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Evidence for a genetic difference in berry weight between Sultana vines

by

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Belege für einen genetisch bedingten Unterschied im Beerengewicht zwischen Sultana-Reben

Zusammenfassung. — Der Vergleich einer Anzahl von Sultana-Klonen zeigte reproduzierbare Unterschiede beim Beerengewicht und der gesamten löslichen Substanz der Beere. Es liegen Hinweise für eine genetische Basis der Kleinbeerigkeit bei einem Klon vor; hier wird bei einem reziproken Pfropfungsexperiment mit diesem und einem größerbeerigen Klon das Beerengewicht der beiden Klone nicht beeinflußt.

Introduction

Reproducible differences in yield between individual Sultana vines (*Vitis vinifera* L. cv. Sultanina, syn. Thompson Seedless) have been demonstrated in the Murray Valley, Australia (WOODHAM and ALEXANDER 1966). According to BIOLETTI (1926) such differences should not have been expected because all Sultana plantings in Australia appear to be derived from only eight vines which survived from a small importation to the Adelaide Botanic Gardens in 1867 (LAMSHED 1955, p. 40). Differences within varieties have been reported, particularly in Europe, and have been used to select clones with defined characteristics (e. g. PEYER 1950, GOEDECKE and SCHÖFFLING 1971); but these have been in varieties with a long history in which mutations could occur and for which in some cases a polyclonal origin has been suspected (RIVES 1961). Another cause of variation, not appreciated at the time of BIOLETTI (1926), is virus infection. Productivity might well vary according to the level of infection (RIVES 1961) and in fact WOODHAM (personal communication) has found variation in the severity of leaf roll symptoms related to the performance of Sultanas in the Murray Valley.

While effects of virus on yield cannot be ignored, mutations have certainly occurred in Australian Sultanas (BARRETT *et al.* 1969). Thus high yielding vines might be mutants and not just low in virus; conversely virus elimination might not produce high yielding vines because of inherent genetic defects.

One component of yield is berry size. ANTCLIFF *et al.* (1961) found two vines in a pruning and disbunching trial which had significantly smaller berries than the mean for their treatment although the difference had not been recognized before the calculations were made. This paper reports two field trials, the first and larger to determine whether the difference was reproducible on propagation, and the second to determine whether a graft transmissible agent was responsible for the smaller berries. Some other apparent differences between vines in yield components were also examined in the larger trial.

Experimental

Growing seasons in the Southern Hemisphere extend over parts of two calendar years and for convenience are referred to by the year of harvest.

The clones compared in the larger trial were selected on the yield components berry weight and total soluble solids rather than on the yield of fresh fruit itself. The two vines with unusually small berries were only a few vines apart in the same row of the former trial suggesting that they may have had a common origin. Data for the other vines in the same treatment showed evidence of more such pairs. The main treatments of the new trial were therefore made up of pairs of clones and the differences within the pairs examined as individual split plot comparisons.

Seven pairs of clones were selected and replicated seven times in a Latin square design. Each plot consisted of four vines and was divided into two subplots allotted at random to the clones of the pair. Four pairs were from the same treatment of the pruning and disbunching trial (Antcliff *et al.* 1961), this being the only trial with berry weight data for individual vines available at the time of selection. Data for their source vines are shown in the upper part of Table 1. A further two pairs were from one of the sites used in a district survey of bud fruitfulness (May 1961). Pruning was not controlled on the vines used in the survey, and the source vines of the pairs were not as close to each other as in the previous case. Data are shown in the lower part of Table 1. The remaining two source vines B1 and B2 were from

Table 1

Data for the source vines for 4 pairs of clones selected from one treatment of a pruning and disbunching trial (upper) and for 2 pairs selected from a district survey of fruitfulness (lower)

Angaben zu den Mutterstöcken von 4 Klonenpaaren (aus einem Versuch über Holzschnitt und Auslichtung der Trauben — oben) sowie von 2 Klonenpaaren (nach einer regionalen Erfassung der Fruchtbarkeit — unten)

Source vine	Mean berry wt. g 1958—1960	Mean total sol. solids °Brix 1957—1960	Mean fresh wt. kg/vine 1957—1960
H19	1.80	22.4	17.6
H20	1.80	24.2	21.0
H23	1.25	24.6	14.7
H24	1.24	23.3	15.9
H25	2.01	23.0	19.9
H26	2.01	24.8	17.0
H28	2.04	25.2	21.5
H29	2.05	25.6	21.5
Mean for 36 vines of treatment	1.835	23.81	19.83
S.D. of mean	0.121	1.116	4.51
		°Brix 1953—1960	kg/vine 1953—1960
N3	—	18.6	33.6
N4	—	18.1	35.7
N2	—	17.9	20.4
N5	—	17.3	23.7
Mean for 20 vines on site		18.46	25.39
S.D. of mean		1.12	5.78

the albino mutant Bruce's sport (Antcliff and Webster 1962). This has smaller berries than the average for Sultanas but no data are available for the individual vines concerned.

