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Chloride accumulation in some hybrids and backcrosses of *Vitis berlandieri* and *Vitis vinifera*

by

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Chloridanreicherung bei F_1-Hybriden und Rückkreuzungen von *Vitis berlandieri* und *Vitis vinifera*

Zusammenfassung. — Die F_1-Populationen aus der Kreuzung von 2 *Vitis-berlandieri*-Klonen und 4 *V.-vinifera*-Sorten zeigten im allgemeinen, ähnlich wie *V. berlandieri,* nur eine schwache Chloridanreicherung; geringfügige Abweichungen traten in Verbindung mit bestimmten Kreuzungseltern auf. Bei den Rückkreuzungspopulationen aus 2 F_1-Klonen und 2 *V.-vinifera*-Sorten wurde eine diskontinuierliche Verteilung der Chloridanreicherung beobachtet; die einzelnen Populationen setzten sich jeweils etwa zur Hälfte aus Sämlingen mit schwacher und mit stärkerer Chloridanreicherung zusammen, die allerdings nicht so hoch wie bei den *V.-vinifera*-Sorten war. In den Rückkreuzungspopulationen waren weder Traubenertrag noch Beerengewicht mit der Chloridanreicherung verknüpft. Die Weine, die von etlichen der stärker tragenden Rückkreuzungssämlinge gewonnen wurden, waren den Weinen von *V.-vinifera*-Klonen vergleichbar.

Introduction

Previous investigations have shown that *Vitis berlandieri* vines accumulate relatively small amounts of chloride in their petioles (DOWNTON 1977, ANTCLIFF *et al.* 1983). Although *V. berlandieri* has small berries with numerous seeds and acid juice, the bunch frame is of reasonable size and the juice and wine are free from objectionable flavours (GALET 1956). This suggests that *V. berlandieri* could be used in breeding for fruiting cultivars, and a number of crosses and backcrosses with *V. vinifera* have been made at Merbein with this aim in view. This paper reports chloride accumulation and harvest data for some of the vines in this program.

Materials and methods

A synopsis of the crosses made and the vines examined for chloride is given in Table 1. All vines were growing at CSIRO Division of Horticultural Research, Merbein within 250 m of the *V. berlandieri* vines which were selected from 2 of the populations previously studied (ANTCLIFF *et al.* 1983). The soil type in all cases was classified as a member of the Coomealla series (PENMAN *et al.* 1939) and the vines were furrow-irrigated during each growing season with water containing about 2—3 mM Cl^-. The F_1 hybrid and backcross populations were planted sequentially in rows of 90—100 vines, as shown for the backcross vines in Fig. 2. Vines to be sampled were selected by dividing each row into 5 segments and selecting about 5—12 vines at random in each segment according to the total number of vines in the population to be sampled. Petioles were sampled between 10 and 13 January 1983 and chloride determined by the method

Table 1

Synopsis of the crosses made, the number of seedlings established and the number of vines examined for chloride

Zusammenstellung der durchgeführten Kreuzungen, der Anzahl aufgezogener Sämlinge und der Anzahl auf Chlorid geprüfter Reben

		No. of vines		
		Total	Sampled	
V. berlandieri populations				
Resseguier no. 1	× 7651 [1])	93	19	includes MG 55-51 [2])
Resseguier no. 2	× 7651	40	20	includes MG 56-100
F_1 hybrid vines				
MG 55-51	× Raisin de Palestine	29	29	
	× Biancone	70	32	
	× Koshu Sanjaku	55	30	
MG 56-100	× Raisin de Palestine	114	35	
	× Biancone	201	62	
	× Koshu Sanjaku	112	49	
	× Sultana	33	33	includes MF 77-13 and MF 78-1
Backcross vines				
MF 77-13	× Biancone	60	29	
	× Koshu Sanjaku	48	27	
MF 78-1	× Biancone	97	33	
	× Koshu Sanjaku	51	30	

[1]) The female parent is shown first in each case.
[2]) Code numbers as given to single vine seedlings at Merbein.

previously described (ANTCLIFF *et al.* 1983). At sampling the pure *V. berlandieri* vines were 14 years old, one hybrid population (progeny from MG 56-100 × Sultana) was 10 years old and the remaining vines were 4 years old. All *V. vinifera* parents were well established vines.

The fruit of the hybrid and backcross vines and the *V. vinifera* parents was harvested and assessed as it matured, between February and mid April 1983. Wine was made, using the methods described by KERRIDGE (1983), from the fruit of a few of the more promising seedlings.

