The Effect of Grapevine Rootstock on the Performance of *Vitis vinifera* L. (cv. Colombard) on a Relatively Saline Soil

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The performance of grapevine cv. Colombard grafted onto 25 rootstocks (1045P, 1103P, 775P, 99R, (RY 13), 99R (RY 2), 110R, 140Ru, 143-B Mgt, 101-14 Mgt, Ramsey, 13-5 EVEX, Constantia Metallica, Jacquez, Grezot 1, 216/3 Castel and US hybrids, 1-6, 3-6, 4-4, 2-1, 24-41, 24-10, 35-1-15, 16-13-23, 16-13-26 and 12-6-8] on relatively saline soils was investigated for six years. The highest yields were obtained with 13-5 EVEX, Ramsey, 143-B Mgt, 1045P and 140 Ru, whereas the US hybrids generally performed poorly, particularly those with Jacquez in their parentage. At this early stage in the trial a highly positive correlation between yield and cane mass was found. Although total soluble solids concentration and pH generally declined with increasing yield and cane mass, differences in grape composition appeared to be largely the result of differences in actual maturity.

Saline soils are encountered in some viticultural areas in South Africa, particularly in the more arid regions where irrigation is practised, such as the Breede River Valley (Saayman, 1981). Although the grapevine is moderately salt tolerant, the detrimental effects of salinity on its performance are widely reported. The extent of these effects, however, has been found to be dependent on the cultivar, both with respect to the scion (Groot Obbink & Alexander, 1973; Barlass & Skene, 1981; West & Taylor, 1984) and the rootstock (Bernstein, Ehlig & Clark, 1969; Downton, 1985). Consequently, provided that the rootstock is sufficiently resistant to soil-borne pests and diseases, these differences in salinity tolerance can be utilised to improve production in areas where salinity is a problem.

According to Galet (1979), *Vitis vinifera* L. can tolerate the highest levels of sodium chloride in the soil, followed by the rootstocks 1616 Couderc (1616C), Aramon X Rupestris Ganzin 1 (AXR 1), Rupestris du Lot and 1103 Paulsen (1103P), whereas 41-B Millardet et de Grasset (41B Mgt) has a very low tolerance. Differences in the order of this ranking, however, are also widely reported.

Decreased growth, lower rates of photosynthesis and the appearance of symptoms of leaf burn have been associated with the presence of chloride in the leaf (Downton, 1977a). Consequently, various workers have regarded the chloride concentrations within the plant as being indicative of salinity tolerance, and on this basis the American *Vitis* species can be ranked in order of decreasing tolerance as follows: *Vitis Berlandieri, V. Champini, V. cinerea and V. rupestris* (Downton, 1977b; Antcliff, Newman & Barrett, 1983).

Rootstock usage in South Africa is dominated by four cultivars, namely 99 Richter (99R), 110 Richter (110R), Ramsey and 101-14 Millardet et de Grasset (101-14 Mgt) (Anon., 1988). Of these, only 101-14 Mgt and Ramsey are regarded as being relatively salt tolerant (Kriel, 1985). The salinity tolerance of the rootstocks traditionally planted in South Africa, however, has predominantly been evaluated by observation, whilst that of the locally produced hybrids is as yet unknown. The aim of this study was, therefore, to ascertain the performance of various rootstock cultivars under relatively saline conditions in the field.

MATERIALS AND METHODS

Soil: The trial was conducted in the Breede River Valley (33.46 S; 19.50 E) on a dark, reddish-brown, sandy clayloam soil with a well-developed crumb structure, which is classified as an Oakleaf form, as described by MacVicar *et al.* (1977). This soil is typical of those occurring on the lower river terraces of the above-mentioned area. The particle size and chemical analyses of the soil samples prior to planting are given in Tables 1a and 1b.

During the 1989/90 season the soil's electrical resistance (saturated paste) was monitored throughout the season. In the shallower soil layers (<600 mm) the mean electrical resistance was 344 ohms and varied from 542 to 133 ohms, depending on the soil water content. In the deeper soil layers (>600mm) the electrical resistance was generally lower (mean = 221 ohms), ranging from 452 to 62 ohms. The minimum electrical resistances measured were below 200-250 ohms, which is the range at which symptoms of salinity become apparent on the grapevine (Saayman, 1981).

The methods described by De Klerk (1970,1978), Marais

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TABLE 1a

Mean particle-size analysis and bulk densities of the Oakleaf soil in the experimental vineyard at Robertson.

Depth	Clay <0,002 mm	Silt 0,002-0,02 mm	Sand: Fine 0,02-0,2 mm	Sand: Medium 0,2-0,5 mm	Sand: Coarse 0,5-2,0 mm	Bulk Density[1]
(mm)	(%)	(%)	(%)	(%)	(%)	kg/m^3
0-300	21,32	15,91	49,91	9,95	2,91	1405
300-600	20,42	14,97	51,93	9,69	2,99	1423
600-900	23,87	12,86	49,47	9,96	3,50	1443
900-1200	—	—	—	—	—	1484

1 = Determined after six years.

TABLE 1b

Results of the chemical analysis of the soil in the experimental vineyard prior to planting.

Depth	pH[1]	Resistance[2]	EC_e	P[3]	K[3]	Total Extractable Cations[4]: K	Na	Ca	Mg	Exchange-able Sodium	CEC[5]	ESP[6]
(mm)		(Ohms)	mS/m	(ppm)	(ppm)	(m.e.100g)	(m.e./100g)	(m.e./100g)	(m.e./100g)	(m.e./100g)	(m.e.100g)	
0-300	7,6	437	404	64	311	1,16	1,44	20,97	6,60	0,81	10,73	7,55
300-600	7,8	241	635	13	109	0,48	3,21	26,50	6,31	2,54	8,10	31,32
600-900	7,8	235	647	2	46	0,33	3,75	34,47	9,37	3,61	6,63	54,45

1 = 0,1 M KC1

2 = Measured on the saturation paste in a standard USDA cup

3 = Bray No. 2

4 = 1 M NH Cl extraction

5 = Cation Exchange Capacity

6 = Exchangeable sodium percentage (Calculated as a % of CEC)

(1983) and Loubser (1985) were used to evaluate the phytosanitary status of the soil with respect to the occurrence of phylloxera, margarodes, phytophthora and nematodes, respectively.

