Vitis 11, 99—107 (1972)

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Quality and yield of Alicante Grenache and Semillon on various rootstocks in an arid climate

by

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Qualitäts- und Ertragseigenschaften von Alicante Grenache und Semillon auf verschiedenen Unterlagen in einem ariden Klima

Zusammenfassung. — In einem ariden Klima wurden Ertrags- und Qualitätskriterien der Keltertraubensorten Alicante Grenache und Semillon bei wurzelechtem Anbau und in Kombination mit sieben Unterlagen untersucht.

Grenache zeigte bei wurzelechtem Anbau überdurchschnittliche Leistungen in Ertrag, Wüchsigkeit, löslicher Trockensubstanz und Säuregehalt. Bei den Pfropfkombinationen wirkte sich 140 Ru auf den Ertrag am vorteilhaftesten aus; es folgten 110 R, 41 B MG, 1103 P. Der Säuregehalt war in Verbindung mit 41 B MG am niedrigsten. Das Traubengewicht war bei den wurzelechten Reben am niedrigsten und auf 140 Ru und 1103 P am höchsten.

Semillon hatte auf 41 B den höchsten Ertrag und Säuregehalt, gefolgt von der wurzelechten Rebe und den Kombinationen mit 161-49 C (schwache Wüchsigkeit) sowie mit 1103 P. Das höchste Traubengewicht wurde nach Pfropfung auf 140 Ru und 41 B MG gemessen, während auf 161-49 C, im wurzelechten Zustand und auf 99 R ein hoher Gehalt an löslicher Trockensubstanz beobachtet wurde.

Auf 1103 P und 140 Ru ließ die Wüchsigkeit beider Sorten mit fortschreitendem Alter weniger nach als bei anderen Pfropfkombinationen.

Introduction

Rootstock influence on yield, total soluble solids, alternate bearing habit, plant growth, bunch weight and compactness, berry weight, colour and acidity, were studied in the arid climate of southern Israel.

Materials and Methods

Alicante Grenache and Semillon were bench-grafted on seven clonal rootstocks each, and for comparison also prepared as own-root cuttings. The vines were planted in 1954 in a loess soil of aeolic origin, in the arid Negev of southern Israel, and irrigated throughout the year as necessary. Each stionic (scion-rootstock) combination was planted in five randomized blocks, of ten vines per plot.

The vines were spaced 2 × 2 meters and pruned to the vase (goblet) shape with 30-cm trunks staked to wooden supports. Both varieties were spur-pruned throughout the experiment; however, vigorous vines of Semillon were left with longer spurs, of three or four buds, from the sixth year on.

Soil, rainfall and experimental procedure were the same as described in an earlier publication on table grapes (20).

Results

The cumulative yield of Alicante Grenache for 10 years of fruiting, averaged about 180% that of Semillon (Table 1). With Grenache, own-root plants yielded

[1]) Contribution from The Volcani Center, Agricultural Research Organization, Bet Dagan, Israel. 1972 Series, No. 2035-E.

Table 1

Cumulative yield and weight of prunings of two grape varieties on seven different rootstocks and on own roots over 11 years[1])

Rootstock	Alicante Grenache				Semillon			
	Cumulative yield 1957—1967[2]) (Y) kg	Cumulative prunings' weight (P) kg	Cumulative ratio yield/prunings' weight Y/P	Y × P × TSS / 100	Cumulative yield 1957—1967[3]) (Y) kg	Cumulative prunings' weight (P) kg	Cumulative ratio yield/prunings' weight Y/P	Y × P × TSS / 100
Own-root	73.1[a]	14.2[a]	5.2	188	39.9[a]	10.8[a]	3.7	72
140 Ru	71.1[a]	10.7[b]	6.6	138	37.7[a]	9.1[ab]	4.1	55
110 R	67.5[a]	9.4[b]	7.2	113	35.2[ab]	8.2[bc]	4.3	48
1103 P	66.5[ab]	10.2[b]	6.5	121	35.7[ab]	10.6[a]	3.4	63
99 R	62.0[b]	8.5[c]	7.3	95	30.1[b]	9.0[b]	3.3	46
41 B MG	59.7[b]	11.1[b]	5.4	117	41.3[a]	10.0[a]	4.1	67
216-3 Cl	52.1[c]	8.6[c]	6.1	80	31.4[b]	8.0[bc]	3.9	42
1202 C	50.1[c]	8.9[bc]	5.6	77	—	—	—	—
161-49 C	—	—	—	—	38.1[a]	7.7[c]	4.9	51

[1]) Values followed by different letters in any one column are statistically different at $P < 0.05$.