Results

Fig. 1 shows the frequency distribution of petiole chloride accumulation in the seedling populations. Of the 13 populations concerned, only 1 (MG 55—51 × Koshu Sanjaku) showed a significant correlation between chloride and position in the row.

Even in this case only 29.4 % of the variation in chloride was related to position in the row, and the chloride tended to decrease with distance from the irrigation outlet. The distribution of chloride accumulation was continuous in the *V. berlandieri* and F_1

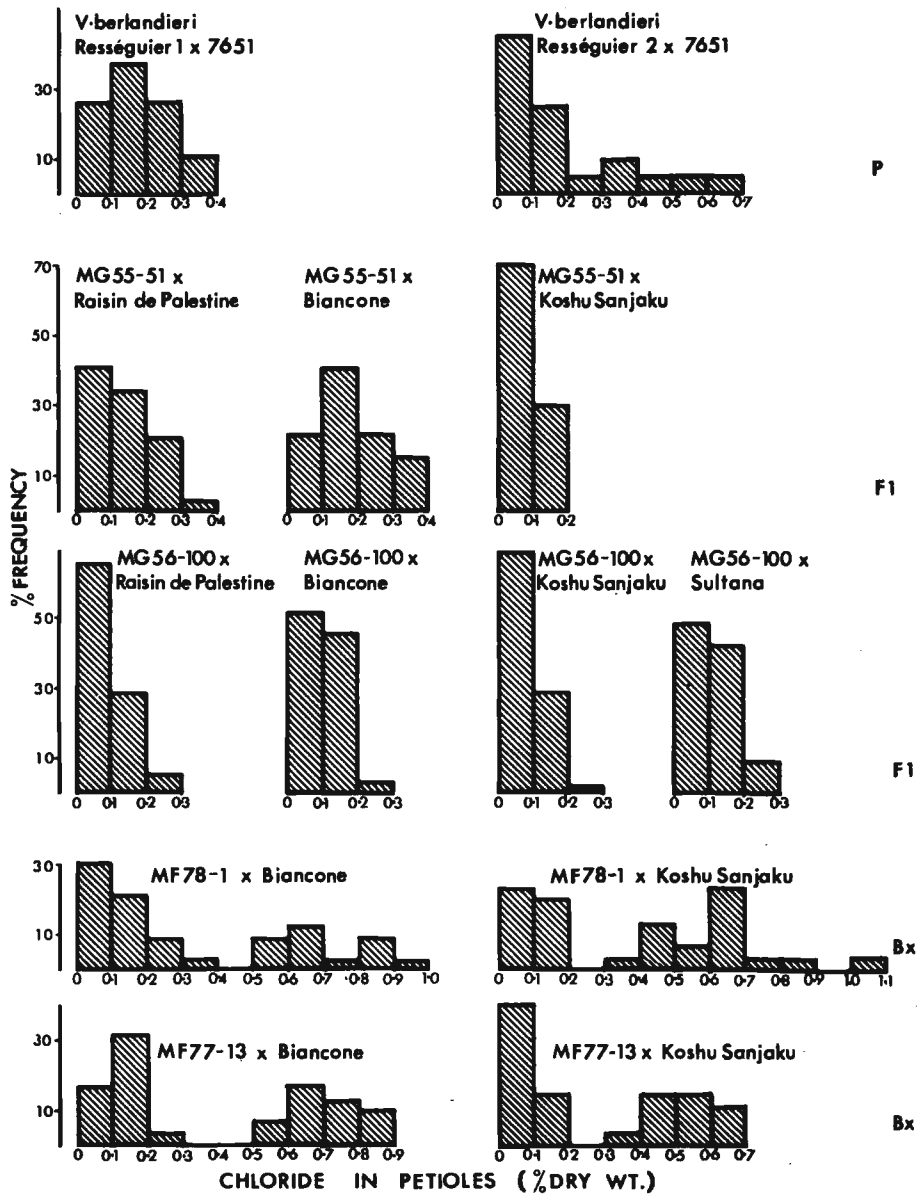

Fig. 1: Frequency distributions for chloride accumulation in populations of *V. berlandieri*, *V. berlandieri* × *V. vinifera* and backcrosses to *V. vinifera*.

Häufigkeitsverteilung der Chloridgehalte in den Populationen von *V. berlandieri*, *V. berlandieri* × *V. vinifera* und deren Rückkreuzung mit *V. vinifera*.