Experimental vineyard: The rootstocks were evaluated for a period of six years, from 1986 to 1990, in a ten-year-old *Vitis vinifera* L. cv. Colombard (Clone CO 1098) vineyard. The scion was grafted onto 25 rootstock cultivars (Table 2). The planting distance was 2,6 m x 1,3 m (2 958 vines per hectare) and the vines were trained onto a 1,5-m slanting trellis as described by Zeeman (1981). Plots consisting of 5 vines of each graft combination were replicated five times in a randomized block design.

For the first 3 years of the trial a minimum tillage practice where a cover crop was planted during the winter and sprayed with a herbicide before budburst, was followed. Thereafter no cover crop was planted and the vineyard was lightly disced for weed control. The vineyard was fertilised annually with 42 kg/ha nitrogen (applied in two increments as limestone ammonium nitrate at budburst and after harvesting) and 68 kg/ha potassium (applied as potassium sulphate after harvest). Standard viticultural practices regarding pest and disease control were followed.

TABLE 2
Genetic origin and clone numbers of the rootstock cultivars studied in the experimental vineyard at Robertson.

Rootstock Cultivar	Clone	Genetic Origin
13-5 E.V.E. Jerex	66-03-08	*Vitis Berlandieri* Planch.
216-3 Castel	66-02-01	1616 C. [Solonis (*V. riparia* Mich. x *V. rupestris* Sch. x *V. candicans* Engel.)] x *V. riparia*.
Grezot 1	GZ 1	1616 C. x *V. rupestris*.
101-14 Millardet et de Grasset	AA 25	*V. rupestris* x *V. riparia*.
1103 Paulsen	PS 28	*V. Berlandieri* x *V. rupestris*.
1045 Paulsen	PZ 1	*V. Berlandieri* x Aramon Rupestris Ganzin No. 2 *(V. vinifera* x *V. rupestris)*.
775 Paulsen	PD 1	*V. Berlandieri* x *V. rupestris*.
Ramsey	SC 18	*V. Champini* Planch.
Jacquez	JC 584	*V. aestivalis* x *V. cinerea* x *V. vinifera*.
143-B Millardet et de Grasset	BA 32	*V. vinifera* x *V. riparia*.
Constantia Metallica	ME 121	*V. rupestris*.
99 Richter	RY 13	*V. Berlandieri* x *V. rupestris*.
99 Richter	RY 2	*V. Berlandieri* x *V. rupestris*.
110 Richter	RQ 28	*V. Berlandieri* x *V. rupestris*.
140 Ruggeri	RU 354	*V. Berlandieri* x *V. rupestris*
US 3-6	-	Jacquez (*V. aestivalis* x *V. cinerea* x *V. vinifera)* x 99 Richter (*V. Berlandieri* x *V. rupestris*).
US 2-1	-	Jacquez (*V. aestivalis* x *V. cinerea* x *V. vinifera*) x 99 Richter (*V. Berlandieri* x *V. rupestris*)
US 4-4	-	Jacquez (*V. aestivalis* x *V. cinerea* x *V. vinifera*) x 99 Richter (*V. Berlandieri* x *V. rupestris*)
US 1-6	-	Jacquez (*V. aestivalis* x *V. cinerea* x *V. vinifera*) x 99 Richter (*V. Berlandieri* x *V. rupestris*)
US 12-6-8	-	Jacquez (*V. aestivalis* x *V. cinerea* x *V. vinifera*) x 99 Richter (*V. Berlandieri* x *V. rupestris*)
US 24-10	-	Ramsey (*V. Champini*) x 99 Richter (*V. Berlandieri* x *V. rupestris*).
US 24-41	-	Ramsey (*V. Champini*) x 99 Richter (*V. Berlandieri* x *V. rupestris*)
US 16-13-23	-	1202 C. (*V. vinifera* L. x *V. rupestris*) x 99 Richter (*V. Berlandieri* x *V. rupestris)*.
US 16-13-26	-	1202 C. (*V. vinifera* L. x *V. rupestris*) x 99 Richter (*V. Berlandieri* x *V. rupestris)*.
US 35-1-15	-	99 Richter (*V. Berlandieri* x *V. rupestris*). x Solonis (*V. riparia* x *V. rupestris* x *V. candicans*).

The district in which the trial is located is classified as being in region IV (2170 degree days) (Le Roux, 1974) and has a low rainfall (approx. 250 mm per annum). The vineyard was irrigated by means of portable overhead sprinklers with 60 mm of water every four weeks during the growth season. The vines were spur-pruned at a constant budload of 24 buds per kilogram cane-mass.

Grapevine performance: Prior to harvesting the total soluble-solids (TSS) concentration of a random sample of berries from all graft combinations was monitored and the vines were harvested on the same day, when the TSS concentration reached 20 degrees Balling. The fresh mass of grapes for each individual vine was determined annually. Representative bunch samples of each plot were collected at harvest and the must was analysed for total titratable acidity (expressed as tartaric acid), TSS concentration and pH. Bunch masses of random samples for each graft combination were determined during two seasons (1987 and 1988). The cane mass of each individual vine was also determined annually.

Statistical analyses: A standard VORI factorial statistical software package was used to test significant differences between rootstock means. The same program was used to determine correlation coefficients.

RESULTS AND DISCUSSION

During November, 1988, spring frosts considerably reduced the crop and resulted in high variation within the individual plots. For this reason the data for the 1989 season were excluded. The mean seasonal yields of the remaining years are given in Table 3.

