sometimes a slight russet is present in the stem cavity, which does not affect its attractiveness.

Fig. 1. Pedigree of 'Ariane'.

Fig. 2. Fruit of 'Ariane' apple.

Many conspicuous lenticels are present on the skin. Fruit are flat globose with a medium size. All these traits make 'Ariane' very attractive and distinct from other cultivars (Fig. 2).

The fruit eating quality is judged to be excellent. The flesh is firm (8 to 9 kg·cm⁻²), crisp and juicy. Taste is flavourful and mildly acidic; values of refractometric index and acidity vary, according to the years, respectively from 13 to 15 Brix and from 9 to 10 eq g malic acid/L.

The storage ability is excellent: 'Ariane' keeps its harvest characteristics during at least 7 months in 1 °C storage conditions. Fruit picked too early can show some susceptibility to fruit storage scald.

Tree. The tree is quite vigorous with a low branching amount. The fruit cropping is generally high and regular every year with a special tendency to get clusters of small fruit grouped together on old branches. To avoid

that, intense chemical thinning programs are necessary. Complementary manual thinning is often recommended to get a large number of good size fruit. Even after a high cropping season, the tendency toward biennial bearing is very low.

Pest and disease susceptibility. 'Ariane' carries the *V_f* gene, so it is resistant to the five most common races of *Venturia inaequalis* (races 1 to 5). Recent scab tests in the greenhouse showed that 'Ariane' was highly susceptible to different strains of race 6 and to the new strain EU-NL24 (Parisi et al., 2004). However, in such controlled inoculations, it has shown consistent resistance against race 7 strains.

Based on glasshouse tests and field observations, 'Ariane' appears to be resistant to fire blight caused by the bacteria *Erwinia amylovora* (Burr.) Winslow. In the orchard, it shows very good field resistance to powdery mildew incited by the fungus *Podosphaera*

leucotricha (Ell. & Ev.) Salm. but it is susceptible to the rosy apple aphid (*Dysaphis plantaginea*).

Availability

Three partners are involved in new releasing INRA cultivars: Agri-Obtentions, an INRA subsidiary company and two French private companies: the SARL (Ltd) NOVADI and the S.A.S. POMALIA. NOVADI was founded in 1997 by 17 French nurserymen with a goal of developing a series of apple cultivars of good eating quality, naturally resistant to the most common diseases. This consolidated group of nurserymen together with some producers and marketing organizations formed a new company named the S.A.S. POMALIA whose main aim is to select the best cultivars from the list proposed by NOVADI. To achieve this, NOVADI is coordinating a network of large-scale trials (>500 trees/orchard) by nurserymen and growers. It is connected with the national level 2 varietal experimental network managed by Ctifl. 'Ariane' was selected as the best cultivar from these trials. It was chosen by POMALIA to be the first cultivar of a series distributed under the generic trademark Les Naturianes. The first commercial plantings of 'Ariane' started in Winter 2001–02 with 45,000 trees. In 2002–03, new plantings reached 95,000 trees. These promising results has POMALIA planning to plant 500 ha of 'Ariane' in 2006.

'Ariane' was registered in the French Official Registration List in 2003. The application for European Registration (CPVO) was submitted on 20 Feb. 2003.

Literature Cited

- Boré, J.M. 1994a. Fiche variétale Judeline. L'Arboricult. Fruitière 472.
- Boré, J.M. 1994b. Fiche variétale Judaine. L'Arboricult. Fruitière 475.
- Decourtye, L.M., E.B. Williams, J. Janick, F.H. Emerson, D.F. Dayton, J.B. Mowry, L.F. Hough, and C. Bailey. 1974. 'Priam' apple. Hortscience 94(4):401–402.
- Laurens, F. 1996. Use of apple genetic resources in apple breeding programs at INRA: Present status and perspectives, p. 69–73. In: H.J. Case (ed.). Proceedings of a workshop, 21–24 June 1995, Wye College, University of London Intl. Plant Genet. Resour. Inst., Rome.
- Laurens, F., Y. Lespinasse, and A. Fouillet. 2000. A new scab resistant apple: 'Initial'. Acta Hort. 538:707–710.
- Lespinasse, Y., J.M. Olivier, J.M. Lespinasse, and M. Leleze. 1985. 'Florina-Querina': la résistance du pommier à la tavelure. L'Arboricult. Fruitière 378:43–47.
- Lespinasse, Y., J.M. Lespinasse, and M. Leleze. 1992. Baujade. Une nouvelle variété de pommier résistante à la tavelure. L'Arboricult. Fruitière 454:15–16.
- Parisi, L., V. Fouillet, H.J. Schouten, R. Groenwold, F. Laurens, F. Didelot, K. Evans, C. Fischer, F. Gennari, H. Kemp, M. Lateur, A. Patocchi, J. Thissen, and C. Tsipouridis. 2004. Variability of the Pathogenicity of *Venturia inaequalis* in Europe. Acta Hort. (in press).