The smaller trial was a reciprocal grafting trial with two clones, one of the small berried clones (H23) of the larger trial and a larger berried clone (G2) from the original selection trial of Woodham and Alexander (1966). Each clone was grown without grafting, grafted on to itself and grafted on to the other clone. The six combinations were planted as single vine plots replicated six times in randomised blocks as part of a larger planting.

The vines for both trials were planted in spring of the 1963 harvest season, in rows 3.35 m apart, with 2.44 m between vines in the row in the larger trial and 2.75 m in the grafting trial. They were trained to a T trellis with two wires 0.25 m apart about 1 m above the ground for wrapping the renewal canes each year and a single foliage wire 0.35 m above the centre of the T. When fully established the vines were pruned to about eight canes each year to leave a total of about 112 nodes per vine. At harvest each year the yield of fresh fruit was recorded for each plot; berry weight and total soluble solids in the juice were determined from samples of at least 100 berries.

Table 2

Mean berry weight (g/b) for 14 clones for 3 seasons
Durchschnittliches Beerengewicht (g/Beere) bei 14 Klonen aus 3 Beobachtungsjahren

Clone	1966	1967	1968	Mean	Mean for clone pair
H19	1.71	1.66	1.56	1.641	1.613
H20	1.58	1.60	1.58	1.586	
H23	1.18	1.24	1.22	1.215	1.251
H24	1.26	1.31	1.30	1.287	
H25	1.76	1.83	1.75	1.778	1.745
H26	1.77	1.65	1.72	1.712	
H28	1.58	1.59	1.61	1.590	1.590
H29	1.59	1.58	1.59	1.589	
N3	1.56	1.51	1.54	1.538	1.575
N4	1.63	1.61	1.60	1.613	
N2	1.68	1.54	1.52	1.581	1.589
N5	1.65	1.58	1.55	1.596	
B1	1.32	1.33	1.24	1.294	1.299
B2	1.34	1.36	1.21	1.303	
				L.S.D. $P < 0.001$	0.128
				$P < 0.05$	0.072

Table 3

Mean total soluble solids (° Brix) for 14 clones for 3 seasons
Durchschnittlicher Gehalt an gesamter löslicher Trockensubstanz (° Brix) bei 14 Klonen aus 3 Beobachtungsjahren

Clone	1966	1967	1968	Mean	Mean for clone pair
H19	19.3	20.9	20.5	20.2	20.5
H20	20.3	21.2	20.9	20.8	
H23	21.9	22.6	20.9	21.8	21.7
H24	21.4	22.1	21.1	21.5	
H25	19.5	20.3	20.6	20.1	20.3
H26	20.3	20.8	20.4	20.5	
H28	21.0	21.9	21.0	21.3	21.1
H29	20.5	21.3	21.0	20.9	
N3	21.4	21.6	21.4	21.5	21.2
N4	19.9	21.4	21.2	20.8	
N2	20.5	20.3	20.8	20.6	20.7
N5	21.1	20.9	20.9	20.9	
B1	17.9	20.4	18.5	18.9	18.9
B2	18.3	20.0	18.2	18.8	
				L.S.D. $P < 0.001$	0.81
				$P < 0.05$	0.46

Results

Berry weight data for the 14 clones of the larger trial are presented in Table 2. Clones H23 and H24, as well as the Bruce's sport clones B1 and B2 had appreciably smaller berries ($P < 0.001$) than the other clones. Two clone pairs, H25 and H26, H28 and H29, were selected as having heavier berries than the "normal" pair H19 and H20 (see Table 1). The source vines for H25 and H26 were close to those for H19 and H20 but those for H28 and H29 were further removed. In the clonal comparison (Table 2) H 25 and H26 had significantly heavier berries than H19 and H20 but H28 and H29 did not.

Table 3 gives the corresponding data for total soluble solids. The Bruce's sport clones show lower values ($P < 0.001$) than all other clone pairs; the other small berried clones H23 and H24 show higher values than all other pairs ($P < 0.05$). The source vines for H28 and H29 were selected as having higher total soluble solids than those for H25 and H26 (Table 1), and this difference is reproduced in the clones (Table 3). This was also the case for the N clone pairs, allowing for the higher yields of the source vines for N3 and N4 and discounting the abnormally low value for clone N4 in 1966.

Yields of fresh fruit, reduced to a single vine basis, are shown in Table 4. Because of the greater variation the differences do not reach as high a level of

Table 4

Mean fresh weight of fruit (kg/vine) for 14 clones for 3 seasons
Durchschnittliches Frischgewicht des Beerenertrages (kg/Rebe) bei 14 Klonen aus 3 Beobachtungsjahren

Clone	1966	1967	1968	Mean	Mean for clone pair
H19	24.6	24.4	21.8	23.57	24.62
H20	23.8	27.3	26.0	25.68	
H23	17.4	21.3	25.1	21.23	21.45
H24	19.6	22.3	23.2	21.68	
H25	23.4	25.8	19.9	23.04	23.05
H26	19.5	24.0	25.7	23.05	
H28	21.0	25.9	27.1	24.70	24.52
H29	21.3	26.4	24.6	24.34	
N3	17.4	25.0	24.2	22.18	21.50
N4	20.8	22.1	19.6	20.83	
N2	16.4	23.4	15.5	18.45	21.19
N5	20.1	28.5	23.3	23.94	
B1	23.3	20.7	24.8	22.90	23.33
B2	23.2	22.6	25.6	23.75	
				LSD $P < 0.05$	2.47

significance as for the other variates. The small berried pair of clones H23 and H24 and the two N-clone pairs yield significantly less ($P < 0.05$) than the pairs H19 and H20, H28 and H29, the other two pairs being intermediate.