The highest mean seasonal yields per vine were obtained with the rootstocks 13-5 E.V.E. Jerex (13-5), Ramsey, 143-B Millardet et de Grasset (143-B Mgt), 1045 Paulsen (1045P), 140 Ruggeri (140Ru) and 775 Paulsen (775P), whereas the University of Stellenbosch hybrids, US 16-13-23, US 3-6, US 4-4, US 2-1 and US 12-6-8, and Jacquez performed relatively poorly (Table 3). The mean cane masses of 13-5, Ramsey, 143-B Mgt, 1045P and 101-14 Mgt were significantly higher ($p<0,05$) than those of the US hybrids, US 35-1-15, US 16-13-23, US 3-6, US 4-4, US 2-1, and US 12-6-8 and Jacquez (Table 3).

TABLE 3
Effect of the rootstock cultivar on the yield, growth and grape composition of *Vitis vinifera* cv. Colombard in the experimental vineyard at Robertson 1985-1990.*

Rootstock cultivar	Yield (kg/vine)	Bunch (g)	Cane mass (kg//vine)	Yield. Cane mass ratio	** TSS mass (°B)	*** TTA (g/l)	pH
13-5 E.V.E Jerex	16,3	258,3	1,6	10,5	20,2	8,8	3,25
Ramsey	15,9	282,1	1,7	9,3	20,7	8,7	3,34
143-B Mgt	15,7	251,3	1,7	9,3	20,8	8,9	3,31
1045 Paulsen	15,2	273,2	1,9	7,9	21,1	8,3	3,31
140 Ruggeri	15,1	246,7	1,4	10,5	20,6	8,8	3,33
775 Paulsen	14,5	239,0	1,5	9,8	20,9	8,6	3,29
US 24-41	13,9	280,8	1,2	11,9	20,3	8,5	3,24
101-14 Mgt	13,7	267,1	1,8	7,6	21,6	8,7	3,32
99 Richter (RY 13)	13,1	251,4	1,4	9,5	20,8	8,0	3,29
Grezot 1	13,0	258,1	1,4	9,2	20,6	8,4	3,29
99 Richter (RY 2)	13,0	244,7	1,5	8,6	20,7	8,7	3,34
US 1-6	12,9	214,5	1,4	9,4	20,9	8,6	3,27
Constantia Metallica	12,5	251,5	1,5	8,1	21,3	8,4	3,37
216-3 Castel	12,3	246,3	1,2	10,7	20,7	8,4	3,29
1103 Paulsen	11,7	260,4	1,3	8,9	21,1	8,5	3,31
US 16-13-26	11,6	210,9	1,1	10,3	20,3	8,4	3,32
US 24-10	11,5	267,7	1,4	8,0	21,5	8,1	3,39
US 35-1-15	11,3	271,3	1,0	11,2	20,8	8,7	3,25
110 Richter	11,2	228,0	1,1	9,7	21,5	8,6	3,29
US 16-13-23	10,4	182,9	0,9	11,1	21,4	8,3	3,32
US 3-6	9,7	238,8	1,0	9,7	21,6	8,1	3,30
US 4-4	9,4	287,3	0,9	10,5	21,6	8,3	3,27
Jacquez	9,1	241,9	0,6	15,2	21,2	8,4	3,21
US 2-1	8,1	275,7	0,9	8,9	21,1	8,4	3,30
US 12-6-8	4,7	173,4	0,6	7,5	22,1	7,9	3,35
Mean	12,2	248,1	1,3	9,7	21,0	8,5	3,30
L.S.D. (P<0,05)	4,5	-	0,6	5,8	1,2	0,8	0,13

* Excluding 1989
** TTS = Total soluble solid concentration
*** TTA = Total titrable acidity

Contrary to the findings of other workers (Spiegel-Roy, Kochba & Lavee, 1971; Belvini *et al.,* 1986), a highly significant positive correlation (p<0,05) was found between the mean yield per vine and its cane mass, within the limits of the cane masses measured (Fig. 1). Excessive vigour can lead to poorer setting of the fruit (Morton, 1979) and decreased budding percentages and fruitfulness (Carstens, Burger & Kriel, 1981), which could account for the generally observed decline in yield that occurs at higher cane masses. At this stage in the trial, however, it appears that the trellis was large enough to accommodate the growth of even the more vigorous rootstocks, for example 1045P, 101-14 Mgt, Ramsey and 143-B Mgt, and consequently a favourable microclimate could have been maintained within the canopies. Whether this will remain so in future is yet to be established.

If the performance of the rootstocks is compared on a relative scale, where the mean yield and cane mass for all the rootstock combinations are given an arbitrary value of 100, then the above-mentioned correlation is clearly discernible (Fig. 2). Generally, cultivars which had above-average yields also had above-average cane masses, and vice versa.

The good performance found with 13-5 and Ramsey (Fig. 2) at this early stage in the trial, confirms the relatively high tolerance of these cultivars to saline conditions found by other researchers (Galet, 1979, Antcliff *et al.,* 1983). Conversely, 216-3 Castel (216-3), which reportedly performs well under saline conditions (Galet, 1979), did not do as well as expected. The yield of this rootstock was only slightly above average while its cane mass was below average (Fig. 2). Although this rootstock is susceptible to nematode injury (Pongracz, 1983), no nematodes were found, indicating that this could not have been the reason for its relatively poor performance. In a root study conducted in the same vineyard (Southey, 1990), the roots of 216-3 were found to be predominantly confined to the upper soil layers, which tended to dry out rapidly after irrigation. Since this rootstock has been found to be poorly adapted