[2]) 1960 missing.

[3]) 1959 missing.

highest, followed closely by those grafted on 140 Ru, 110 R and 1103 P. Of the Semillon combinations 41 B MG was first in rank and was followed by own-root, 161-49 C (a combination not employed with Grenache), 140 Ru, 110 R and 1103 P. Lowest yields with Grenache were obtained on 216-3 Cl and 1202 C, and with Semillon — on 216-3 Cl and 99 R.

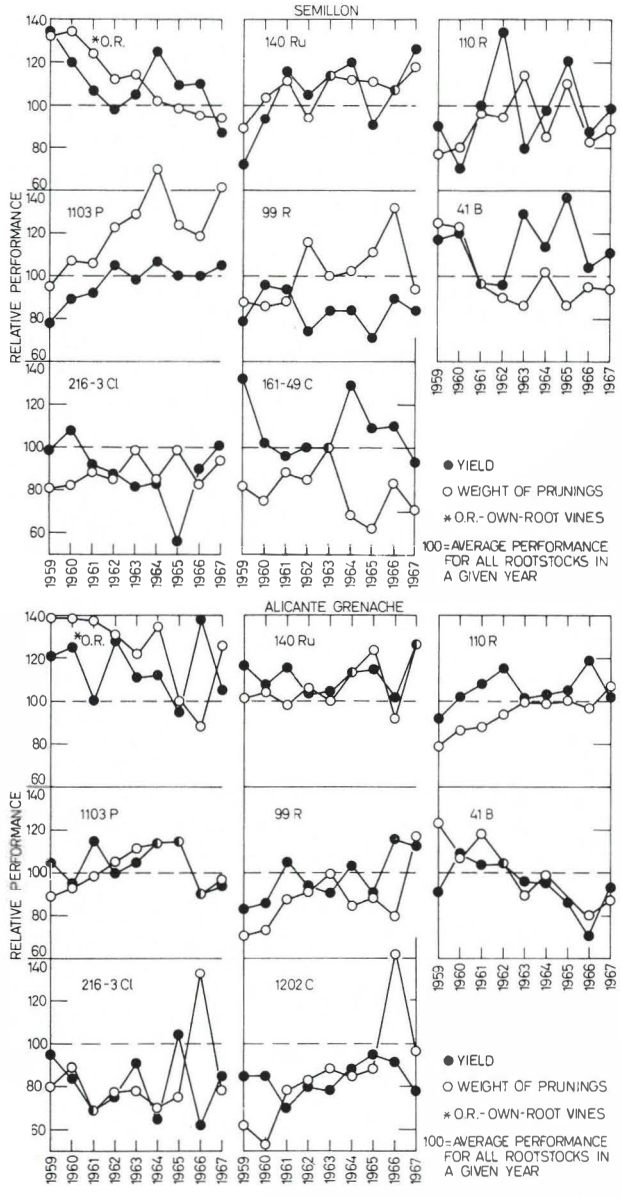

Fig. 1: Relative performance (yield and weight of prunings) of (a) Semillion and (b) Alicante Grenache on different rootstocks from 1959 to 1967. Average performance for all rootstocks in a given year = 100.

The yield/prunings ratio, used by us as a measure of relative fruitfulness per unit of growth, was found to be low in own-root Grenache, a high yielder. Own-root Semillon, the most vigorous Semillon combination, had less of an advantage in yield over grafted Semillon combinations than did own-root Grenache over Grenache combinations. The highest ratio of yield/prunings with Semillon was on 161-49 C, but even this ratio was lower than with any Grenache combination, because of the latter's much higher yield.

An index of dry matter production — cumulative yield × prunings weight × total soluble solids (T.S.S.) in the fruit — was high for own-root vines; second in rank were 41 B MG with Semillon and 140 Ru with Grenache. Rank by this index was not identical to rank by yield alone. Yield × T.S.S. (not listed), considered a good index for alcohol production, produced a ranking similar to that of yield.

