Breeding and regional evaluation of mildew-resistant winegrape varieties for Australian conditions

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The costs involved in the annual spray programs to control powdery and downy mildew can drastically be reduced by establishment of disease-resistant vineyards. The need for environmental preservation contribute to the necessity for breeding and evaluating disease-resistant winegrape varieties suited for Australian conditions.

The 1st generation of mildew-resistant winegrape varieties, are being evaluated for field performance and winemaking potential. The breeding of 2nd generation of mildew-resistant varieties with additional resistance loci for more durable resistance is now underway.

Breeding for disease resistance

1st generation varieties

A classical breeding approach was undertaken by INRA in France to introgress mildew resistance loci from the wild North American grapevine species *Muscadinia rotundifolia to* create a disease resistant winegrape genotype VRH 3294 (Figure 1). This genotype contains the *RUN1* and *RPV1* loci which confer resistance to powdery and downy mildew, respectively.

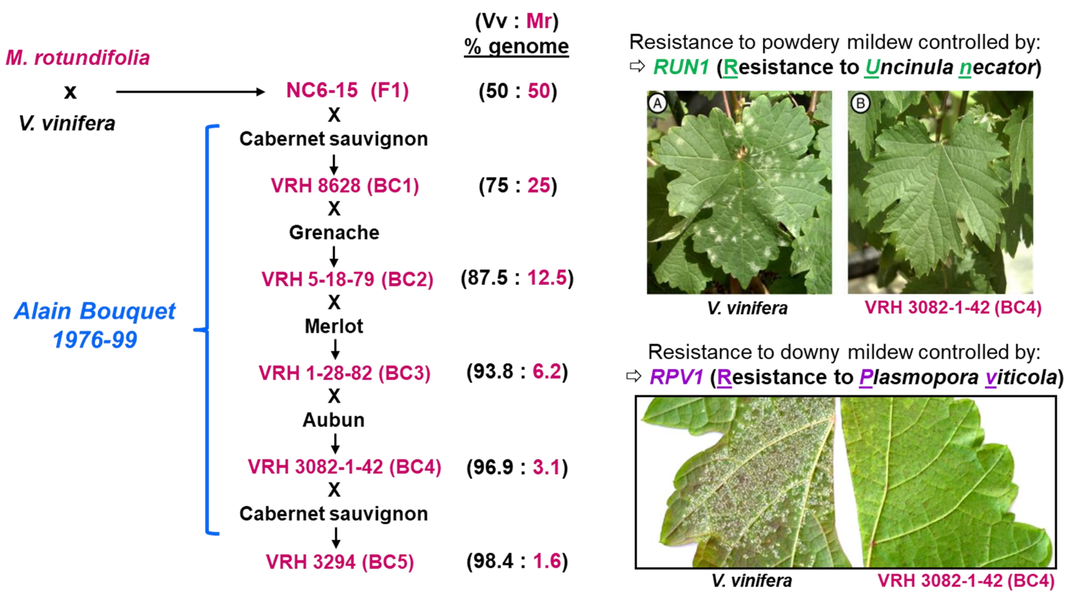

Figure 1. Illustration of the backcross breeding program used to generate the powdery and downy mildew-resistant winegrape genotype VRH 3294.

VRH 3294 was subsequently crossed with eight premium white and red *Vitis vinifera* varieties by CSIRO to create the 1st generation mildew-resistant grapevines in Australia. The parental varieties included the reds Dunkelfelder, Shiraz, Tannat and Tempranillo, and whites Frontignac, Muscat Gordo Blanco, Riesling, and Verdelho. Characteristics of the new varieties include red flesh and Muscat aromas.

The 1st generation varieties have been planted in no-spray vineyards since 2009 and no powdery or downy mildew infections have been observed on the unsprayed vines (Figures 2 and 3).

Figure 2. The bunch on the left is from a sprayed old variety block, and was evidently covered with powdery mildew during a period of extreme disease pressure. The bunch on the right was from an unsprayed neighbouring block (new disease resistant variety) and shows no sign of powdery mildew.

Figure 3. Example of an unsprayed 1st generation mildew resistant grapevine grown in the field at the Irymple site.

2nd generation varieties

The breeding of 2nd generation mildew-resistant winegrape varieties containing two powdery mildew loci (*RUN1* & *REN4*) and two downy mildew resistance loci (*RPV1* & *RPV16*) is now underway. The additional resistance loci are being introgressed from wild Chinese *Vitis* species. The 'stacking' of multiple resistance loci from different sources will provide increased durability of the resistance in the vineyard.