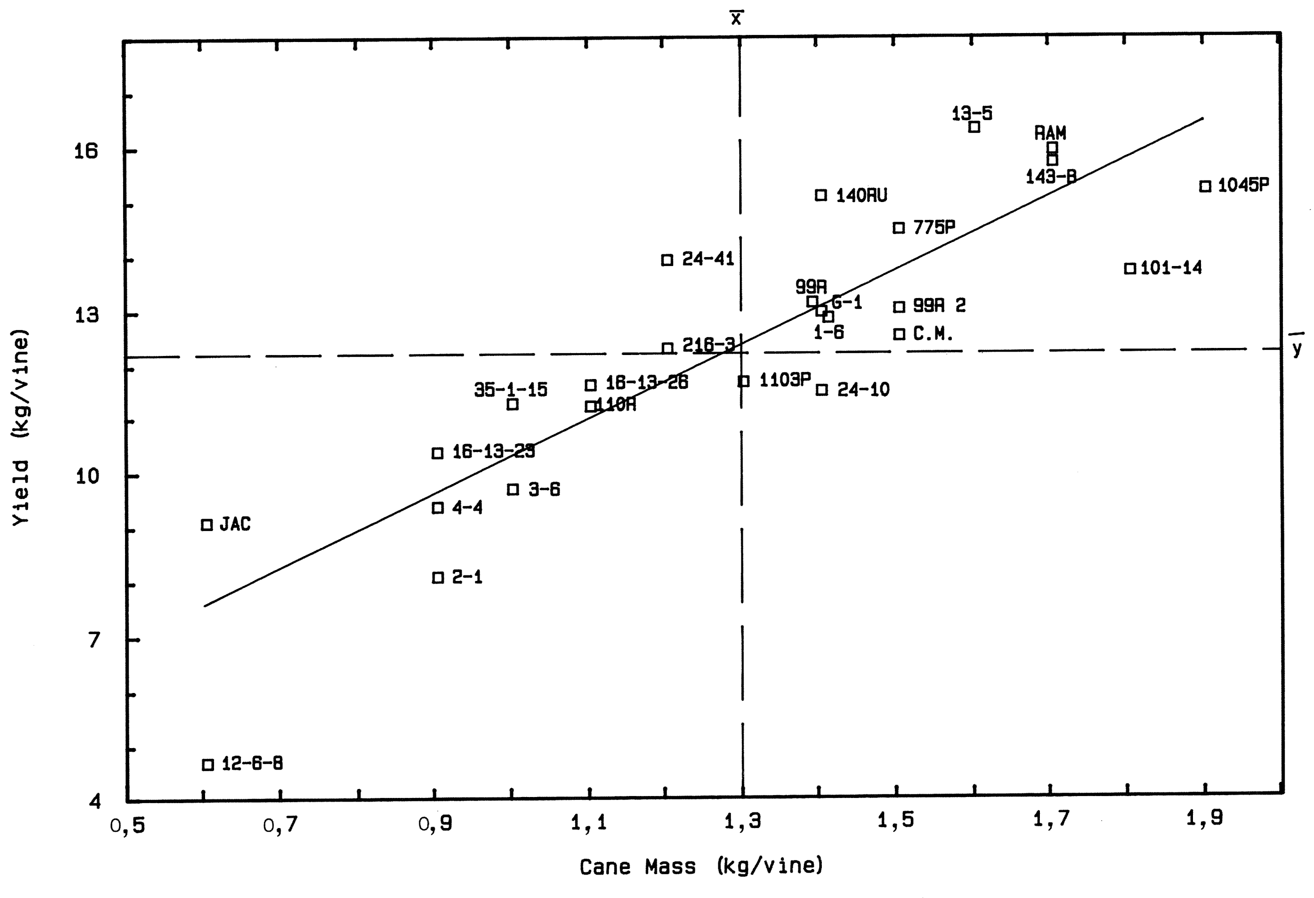

FIGURE 1

Relationship between mean yield (kg/vine) and mean cane mass (kg/vine) of Colombard grafted onto 25 rootstocks on a relatively saline soil in the experimental vineyard at Robertson. 1985-1990, excluding 1989.

13-5 = 13-5 E.V.E. Jerex; 216-3 = 216-3 Castel; C.M. = Constantia Metallica; G-1 = Grezot 1; Jac = Jacquez; 101-14 = 101-14 Millardet et de Grasset; 143-B = 143-B Millardet et de Grasset; 775P = 775 Paulsen; 1045P = 1045 Paulsen; 1103P = 1103 Paulsen; Ram = Ramsey; 99R = 99 Richter (RY 13); 99R 2 = 99 Richter (RY 2); 110R = 110 Richter; 140Ru = 140 Ruggeri; 1-6 = US 1-6; 2-1 = US 2-1; 3-6 = US 3-6; 4-4 = US 4-4; 24-10 = US 24-10; 24-41 = US 24-41; 12-6-8 = US 12-6-8; 16-13-23 = US 16-13-23; 16-13-26 = US 16-13-26; 35-1-15 = US 35-1-15.