The influence of age on vigour and yield is illustrated in Fig. 1. There was an apparent relative increase in average vigour with Grenache on 110 R and 1202 C and for seven years also on 1103 P; a decrease in relative vigour was found on 41 B MG and with own-root vines. In some combinations there was a tendency toward low prunings' weight following a high yield, and high prunings' weight following a low yield. Semillon showed a relative increase in vigour with age, in comparison with other rootstocks, on most *Vitis berlandieri* × *V. rupestris* rootstocks, e. g. 140 Ru, 1103 P and 99 R, while on own-root vines and 41 B MG there was an evident decline in vigour with age. Grenache on its own roots had less pronounced alternate bearing than grafted combinations (Table 2); intensity of alternate bearing was generally low, from I = 0.05 on its own roots to I = 0.22 on 216-3 Cl. Semillon had a similar trend: on its own roots it had the least alternate bearing followed by 41 B MG, 99 R and 161-49 C; however, grafted vines had less alternate bearing than found with Grenache.

Scion considerably overgrew rootstocks in all Grenache combinations except on 1202 C (Table 3). The largest overgrowth was observed on 110 R. With Semillon, little overgrowth was observed on 216-3 Cl, but more was found on 110 R and 161-49 C; the latter promoted good yields but the vigour of the combination was low.

Table 2

Alternate bearing habit (B)[1]) and intensity of alternate bearing (I)[2]) in Alicante Grenache and Semillon grapes on different rootstocks

Rootstock	Alicante Grenache		Semillon	
	B	I	B	I
Own-root	0.43	0.05	0.43	0.09
140 Ru	1.00	0.14	0.71	0.09
110 R	1.00	0.10	0.71	0.22
1103 P	1.00	0.15	0.71	0.09
99 R	0.71	0.14	0.57	0.07
41 B MG	0.71	0.13	0.57	0.11
216-3 Cl	1.00	0.22	0.71	0.11
1202 C	1.00	0.09	—	—
161-49 C	—	—	0.57	0.10

[1]) Number of alternate-bearing-year-pairs divided by number of pairs.
[2]) Average difference in yield of alternate-bearing-year-pairs.

Table 3

Scion and rootstock circumference[1]) 13 years after planting[2])

Rootstock	Alicante Grenache			Semillon		
	Top cm	Rootstock cm	Top/rootstock ratio	Top cm	Rootstock cm	Top/rootstock ratio
Own-root	30.8[a]	25.1[a]	1.23	21.5	20.0	1.08
140 Ru	28.0[a]	18.8[abc]	1.49	20.6	16.2[abc]	1.27
110 R	27.4[a]	16.4[c]	1.67	19.9	13.7[c]	1.45
1103 P	29.4[a]	18.6[abc]	1.58	21.3	16.5[abc]	1.29
99 R	28.0[a]	18.0[abc]	1.56	22.9	18.0[a]	1.27
41 B MG	29.2[a]	21.2[abc]	1.38	21.7	17.7[abc]	1.23
216-3 Cl	27.7[a]	18.6[abc]	1.49	18.3	16.0[bc]	1.14
1202 C	23.6[b]	18.2[abc]	1.30	—	—	—
161-49 C	—	—	—	21.4	14.9[bc]	1.44
Level of significance	0.05	0.05		N.S.	0.05	

[1]) Scion measured 10 cm above, stock measured 10 cm below graft union.
[2]) Values not followed by a common letter in any one column are statistically different at $P < 0.05$.

Bunch and berry weight, compactness, T.S.S. and acidity were determined on the same date, earlier than generally recommended for harvesting table wine grapes (Table 4). Early harvesting resulted thus in lower T.S.S. and higher acidity; however, rootstock effects were comparable.

Own-root Grenache had the second smallest bunch weight and the highest yield, a reflection of its large number of bunches, compared with its grafted combinations. No significant variation was observed in compactness of the clusters. Still, 216-3 Cl had the most compact clusters with Grenache, and 140 Ru with Semillon. Semillon on its own roots had the lowest berry weight, and along with 216-3 Cl — a low-yielding combination — it had the lowest bunch weight. Semillon on 41 B MG, 161-49 C and 140 Ru had high bunch weights and yields. No appreciable differences in compactness were observed.

