

‘Arandell’—a Disease-resistant Red Wine Grape

Bruce I. Reisch¹ and R. Stephen Luce

Department of Horticulture, New York State Agricultural Experiment Station, 630 W. North Street, Cornell University, Geneva, NY 14456

Anna Katharine Mansfield

Department of Food Science, New York State Agricultural Experiment Station, 630 W. North Street, Cornell University, Geneva, NY 14456

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‘Arandell’ is a disease-resistant red wine grape cultivar that ripens midseason. Only minimal efforts are needed to control powdery mildew (*Erysiphe necator* Schw.), downy mildew (*Plasmopara viticola* Berl. & de Toni), and Botrytis bunch rot (*Botrytis cinerea* Pers.). The vine is moderately productive and, in New York’s Finger Lakes region, it is adequately winter hardy. The wine is dark red with dominant aromas of blueberry and black cherry.

Origin

‘Arandell’ (Fig. 1) was developed at the New York State Agricultural Experiment Station, Cornell University, Geneva, NY. It resulted from a cross between two interspecific hybrid selections from the Cornell Grape Breeding Program (Fig. 2). This cross was made in 1995, and 183 seedlings were planted to a fungicide-free nursery in 1996. The 23 most disease-resistant seedlings were saved and planted to a permanent vineyard site in 1997. One seedling stood out from the rest as a result of its high resistance to downy and powdery mildew combined with promising vine size and cluster characteristics. This seedling (designated NY95.0301.01) was selected and propagated in 2001.

Description and Performance

General growth and yield. For both enological and viticultural comparisons, ‘Chambourcin’, an interspecific hybrid red wine cultivar, was used as a standard. ‘Arandell’

was tested only in the absence of fungicides to allow for disease resistance assessment under adverse conditions. In these vineyards, ‘Concord’ was grown as a control because it continues to survive and can be used to indicate the presence of powdery mildew. ‘Chambourcin’ was grown in a nearby vineyard with standard disease control measures because it is known to be highly susceptible to powdery mildew. Own-rooted vines of ‘Arandell’ grown in phylloxera (*Daktulosphaira vitifoliae*) infested soils are moderately vigorous. Vines have an orderly and distinct upright growth habit with smaller leaves and a less dense canopy than most hybrid (*Vitis* sp.) cultivars. Budbreak usually occurs before ‘Chambourcin’ and ‘Traminette’ but after ‘Concord’. Among field-grown vines with 2.74 × 2.44-m spacing at Geneva, NY, pruning weights averaged 0.73 kg/vine, whereas fruit yield per vine averaged 4.5 kg/vine (≈6.8 t·ha⁻¹; Ravaz index = 6.2) from 2006 to 2012, but when 3 years with bird depredation and Japanese beetle (*Popillia japonica* Newman) damage are excluded, fruit yield per vine averaged 5.4 kg/vine (≈8.1 t·ha⁻¹). In the same period, ‘Chambourcin’ produced 9.1 kg/vine (≈13.6 t·ha⁻¹) of fruit with a mean cane pruning weight of 1.3 kg/vine (Ravaz index = 7.0). Cluster weights for ‘Arandell’ and ‘Chambourcin’ were 68 and 181 g, respectively, whereas berry weights were 1.1 and 2.0 g/berry, respectively.

Winterhardiness. Vines of ‘Arandell’ are moderately winter hardy and should be suitable for viticultural growing regions similar to the Finger Lakes of New York. Tests of midwinter primary bud-hardiness (Differential Thermal Analysis per Mills et al., 2006) indicated that 50% bud kill would occur at ≈–25 °C with a range of –21.7 to –27.2 °C. Small amounts of trunk damage have been observed after mid winter low temperatures of –26 to –27 °C, but crown gall disease (*Agrobacterium vitis* Ophel and Kerr) has not been observed.

Disease resistance. The goal of the cross that produced ‘Arandell’ was to combine superior wine quality with high levels of disease resistance. The primary diseases observed during development were powdery mildew, downy mildew, and Botrytis bunch