Evaluation of 1st generation varieties

The first step was to select 1200 seedlings for field evaluation in Nuriootpa, Barossa Valley. Twenty red and white varieties with high yields and good winemaking potential were subsequently selected for larger scale evaluation by CSIRO and the New South Wales DPI in different regions across Australia. The selected varieties were planted in the Barossa (Nuriootpa), Riverina (Wagga Wagga), Sunraysia (Irymple) and most recently in the cool climate region Orange (Figure 5).

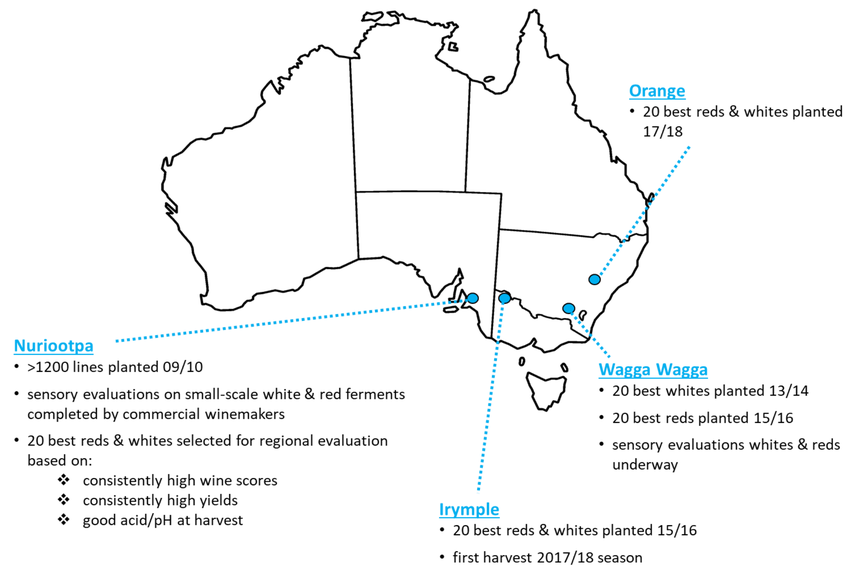

Figure 4. Map indicating the different regional sites where the 20 red and white 1st generation mildew resistant varieties are being evaluated.

Viticultural properties

Assessments of vegetative growth, yield parameters, fruit chemical composition and time of ripening are being conducted and compared for the different regions. The new varieties show differences in time of grape maturity of up to two months for both red and white varieties within the same vineyard. The selections give rise to considerable differences in vegetative growth, fruit parameters and ripening, including four- and 14-fold variation in winter pruning weight and fruit yield, respectively. The ranges of berry maturity date, fruit yield and red grape anthocyanin concentration in Wagga Wagga and Irymple for the 2018/19 season are shown in Table 1.

Table 1. Measured ranges for the different fruit characteristics of 1st generation disease resistant varieties in Wagga Wagga and Irymple in the 2018/19 season

SITE	GRAPE COLOUR	BERRY MATURITY DATE	FRUIT YIELD (T/HA)	ANTHOCYANINS (MG/G)
Wagga Wagga	White	08/02 – 22/03	8 – 26	-
	Red	15/02 – 15/03	6 – 16	0.8[1] – 2.6[2]
Irymple	White	21/01 – 27/03	13 – 42	-
	Red	07/02 – 27/03	16 – 54	0.6[1] – 2.5[2]

[1]White fleshed, [2]Red fleshed

Wine properties

Wines made from the new varieties show not only a considerable range in overall scores, but also differences in aromas and attributes. Figure 6 illustrates the differences in wine aromas and attributes as evaluated for different wines made from the new varieties in the 2018/19 season.

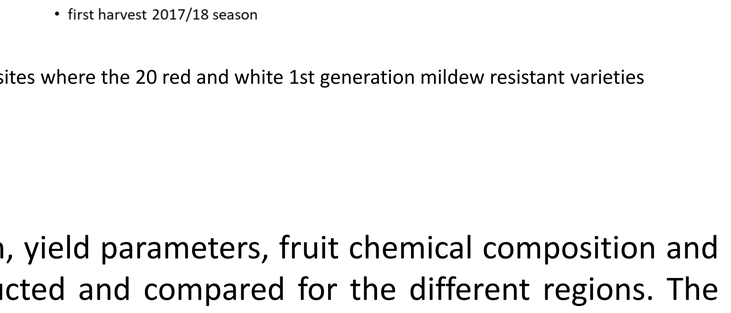

Figure 5. Examples of differences in the aroma composition of whites wines (A) and the attributes of red wines (B) made from grapes grown in Wagga Wagga and Irymple during the 2018/19 vintage.

FOR FURTHER INFORMATION
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ACKNOWLEDGEMENTS
The authors thank Wine Australia and CSIRO for the funding of the project. We also thank staff at CSIRO Waite campus and Irymple, as well as the National Wine and Grape Industry centre for technical support.