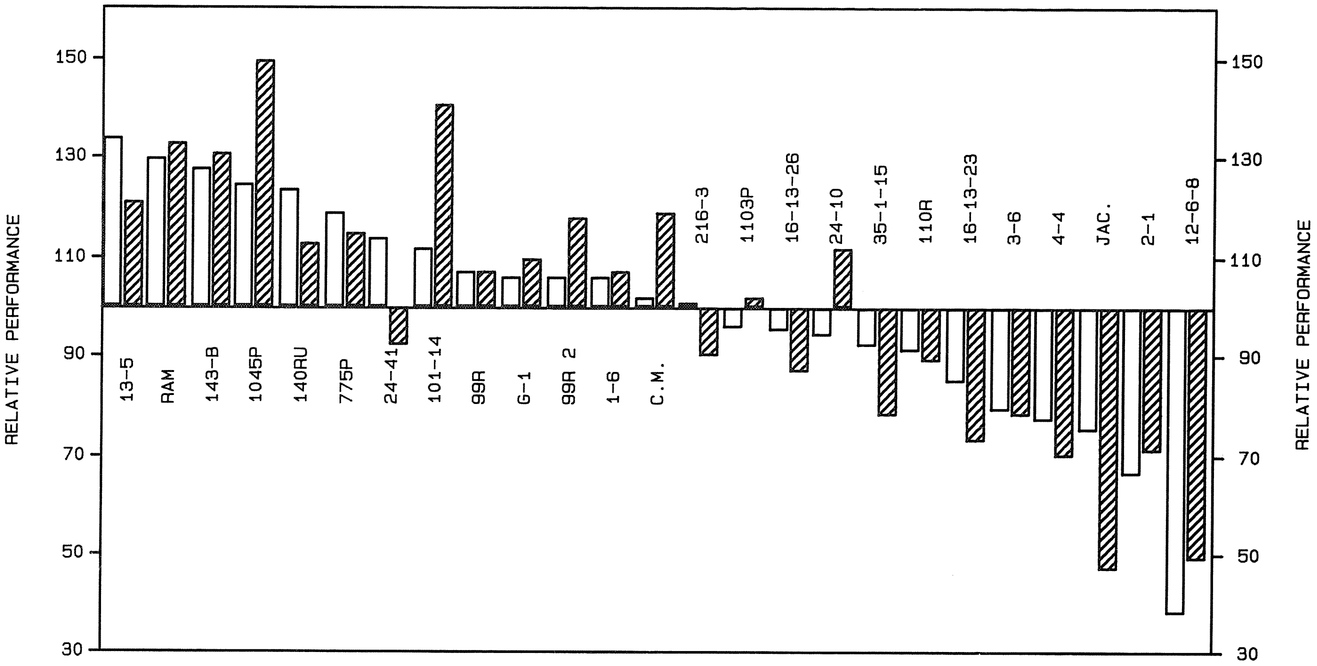

FIGURE 2

Relative mean performance of Colombard grafted onto 25 rootstock cultivars on a relatively saline soil in the experimental vineyard at Robertson. 1985-1990, excluding 1989. Rootstocks as in Figure 1.

Relative mean yield. Relative mean cane mass.

to drought (Spiegel-Roy, Kochba & Lavee, 1972; Pongracz, 1983), this could have contributed to its poorer performance.

The performance of 1103 P, which, according to Galet (1979) and Kriel (1985), is relatively well adapted to salinity, was surpassed by that of other cultivars (Fig. 2). Antcliff *et al.* (1983), however, found this rootstock to be a poor excluder of chloride.

Relatively high mean yields and cane masses were recorded with the rootstocks 143-B Mgt and 101-14 Mgt, whereas Jacquez performed poorly (Table 3). Although European researchers (Pongracz, 1983) regard 101-14 Mgt as being poorly adapted to salinity, the results of the present study confirm the findings of a vineyard survey conducted by Ambrosi *et al.*, (1966), in which 143-B Mgt and 101-14 Mgt were found to be well adapted to salinity.

Of the US hybrids, only US 24-41 and US 1-6 produced above-average yields, but the cane mass of US 24-41 was below average (Fig. 2). Although the yield of US 24-10 was below average, its cane mass was relatively high (Fig. 2). Those US rootstocks that have Jacquez in their parentage, namely US 12-6-8, US 2-1, US 4-4, US 3-6 and US 1-6 (Table 1), performed relatively poorly, with the exception of US 1-6 (Fig. 2). These results suggest that the poor performance of Jacquez under saline conditions (Ambrosi *et al.*, 1966) may be manifested in the progeny of this rootstock. Conversely, hybrids with Ramsey in their parentage, such as US 24-41 and US 24-10, tended to be better adapted to saline conditions (Fig. 2). The rootstock 1202 Couderc (1202C) is also well adapted to salinity (Galet, 1979) and its hybrids, namely US 16-13-23 and US 16-13-26, also tended to perform better than the Jacquez hybrids (Fig. 2).

Of the rootstocks that produced higher than average yields, US 24-41, 140 Ru, 13-5 and 216-3 had crop-to-cane mass ratios greater than 10 (Table 3). According to Zeeman and Archer (1981) a crop-to-cane mass ratio of between 7 and 9 is optimal for the region in which this study was done. The optimal crop load, however, has been found to be dependent inter alia on the rootstock (Archer & Fouché, 1987). In a trial conducted under similar climatic conditions, Southey & Fouché (1990) found that a higher ratio than the above had no detrimental effects on the performance of Chenin blanc grafted onto Dog Ridge, Ramsey and Constantia Metallica. Whether this high crop-to-cane mass ratio is suitable for the above-mentioned rootstocks, needs to be ascertained in the long term.

The rootstocks Jacquez and US 16-13-23 had above-average TSS concentrations associated with relatively high yield-to-cane mass ratios (>11.0) (Table 3), which may ultimately lead to overcropping. The cane mass and TSS concentration of the latter cultivar decreased with age (data not shown), which suggests that this cultivar could be overcropped. The cane mass of Jacquez, on the other hand, remained relatively stable over time. Whether this rootstock will be capable of maintaining this high crop-to-cane mass ratio, is yet to be established. Conversely, US 24-41 and US 35-1-15 had below-average TSS concentrations and above-average

TTA associated with high crop-to-cane mass ratios, which could be indicative of delayed ripening.

Although no significant correlation (p<0,05) was found between the TSS concentration and yield, the former tended to decrease with increasing yield (Fig. 3). Certain workers (Winkler, 1958; Freeman, Lee & Turkington, 1980) have found that high yields can result in delayed ripening, but Amerine (1961) and Spiegel-Roy *et al.* (1972) found no adverse effects with above-average yields.