rot. ‘Arandell’ is highly resistant to all three diseases. Between 2005 and 2012, two plots of ‘Arandell’ (three and 10 vines, respectively) were rated for foliar symptoms of powdery and downy mildew using a modified Barratt-Horsfall scale (1, 0% to 3% leaf surface infected; 2, 3% to 12%; 3, 12% to 25%; 4, 25% to 50%; and 5, greater than 50%; Horsfall and Barratt, 1945). Under fungicide-free conditions, ‘Concord’ was rated 4.1 and 2.2, whereas ‘Arandell’ was rated 2.4 and 1.7 for powdery mildew and downy mildew symptoms, respectively. For both ‘Concord’ and ‘Arandell’, neither powdery nor downy mildew symptoms were observed on the fruit. Berries infected by Botrytis bunch rot have never exceeded 2% at harvest. Black rot (*Guignardia bidwellii* Viala & Ravaz) on fruit and Phomopsis [*Diaporthe ampelina* (Berk. & M.A. Curtis) R.R. Gomes, C. Glienke & Crous, comb. nov.] cane lesions have been observed in some years, and vines of ‘Arandell’ were moderately resistant to these diseases.

Canopy management. Although the upright growth habit of ‘Arandell’ makes it suitable for training systems with vertical shoot positioning, vines also grow well and often produce more fruit on a high wire cordon. Vines should be grafted and/or grown with closer spacing between vines to increase fruit production, although, as a result, cluster thinning may be needed in some years (Justine Vanden Heuvel, personal communication).

Enological performance. Research wines have been produced from ‘Arandell’ grapes at Cornell’s Vinification and Brewing Laboratory in single trial lots since 2007, and in multiple lots, for processing parameter trials, since 2008. Control wines were produced following a standard procedure; in short, grapes were crushed, destemmed, and inoculated with yeast strain ICV-GRE (Lallemand, Montreal, CA). Fermentation proceeded with skin contact and thrice-daily punchdowns at ambient temperature (21 °C) for 7 d. Wines were then dejuiced into glass carboys and inoculated with lactic acid bacteria strain Alpha (Lallemand) and held at ambient temperature during malolactic fermentation (MLF). After completion of MLF, wines were cold-stabilized for 2 weeks before bottling under screw caps in standard, 750-mL bottles.

Juice and wine analysis. In all juice samples, soluble solids were measured with a handheld Atago Alpha-PAL refractometer (Bellevue, WA), pH with an Accumet Excel XL25 pH meter (Thermo-Fisher Scientific, Waltham, MA), and titratable acidity [expressed as Tartaric acid equivalents (TAE)] on a Titro Plus 848 titrator and 869 autosampler (Metrohm USA, Riverview, FL). Beginning in 2010, juice was also analyzed for yeast assimilable nitrogen (YAN) by enzymatic analysis. Wines were analyzed for pH and titratable acidity as described previously and for organic acids (tartaric, malic, lactic) by high-performance liquid chromatography (HPLC). A group of trained panelists screened all wines for selected sensory characteristics, providing descriptors

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¹To whom reprint requests should be addressed; e-mail bruce.reisch@cornell.edu.

for aroma (orthonasal) and palate (retronasal odors, tastants, mouth feel, and acid/sugar balance) and pleasantness rankings for aroma, palate, and overall wine on a standard 9-point hedonic scale.

Harvest parameters. At the Geneva site, ‘Arandell’ was harvested an average of 15 d earlier than ‘Chambourcin’ and had lower average soluble solids and titratable acidity (1.3° Brix and $2.1 \text{ g}\cdot\text{L}^{-1}$, respectively) and slightly higher pH (Table 1). During the 5 years reported, ‘Arandell’ showed the highest average soluble solids (21.4° Brix) and lowest titratable acidity (TA) ($9.1 \text{ g}\cdot\text{L}^{-1}$) in 2012, although pH was notably similar to that in years with lower sugar and higher TA (Table 1).

Both ‘Arandell’ and ‘Chambourcin’ juice showed pronounced ranges in total YAN

concentration, which is known to vary widely by year, site, and cultivar (Butzke, 1998). Individual concentrations of YAN in ‘Arandell’ ranged from 112 to 278 mg nitrogen (N) per liter (data not shown) with means ranging from 134 to 250 mg N/L (Table 2) compared with 105 to 187 mg N/L in ‘Chambourcin’. Because the minimum YAN concentration required for healthy fermentation is 140 mg N/L (Bely et al., 1990), juice from both cultivars will need nutrient supplementation in most years. It is also interesting to note that the YAN concentration in both cultivars consists primarily of primary amino nitrogen with relatively low ammonium (AMM) concentrations. Because AMM is the preferred N source for yeast, this imbalance may impact fermentation and wine aroma development but is also easily amended through

the addition of diammonium phosphate (Bell and Henschke, 2005). Furthermore, because both AMM and YAN vary by vineyard site, season, and viticultural treatments, YAN concentration and makeup may be quite different in ‘Arandell’ grown in other regions.