For all variates differences within each H-clone pair, from source vines close to each other, were small compared with the differences between pairs.

Examination of the data from the grafting trial showed that there were no significant differences between treatments in either yield of fresh fruit or total soluble solids, so only the data for mean berry weight are presented (Table 5). The difference between the scion means is very highly significant ($P \leqslant 0.001$) while the differences due to rootstocks within each scion treatment are less than might have been expected from random variation.

Discussion

The results of the larger trial demonstrate differences between Sultana clones in berry weight and total soluble solids in the berries. Only Bruce's sport can be readily recognised in the field. The smaller berries of H23 and H24 are apparent on closer observation but measurements are needed to distinguish the other clones. Differences in berry weight between the original source vines appear to be sometimes intrinsic and reproducible e. g. H25 and H26 with heavier berries than H19 and H20, and sometimes environmental and not reproducible e. g. H28 and H29 with

Table 5

Mean berry weight (g/b) for 3 seasons for all combinations of two clones in a reciprocal grafting trial

Durchschnittliches Beerengewicht (g/Beere) für 3 Beobachtungsjahre bei allen Kombinationen zweier Klone in einem reziproken Pfropfversuch

	1966	1967	1968	Mean	Scion mean
G2	1.69	1.50	1.91	1.70	
G2/G2	1.67	1.49	1.79	1.65	
G2/H23	1.63	1.44	1.82	1.63	
					1.66
H23	1.22	1.31	1.37	1.30	
H23/G2	1.30	1.21	1.37	1.29	
H23/H23	1.23	1.28	1.34	1.28	
					1.29

heavier berries than H19 and H20 on the source vines but not in the clonal comparison. Unusually low berry weight is clearly reproduced in clones H23 and H24 and the results of the grafting trial show that for clone H23 at least this difference is not due to the presence of a graft transmissible agent, but may have a genetic basis. Anatomical studies (Harris *et al.* 1968) showed that the smaller berries were due to smaller, not less, cells in the pericarp. If a genetic difference in berry weight can occur, it is possible that similar differences in other yield components such as inflorescences per shoot, flowers per inflorescence or percentage of flowers setting fruit could also occur and be extremely difficult to recognise in the field. These could lead to differences in yield like those found by Woodham and Alexander (1966). Therefore freedom from virus would seem to be inadequate as a sole basis for the selection of propagating material, and it could be unwise to undertake heat therapy for elimination of virus from untested clones because their genetic constitution might still limit their productivity.

Summary

Comparison of a number of Sultana clones has shown reproducible differences in berry weight and total soluble solids in the berry. A genetic basis for small berries on one clone is indicated, there being no effect on the berry weight of either clone in a reciprocal grafting experiment with this and a larger berried clone.

Literature Cited

Antcliff, A. J. and Webster, W. J., 1962: Bruce's sport — a mutant of the Sultana. Austral. J. Exp. Agricult. Animal Husb. 2, 97—100.

— —, — — and May, P., 1961: Studies on the sultana vine. VII. A comparison of crop regulation by pruning with crop regulation by disbunching. Austral. J. Agricult. Res. 12, 69—76.

Barrett, H. C., Kerridge, G. H. and Antcliff, A. J., 1969: The drying characteristics of several Sultana clones. Food Technol. Austral. 21, 516—517.

Bioletti, F. T., 1926: Selection of planting stock for vineyards. Hilgardia 2, 1—23.

Goedecke, H. und Schöffling, H., 1971: Klonenselektion in der Vorprüfung nach der Vierfeldermethode. Wein-Wiss. 26, 1—49.

Harris, J. M., Kriedemann, P. E. and Possingham, J. V., 1968: Anatomical aspects of grape berry development. Vitis 7, 106—119.

Lamshed, M., 1955: The People's Garden. In: Centenary Vol. 1855—1955 publ. by board of governors of the Botanic Garden, Adelaide, S. Australia. S. A. Govt. Printer.

May, P., 1961: The value of an estimate of fruiting potential in the Sultana. Vitis 3, 15—26.

Peyer, E., 1950: Der Blauburgunder in der Ostschweiz und seine Selektion. Schweiz. Z. Obst-Weinbau 59, 361—366, 380—386.

Rives, M., 1961: Bases génétiques de la sélection clonale chez la vigne. Ann. Amelior. Plantes 11, 337—348.

Woodham, R. C. and Alexander, D. McE., 1966: Reproducible differences in yield between sultana vines. Vitis 5, 257—264.

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