Of the relatively high-yielding rootstocks such as 13-5, Ramsey, 143-B Mgt, 1045P, 140 Ru and 775P, only 13-5 had a significantly lower (p<0,05) TSS concentration than those rootstocks, which had the highest TSS concentrations, namely US 12-6-8, US 4-4, US 3-6 and 101-14 Mgt (Table 3). Since all the rootstocks were harvested on the same day, a relatively low TSS concentration and high TTA could be indicative of delayed ripening, which could account for that found with 13-5. This rootstock, however, is known to have a long vegetative cycle (Pongracz, 1983).

The majority of rootstocks with higher cane masses (>1,3 kg/vine) had below average TSS concentrations (Fig. 4) and above-average TTA, which could possibly be the result of excessive vigour and subsequent delayed ripening (Morton, 1979). Some relatively vigorous rootstocks, however, such as 1045P, 101-14 Mgt, Constantia Metallica and US 24-10, had above-average TSS concentrations (Fig. 4) and of these rootstocks 1045P, 101-14 Mgt and Constantia Metallica also produced above-average yields (Table 3). Since the crop-to-cane mass ratios of these cultivars were relatively low, these results could indicate a slight imbalance between yield and growth. Consequently, the yields of these cultivars could possibly be increased without adversely affecting berry composition. The high TSS concentration of 101-14 Mgt, however, could also be the consequence of its short vegetative cycle (Pongracz, 1983).

The acid levels of 13-5, 143-B Mgt, 140 Ruggeri were significantly higher (p<0,05) than those of 99R (RY 13) and US 12-6-8 (Table 3), and the cane masses of the former were significantly higher than US 12-6-8. Since high vigour is normally associated with low acid levels (Smart, 1985), these results suggest that the trellis was large enough to accommodate the growth of these more vigorous vines.

The pH of the juice of the different rootstock combinations

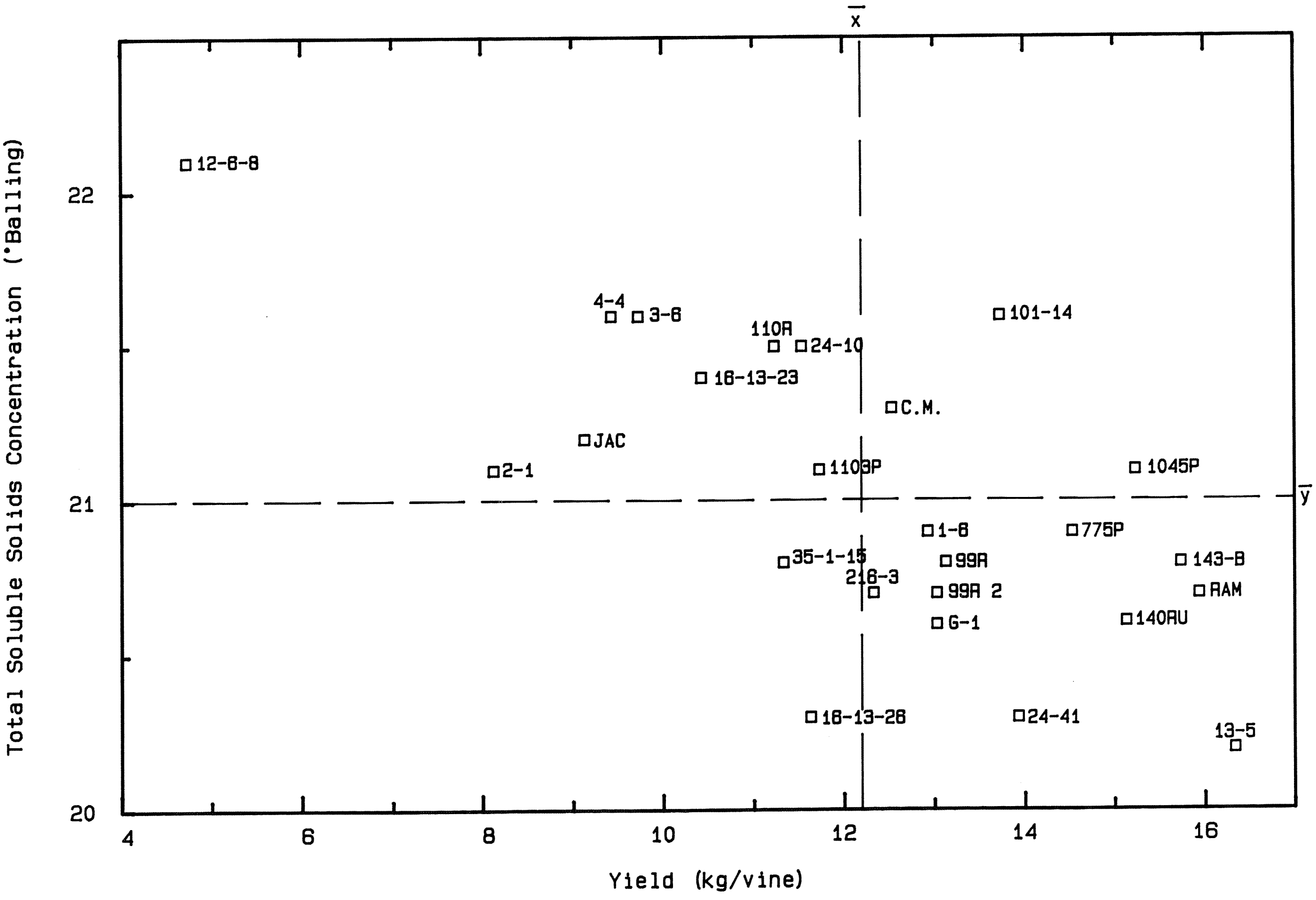

FIGURE 3

Relationship between mean total soluble solids (TSS) concentration (Degrees Balling) and mean yield (kg/vine) of Colombard grafted onto 25 rootstocks on a relatively saline soil in the experimental vineyard at Robertson 1985-1990, excluding 1989. Rootstocks as in Figure 1.

did not differ markedly (Table 3). That of US 24-10, however, was significantly higher (p<0,05) than of 13-5, US 35-1-15, US 24-41 and Jacquez.