Wine chemistry. MLF is generally recommended to ameliorate the relatively high acidity in ‘Arandell’ wines and has been found to reduce TA to a manageable average of $6.1 \text{ g}\cdot\text{L}^{-1}$ TAE compared with $10 \text{ g}\cdot\text{L}^{-1}$ for ‘Chambourcin’ (Table 3). Average lactate concentrations are roughly equivalent in both wines, but the lower tartrate concentration in ‘Arandell’ wines (averaging $2.1 \pm 0.3 \text{ g}\cdot\text{L}^{-1}$ compared with $3.7 \pm 0.7 \text{ g}\cdot\text{L}^{-1}$ in ‘Chambourcin’) culminates in lower overall TA. Although this conversion of malic acid to lactic is considered advantageous for palate balance, it may push wine pH above the microbial safety point of pH 3.8 (Du Toit and Pretorius, 2000) (Table 3). This issue is easily solved, however, with post-fermentation acidification and by inhibiting microbial growth with 0.5 ppm free molecular SO_2 (Fugelsang and Edwards, 2007).

Wine color, astringency, and bitterness are dictated by the concentration of phenolic compounds (Kennedy, 2008). When characterized using HPLC and phloroglucinolysis, ‘Arandell’ wine pigments were found to consist primarily of diglucoside anthocyanins, rather than the monoglucoside anthocyanins produced by *V. vinifera* cultivars, and concentration of polymeric pigment was similar to that of hybrid cultivars Maréchal Foch and Corot noir (Thomas, 2013). Condensed tannin concentration was found to be relatively low, and mean degree of polymerization averaged less than 4.0, suggesting that extant tannins are likely to contribute mild bitterness rather than astringency when present in concentrations above gustatory threshold (Thomas, 2013).

Sensory characteristics. Sensory panelists screening ‘Arandell’ research wines described berry notes in both aroma and palate, especially blueberry, black cherry, and blackberry, with tobacco with hints of black pepper or cedar on the finish. In cooler years, panelists noted some vegetal character, tending toward green pepper or currant leaf rather than “hybrid” character. In hedonic rankings, ‘Arandell’ wines averaged 4.4 (out of 9) for quality of nose, 5.0 for palate, and 4.9 for overall pleasantness compared with 4.7, 4.9, and 4.9, respectively, for the standard comparison wine ‘Chambourcin’.

In parameter trials, panelists showed a slight preference for wines fermented with skin contact time for 3 d rather than 7 or 10 d, and for wines fermented with yeast strain ICV-GRE (Lallemand, Montreal, CA) when compared with those fermented with RC212 (Lalvin, Montreal, CA), CSM (Lallemand), BM4X4 (Lalvin), and BRL 97 (Lallemand).

Overall recommendation. ‘Arandell’ is recommended for wine production under low-input management systems. One or two sprays per season may be needed to reduce the possibility that the pathogen may overcome



Fig. 1. Fruit cluster of the ‘Arandell’ grape.

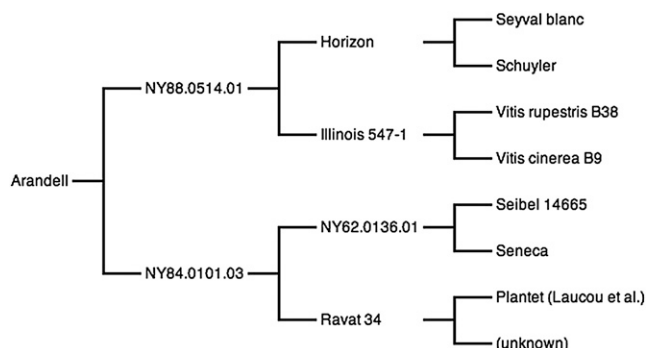


Fig. 2. Pedigree of the ‘Arandell’ grape.

Table 1. Soluble solids, titratable acid content, and pH value of ‘Arandell’ and ‘Chambourcin’ must at crush, 2008–12, Cornell Vinification and Brewing Laboratory, Geneva, NY.