Except for Grenache fruit on 99 R, which was light in colour, no appreciable differences in colour were observed.

Variations in T.S.S. with Grenache were moderate, but some differences were statistically significant; 1202 C induced the lowest T.S.S. and 140 Ru and 99 R the highest. More significant differences in T.S.S. were observed in Semillon. Semillon on 99 R, 161-49 C and on its own-roots was highest in T.S.S. Contrary to the results with Grenache, lowest T.S.S. was observed with Semillon on 140 Ru.

High acidity, especially of malic acid in grape juice, enhances table wine quality in warm climates (2, 3, 4, 7, 13). Grenache on its own roots, the most vigorous combination, had the highest total acid, while on 41 B MG — still above average vigour — acidity was low. This again did not correspond with the results obtained with Semillon, where highest acidity was obtained on 41 B MG. This difference may have been due to differences in yield between the varieties.

Discussion

Grenache on its own roots was clearly the best combination of those studied, being high in yield and acid, vigorous, and with adequate T.S.S. It is sensitive to

Table 4

The effect of seven different rootstocks on maturation and bunch characteristics of two wine grape varieties[1])

Rootstock	Bunch weight g	Berry weight g	Compactness[2]) degree	T.S.S. °Brix	Acid[3]) mg/100 ml	T.S.S./acid ratio
			Alicante Grenache			
Own-root	241^{bc}	1.9	2.3	18.1^{a}	674^{a}	26.85
140 Ru	280^{a}	1.8	2.1	18.1^{a}	614^{c}	29.48
110 R	257^{b}	1.8	2.3	17.8^{a}	635^{abc}	28.03
1103 P	289^{a}	1.8	2.2	17.9^{a}	634^{abc}	28.23
99 R	252^{bc}	1.8	2.2	18.1^{a}	615^{bc}	29.43
41 B MG	240^{bc}	1.7	2.2	17.6^{ab}	603^{c}	29.19
216-3 Cl	220^{c}	1.9	2.4	17.9^{a}	616^{bc}	29.06
1202 C	256^{b}	1.7	2.2	17.2^{b}	622^{bc}	27.65
Level of significance	0.05	N.S.	N.S.	0.05	0.05	
			Semillon			
Own-root	141^{b}	1.8	2.4	16.8^{a}	590^{a}	28.47
140 Ru	164^{a}	2.1	2.5	15.9^{b}	562^{ab}	28.29
110 R	144^{ab}	2.0	2.4	16.5^{ab}	556^{ab}	29.68
1103 P	158^{ab}	2.2	2.3	16.7^{a}	588^{ab}	28.40
99 R	145	1.9	2.4	16.8^{a}	545^{b}	30.83
41 B MG	170^{a}	2.0	2.4	16.3^{b}	595^{a}	27.39
216-3 Cl	141^{b}	1.9	2.4	16.7^{a}	546^{b}	28.99
161-49 C	158^{ab}	2.0	2.3	17.3^{a}	564^{ab}	30.67
Level of significance	0.05	N.S.	N.S.	0.05	0.05	

[1]) Values not followed by a common letter in any one column are statistically different at $P < 0.05$.
[2]) Rating from 1—5 with 5 = maximum compactness.
[3]) Calculated as tartaric acid.

certain rootstocks (5), but on its own roots its salt tolerance exceeds that of other wine grape viniferas (12). Where phylloxera is no problem, Grenache on its own roots may be of extraordinary value.

A moderate bearer, Semillon requires suitable rootstocks to increase its yield (5). Semillon was a little better on 41 B MG than on its own roots, in yield and acid. This rootstocks has been reported (6, 11) to promote Semillon yield; 140 Ru, 1103 P and 161-49 C have also promoted yield with Semillon. However, 161-49 C, while promoting high T.S.S. and yield, reduced vigour significantly, and this may lead ultimately to overcropping.