Although the mean pH of the more vigorous rootstocks (those with significantly higher cane masses) was higher than that of rootstocks which grew less vigorously (Table 3), no significant relationship (P<0.05) between the pH of the juice and the cane mass was discernible (r=0,30). The pH, however, decreased significantly with an increasing crop-to-cane mass ratio, (Fig. 5). Higher pH's were found with those rootstocks, such as 1045P, 101-14 Mgt, 99R (RY 2), 1103P, Constantia Metallica and US 24-10 (Table 3), where relatively higher cane masses were associated with lower yields (Fig. 2).

A high juice pH is detrimental to wine quality (Boulton, 1980) and has been associated with excessive vigour (Jackson, 1986) and within canopy shading (Smart, 1985). According to Zeeman (1978) a low yield-to-cane mass ratio associated with a high cane mass can be indicative of excessive vigour. The relatively high TSS concentrations of the above-mentioned rootstocks [with the exception of 99R (RY 2)], suggests that, since all the rootstocks were harvested on the same day, the high pH's could be the consequence of earlier maturity rather than excessive vigour as such. The relatively low crop-to-cane mass ratios found with these rootstocks suggests that higher budloads would not neccessarily a affect the grape composition adversely. This supports the finding of Archer and Fouché (1987), that optimum budload is a function of the rootstock.

Despite the low cane mass found with US 12-6-8, its pH was relatively high (Table 3). According to Lipe & Perry (1988) and Ruhl *et al.*, (1988), the rootstock can also have a direct effect on pH, owing to differences in mineral uptake. The afore-mentioned rootstock, however, had a relatively high TSS concentration and low acidity (Table 3), which suggests that the high pH was the result of earlier ripening and not of the rootstock *per se*.

CONCLUSIONS

Under relatively saline conditions, rootstock cultivar affects yield and cane mass significantly. Over a period of six years, the rootstock cultivars 13-5, Ramsey, 143-B Mgt, 1045P and 140 Ru appear to be well adapted to relatively saline soils.

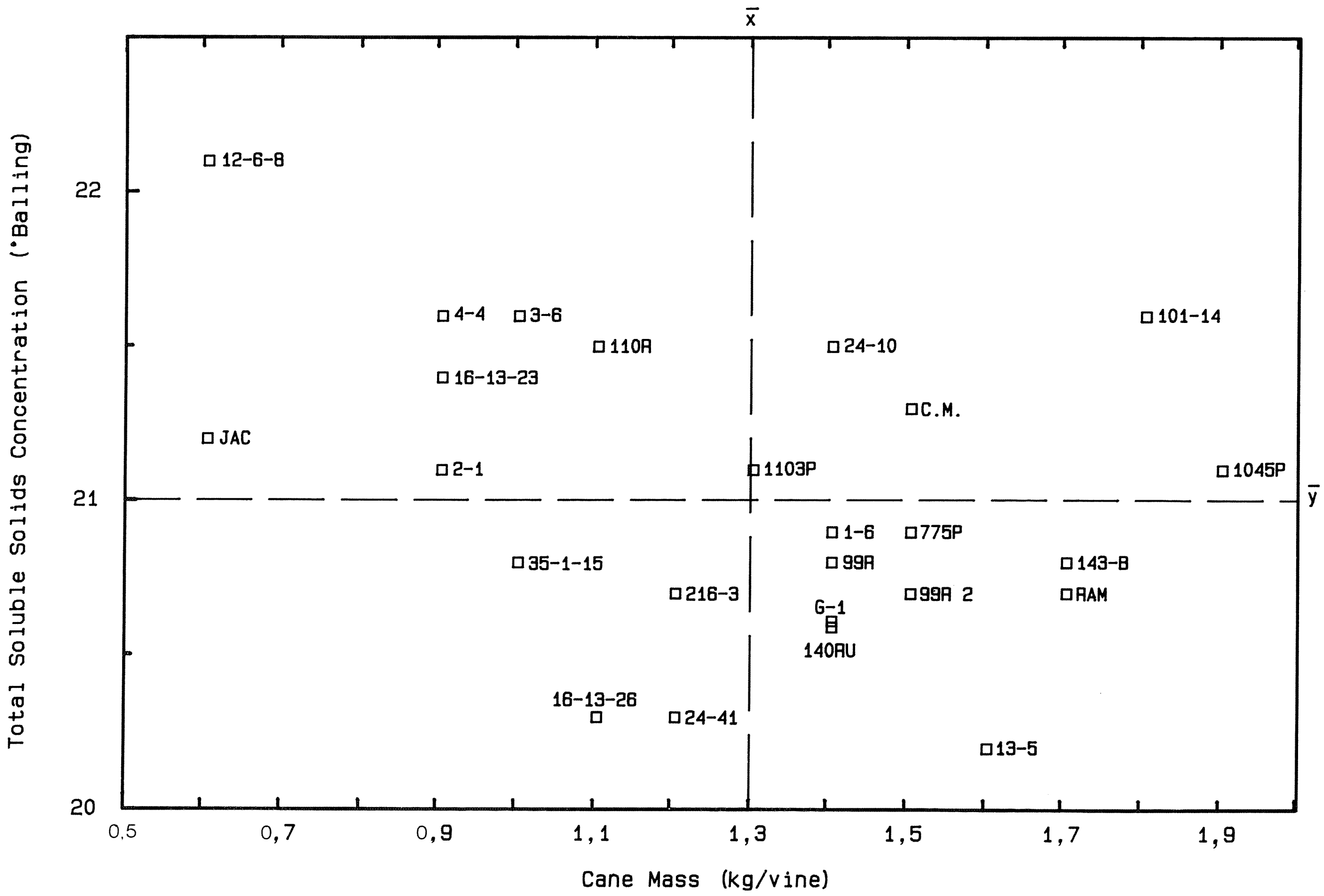

FIGURE 4

Relationship between mean total soluble solids (TSS) concentration (Degrees Balling) and mean cane mass (kg/vine) of Colombard grafted onto 25 rootstocks on a relatively saline soil in the experimental vineyard at Robertson. 1985-1990, excluding 1989. Rootstocks as in Figure 1.