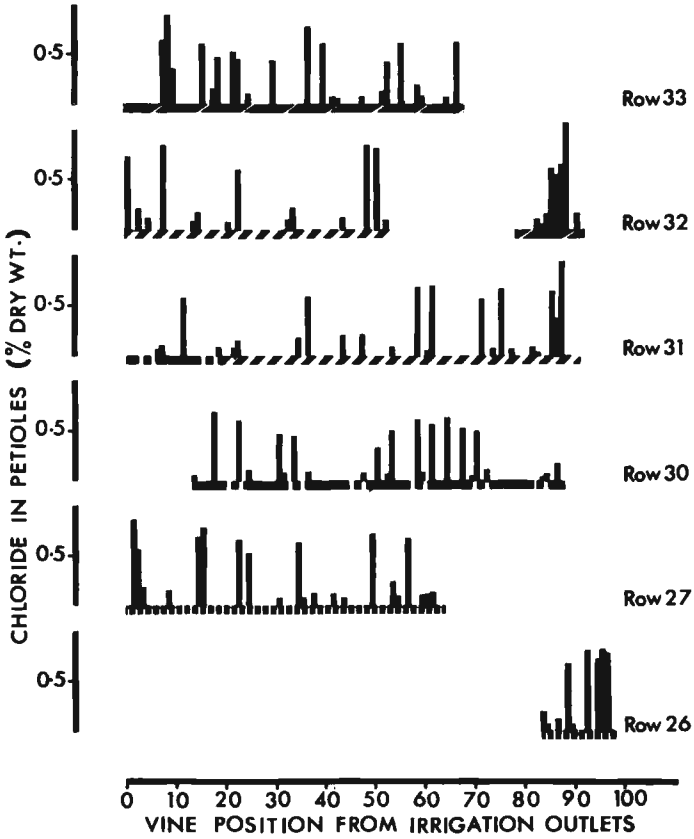

Fig. 2: Petiole chloride (% dry weight) of individual vines from 4 populations of *V. berlandieri* × *V. vinifera* backcrossed to *V. vinifera*. The crosses, shown by different base lines, are respectively from Row 26, MF 77-13 × Biancone, MF 77-13 × Koshu Sanjaku, MF 78-1 × Biancone and MF 78-1 × Koshu Sanjaku.

Chloridgehalt der Blattstiele (% des Trockengewichtes) von Einzelreben aus 4 Rückkreuzungspopulationen von (*V. berlandieri* × *V. vinifera*) × *V. vinifera*. Bei den Kreuzungen, die durch verschiedene Grundlinien gekennzeichnet sind, handelt es sich, ausgehend von Zeile 26, um MF 77-13 × Biancone, MF 77-13 × Koshu Sanjaku, MF 78-1 × Biancone und MF 78-1 Koshu Sanjaku.

hybrid populations, but discontinuous in the backcross populations, with a clear division into low and high cloride groups. Fig. 2 presents the data for individual vines in the backcross populations and shows that low and high chloride values were not related to position in the row. Overall, the mean (with standard error) for 270 F_1 hybrid vines was 0.116 % ± 0.004 dry weight of chloride, while for 119 backcross vines 63 fell into the low chloride group with a mean of 0.111 % ± 0.007 dry weight and 56 into the high chloride group with a mean of 0.636 % ± 0.020.

Table 2 presents the mean chloride accumulation for each F_1 hybrid population, and for the 2 groups within each backcross population. The progeny of MG 55—51 had a significantly higher mean chloride level than the progeny of MG 56—100 when Biancone or Raisin de Palestine was the *V. vinifera* parent, but not when Koshu Sanjaku was the parent. There were also differences in mean chloride level between the pro-

Table 2

Mean petiole chloride (% dry weight) for the populations of *V. berlandieri* × *V. vinifera* and for low and high chloride groups within populations of backcrosses to *V. vinifera* · Chloride values for the parents are shown in brackets

Mittlerer Chloridgehalt der Blattstiele (% des Trockengewichtes) bei den (*V. berlandieri* × *V. vinifera*)-Populationen sowie bei den Gruppen mit niedrigem und hohem Chloridgehalt der *V.-vinifera*-Rückkreuzungen · Die Chloridwerte der Eltern sind in Klammern angegeben

			Mean	S. E.
F_1 hybrid vines				
MG 55-51 (0.30)	× Raisin de Palestine (1.12)		0.142	0.016
	× Biancone (1.20)		0.187	0.017
	× Koshu Sanjaku (0.89)		0.089	0.006
MG 56-100 (0.19)	× Raisin de Palestine (1.12)		0.102	0.008
	× Biancone (1.20)		0.107	0.006
	× Koshu Sanjaku (0.89)		0.087	0.006
	× Sultana (1.96)		0.124	0.011
Backcross vines				
MF 77-13 (0.07)	× Biancone (1.20)	Low	0.123	0.013
		High	0.713	0.028
	× Koshu Sanjaku (0.89)	Low	0.083	0.010
		High	0.539	0.025
MF 78-1 (0.12)	× Biancone (1.20)	Low	0.122	0.013
		High	0.695	0.042
	× Koshu Sanjaku (0.89)	Low	0.116	0.009
		High	0.608	0.044

genies of *V. vinifera* parents. These differences tended to follow the order of chloride accumulation of the parents.