	Harvest date		Soluble solids (° Brix) (± SD)		Titratable acidity ^z (g·L ⁻¹) (± SD)		pH (± SD)	
	Arandell	Chambourcin	Arandell	Chambourcin	Arandell	Chambourcin	Arandell	Chambourcin
2008 ^w	1 Oct.	20 Oct.	18.0 ± 1.1	22.0	10.3 ± 0.6	16.0	3.3 ± 0.1	2.9
2009 ^x	5 Oct.	19 Oct.	20.3 ± 0.1	19.3	13.1 ± 0.2	18.3	3.3 ± 0.0	3.2
2010 ^x	8 Sept.	29 Sept.	19.6 ± 0.3	20.1	10.5 ± 0.7	13.2	3.3 ± 0.1	3.1
2011 ^x	19 Sept.	3 Oct.	18.4 ± 1.0	20.7	9.8 ± 0.5	12.1	3.3 ± 0.0	2.9
2012 ^w	12 Sept.	19 Sept.	21.4 ± 0.4	22.5	9.1 ± 0.7	12.8	3.3 ± 0.0	2.9
Mean	21 Sept.	6 Oct.	19.5 ± 1.4	20.8 ± 1.2	10.5 ± 1.4	12.6 ± 2.7	3.3 ± 0.1	3.1 ± 0.1

^zReported in tartaric acid equivalents.

^wn = 2.

^xn = 5.

^wn = 2.

Table 2. Ammonium (AMM), primary amino nitrogen (PAN), and yeast assimilable nitrogen (YAN), in milligrams nitrogen per liter, in ‘Arandell’ and ‘Chambourcin’ must at crush, 2010–12, Cornell Vinification and Brewing Laboratory, Geneva, NY.

	AMM (± SD)		PAN (± SD)		YAN (± SD)	
	Arandell	Chambourcin	Arandell	Chambourcin	Arandell	Chambourcin
2010 ^z	18 ± 9	40.4	232 ± 35	147	250 ± 43	187
2011 ^y	11 ± 5	9.1	176 ± 31	108	187 ± 36	117
2012 ^z	4 ± 6	8.2	130 ± 16	97	134 ± 20	105
Mean	10 ± 9	19 ± 18	183 ± 51	117 ± 23	193 ± 58	136 ± 44

^zn = 5.

^yn = 6.

Table 3. pH value, titratable acid content, and tartrate and lactate concentration of wines produced from ‘Arandell’ and ‘Chambourcin’ after malolactic conversion, 2008–12, Cornell Vinification and Brewing Laboratory, Geneva, NY.

	pH (± SD)		Titratable acidity ^z (g·L ⁻¹) (± SD)		Tartrate ^y (g·L ⁻¹) (± SD)		Lactate ^y (g·L ⁻¹) (± SD)	
	Arandell	Chambourcin	Arandell	Chambourcin	Arandell	Chambourcin	Arandell	Chambourcin
2008 ^w	3.8 ± 0.2	3.1	5.6 ± 0.1	13.1	— ^x	—	—	—
2009 ^w	3.6 ± 0.0	3.2	6.1 ± 0.3	9.9	2.1 ± 0.1	3.9	3.9 ± 0.1	4.4
2010 ^w	4.1 ± 0.1	3.3	6.4 ± 0.1	8.3	1.7 ± 0.1	2.5	4.5 ± 0.3	4.3
2011 ^v	3.9 ± 0.3	3.1	6.1 ± 0.6	9.1	2.2 ± 0.3	3.8	3.6 ± 0.3	2.6
2012 ^v	3.8 ± 0.1	3.1	5.7 ± 0.1	9.7	2.2 ± 0.1	4.4	3.0 ± 0.3	2.9
Mean	3.9 ± 0.2	3.1 ± 0.1	6.1 ± 0.5	10.0 ± 1.6	2.1 ± 0.3	3.7 ± 0.7	3.7 ± 0.6	3.5 ± 0.8

^zReported in tartaric acid equivalents.

^yAnalyzed by high-performance liquid chromatography.

^xData not recorded.

^wn = 2.

^vn = 6.

^wn = 7.

^vn = 13.

the natural disease resistance of the vine. Black rot may require control efforts in disease-prone regions. Wines made using standard red wine production methods are medium-bodied, clean, and enjoyable.

Availability

Vines of ‘Arandell’ may be purchased from licensed commercial nurseries; contact Ms. Jessica Lyga (JML73@cornell.edu) of the Cornell Center for Technology Enterprise and Commercialization for a list of licensees or to become a licensee. You may also access a list of sources at <http://www.cctec.cornell.edu/plants/index.php>. Virus-tested cuttings may be obtained from Foundation Plant Services, University of California, One Shields

Avenue, Davis, CA 95616-8600 (phone: 530-752-3590; e-mail fgs@ucdavis.edu; <http://fgs.ucdavis.edu/>).

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