The good performance of 143-B Mgt and 101-14 Mgt confirms the previous observations made in South Africa, that these rootstocks are well adapted to relatively saline soils under South African conditions.

The highly significant positive correlation found between yield and cane mass is possibly the result of the trellising system being large enough to accommodate the growth of the vines at this stage in the trial, thereby ensuring that a favourable microclimate was maintained. The negative effects of excessive shading might, however, become apparent in the future in the more vigorous rootstocks. This aspect is to be investigated in the long term.

Jacquez and those hybrids which have Jacquez in their parentage performed relatively poorly under the saline conditions of this trial, whereas the progeny of Ramsey, which appears to be salt tolerant, performed better. Thus it is apparent that tolerance or sensitivity to salinity is generally manifested in the progeny of a rootstock, which has implications for the breeding of salinity-tolerant hybrids.

The results found in this trial, however, are based on five seasons and the ranking of the performance of different rootstocks may well change with the continuation of the trial.

Differences in the grape composition of Colombard grafted onto different rootstocks appeared to be largely the result of differences in actual maturity and not of the rootstock *per se*. The indirect effects of rootstock vigour on grape composition might become more apparent as the trial progresses and this aspect will be clarified with the continuation of the trial.

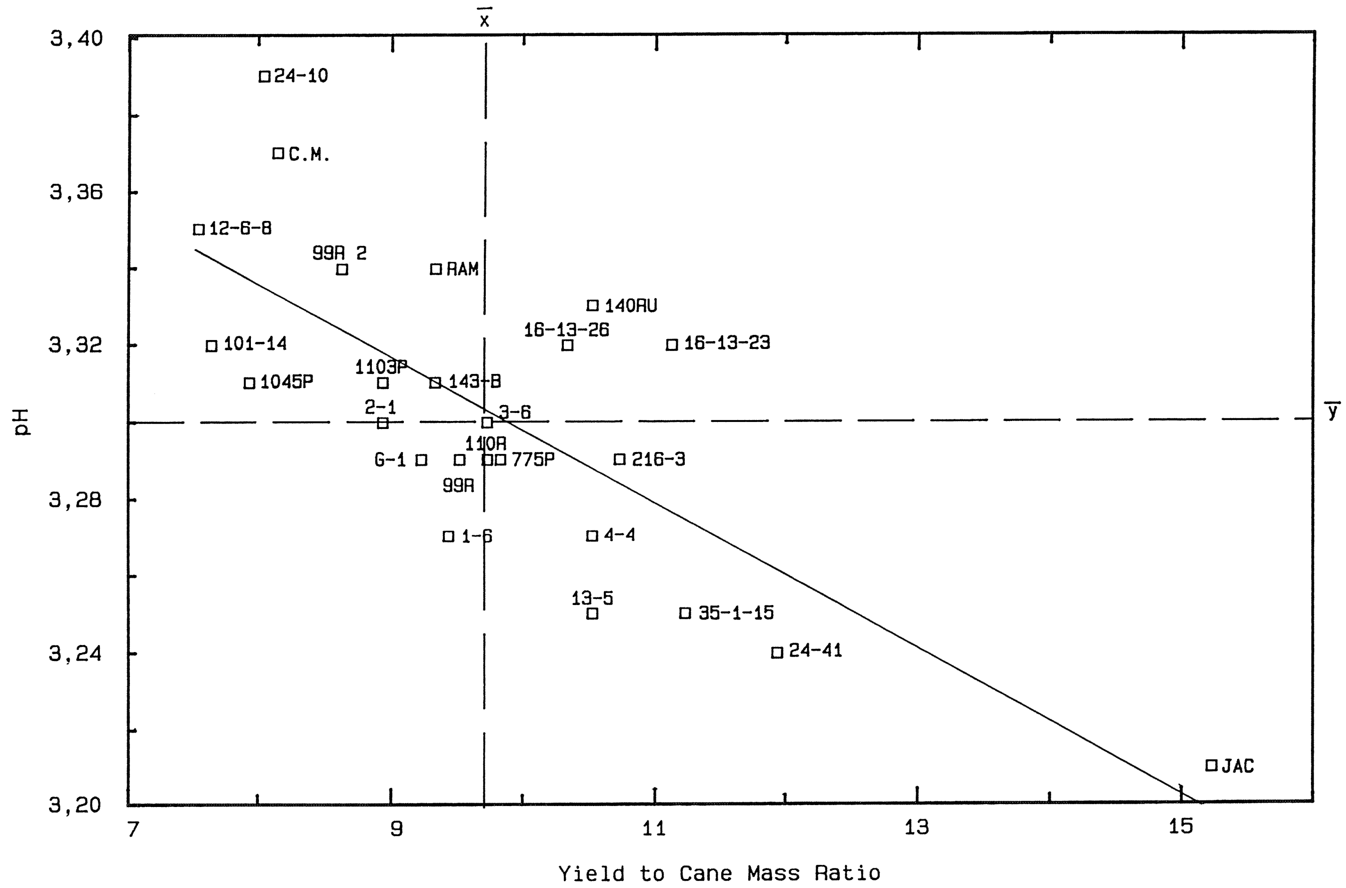

FIGURE 5

Relationship between pH and mean yield-to-cane mass ratio of Colombard grafted onto 25 rootstocks on a relatively saline soil in the experimental vineyard at Robertson. 1985-1990, excluding 1989. Rootstocks as in Figure 1.

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