Rootstock 216-3 Cl gave good results with Semillon on heavy soil in the more rainy coastal region of Israel (5), but was disappointing under conditions of the present study. The two Sicilian *V. berlandieri* × *V. rupestris* rootstocks, 140 Ru and 1103 P, generally performed a little better than 110 R and much better than 99 R, which has done well in California, North Africa and Spain with wine grapes (1, 10, 15, 22).

Alternate bearing was more pronounced with Grenache than with Semillon; however, in both cases, the intensity was low, probably due to the regular pruning of a much more severe character than that performed with fruit trees. Plants on their own roots were the least alternative, perhaps due to a better relationship between yield and vigour and to the absence of the graft union. However, high-yielding rootstocks like 41 B MG and 161-49 C also had a low alternate bearing habit, compared with *V. rupestris* crosses.

Considerable scion overgrowth has been reported with some combinations of Grenache, especially on 110 R and 99 R (11). We observed a large scion overgrowth with 110 R, 1103 P, 99 R, 216-3 Cl and 140 Ru. The relative vigour of Grenache on 110 R (as compared with other combinations) increased with age, in spite of its high top rootstock circumference ratio.

Little has been reported on compatibility problems in Semillon. Overgrowth of the scion on 161-49 C and 110 R was observed by us, but declining vigour with age was evident only with 161-49 C.

Winkler found that any crop above normal delays fruit maturity (21), while we found that high-yielding combinations did not have lower T.S.S. at the same date, as compared with low-yielding combinations, and often had even higher T.S.S. Amerine (2) also found better quality with moderately higher-than-average yields in Grenache. A longer period of experimentation, involving perhaps 20 crops instead of ten, might have shifted the overall picture in favour of combinations whose vigour did not dimish so much with age, like 140 Ru, 1103 P and 110 R. However, own-root Grenache vines were still the most vigorous ones at the termination of our experiment.

Rootstocks affected bunch weight more in these tests than was found with table grapes (20). Low leaf area per cluster usually decreases berry growth (22) but this was not the cause of low weight in the vigorous own-root Grenache vines. In addition to normal-size clusters, Grenache on its own roots and possibly also own-root Semillon bore a larger number of secondary small clusters, resulting in lower-than-average bunch and berry weights.

Sicilian *V. berlandieri* × *V. rupestris* hybrid rootstocks proved valuable for wine grapes, especially 140 Ru with Grenache and 1103 P with Semillon. Their performance with wine grapes exceeded that found by us with table grapes (20). Both 41 B MG and 161-49 C promoted yield of the modest-yielding Semillon, confirming previous results (8, 9, 11, 16), but on the other hand 41 B MG with Grenache resulted in lower acidity, and 161-49 C with Semillon resulted in low vigour, calling for caution.

Own-root Semillon, while only little better than the best grafted combinations, performed much better than postulated by Hochberg for Israeli conditions (11).

Variation in fruit acidity with different rootstocks, however small, merits further consideration because of its special significance under arid growing conditions. Acidity values tend to be lower and to drop faster in warm climates (7, 13, 17, 18). On the other hand, as Kliewer has shown (12, 14, 19), shade has an important acid-conserving effect. Vigorous, productive vines and stionic combinations with abundant foliage are, therefore, to be preferred for table wine production in an arid climate, a conclusion supported by our present study.

Summary

Alicante Grenache and Semillon wine grape varieties, were studied on their own roots and on seven rootstocks, for yield and quality criteria, in an arid climate.

Grenache on its own roots was outstanding in yield, vigour, T.S.S. and acid content. Of the grafted rootstock combinations, 140 Ru yielded highest, followed by 110 R, 41 B MG, 1103 P. Acid content was lowest with 41 B MG. Bunch weight was lowest on ungrafted vines and highest on 140 Ru and 1103 P.

Semillon had the highest yield and acid content on 41 B MG, followed by own-root vines, 161-49 C (low vigour) and 1103 P. Highest bunch weights were observed with 140 Ru and 41 B MG, while high T.S.S. were observed with 161-49 C, own root-vines and 99 R.

On 1103 P and 140 Ru, both varieties showed less decline in vigour with age, relative to other combinations.

Acknowledgements

The authors wish to thank Dr. A. H. Teich for valuable suggestions and critical reading of the manuscript.

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Eingegangen am 6. 1. 1972

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