There were no significant differences related to parentage between the mean chloride levels of the various backcross populations but Fig. 1 suggests that the break in the distribution of chloride accumulation may occur at a lower value with Koshu Sanjaku than with Biancone as a parent. There were no significant differences between the low chloride means but the high chloride means differed significantly with the progeny of Koshu Sanjaku being significantly lower when MF 77-13 was the female parent, but not when MF 78-1 was the parent.

There were no significant correlations between yield and chloride level, or yield and vine position within the row. Yield differences between the backcross populations were not significant (overall mean 3.87, S.E. ± 0.332 kg/vine) but the F_1 hybrids showed a significant difference between the progenies of Sultana and Biancone (2.81 ± 0.204 kg/vine) and those of Raisin de Palestine and Koshu Sanjaku (1.83 ± 0.145 kg/vine). Variation within the populations might be expected from both genotypic variation and the difficulty of giving equal treatments to the seedlings. Sultana and Biancone, if planted at the same spacing as the seedlings, might have been expected to yield about 9—10 kg/vine and the other two cultivars not more than 7 kg/vine.

Only 3 of the 270 F_1 hybrids yielded more than 8 kg compared with 17 of the 119 backcross vines. Of these higher yielding backcross vines, about half showed low chloride, mean value 0.13 % dry weight (9 vines, range 0.09 to 0.21), and half high, mean

value of 0.61 (8 vines, range 0.47 to 0.83). These results are very similar to those for the total backcross population.

The mean berry weight for the backcross populations was 1.650 ± 0.054 g with no differences related to parentage or to high or low chloride accumulation. This was greater than the mean for the F_1 hybrid populations, 0.824 ± 0.015 g, which was in turn greater than the value for the *V. berlandieri* parent MG 56-100 of 0.22 g. There were significant differences between the means of the F_1 hybrid populations, the extreme values being 0.668 ± 0.023 g for MG 56-100 × Raisin de Palestine and 0.979 ± 0.054 for MG 56-100 × Sultana.

While juice composition would be affected by yield and by date of harvest, which could not be completely controlled because of the number of seedlings involved, the F_1 populations involving Biancone and Koshu Sanjaku had a mean sugar concentration of 28.3 °Brix and a mean titratable acidity of 6.26 g/l as tartaric. The corresponding values for the backcross populations were 24.7 °Brix and 6.09 g/l as tartaric. In blind tastings, wines made from a few of the most promising backcross seedlings could not be distinguished from wines from selections of *V. vinifera*. 3 seedlings with white fruit, good yield and low chloride accumulation gave quite acceptable wines.

Discussion

The data presented suggest that a single dominant gene may be the major factor governing the inheritance of chloride exclusion ability in hybrids of *V. berlandieri* with *V. vinifera*. However, as *V. berlandieri* was always used as the female parent, maternal inheritance cannot be discounted or established.

The F_1 and backcross populations showed improved fruiting characteristics when compared to pure *V. berlandieri*. As the proportion of *V. vinifera* increased yield and berry size increased and the sugar/acid ratio decreased, thus making the must more suitable for vinification.

Harvest data showed that chloride exclusion was independent of both yield and berry weight. Selection on fruiting characteristics within the low chloride vines from successive generations should enable the further development of cultivars with both high fruiting quality and the ability to exclude chloride.

Summary

F_1 hybrid populations from crosses of 2 selections of *V. berlandieri* and 4 cultivars of *V. vinifera* showed generally low chloride accumulation, as in *V. berlandieri*, with some small variations related to particular parents. Backcross populations from crosses of 2 F_1 hybrid selections and 2 of the cultivars of *V. vinifera* showed a discontinuous distribution with about half of each population showing low chloride accumulation as in *V. berlandieri*, and the rest higher chloride, although not as high as in the *V. vinifera* cultivars. Neither yield nor berry weight in the backcross populations was linked with chloride accumulation. Wines made from a few of the higher yielding backcross seedlings were comparable with wines from selections of *V. vinifera*.

Acknowledgement

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