THE EFFECT OF SOIL AND CLIMATE ON THE CHARACTER OF SAUVIGNON BLANC WINE

KOBUS CONRADIE

ARC Fruit, Vine and Wine Research Institute, Nietvoorbij Centre for Vine and Wine.
Private Bag X5026, 7599 Stellenbosch, South Africa

Summary

* *Substantial climatic differences occur between localities in the districts of Stellenbosch and Durbanville.*
* *In general, wines from coolest localities score the highest for intensity and quality of aroma.*
* *In some cases wines from warmer localities score better than expected (adequate soil preparation, good canopy management).*
* *Wine from soils at the same locality show major differences.*
* *During dry summers wines from soils with higher water supplying capacities show highest aroma intensity, while the situation may be reversed during milder summers.*
* *Harmony exist between the textural nature/water regime of a soil and climate experienced during a specific season.*

Resumé

Un projet multidisciplinaire sur l'effet du sol et du climat sur la qualité du vin a débuté en Afrique du Sud il y a 5 ans. Des mesures sont effectuées sous culture sèche dans des vignes de Sauvignon Blanc dans six localités différentes, cinq dans le district de Stellenbosch et une à Durbanville. Au moins deux types de sol différents sont présents dans chaque localité. Les températures maximales moyennes en été varient de 28ºC pour la localité la plus chaude à 25ºC pour la plus froide. En général, les vins issus des localités les plus froides enregistrent des résultats les plus élevés pour l'intensité et la qualité des arômes. Quelques fois des vins issus de localités plus chaudes enregistrent cependant des résultats meilleurs que prévus. Ceci est attribué à des pratiques adéquates de préparation des sols qui résultent dans une bonne distribution des racines et une bonne gestion de la ramure. L'état hydrique des sols à la même localité montre des différences majeures malgré des sites d'expérimentation souvent éloignés de moins de 50 m l'un de l'autre. Ceci résulte dans de forts stress hydriques pour les vignes situées sur des sols qui ont une faible capacité hydrique. Les profils aromatiques des vins issus de différents sols à la même localité montrent aussi par conséquent des différences majeures. Les résultats mettent en évidence l'harmonie entre la nature de la texture/régime hydrique du sol et le climat de la saison. Une performance suSpérieure au cours d'une saison n'est pas nécessairement répétée la saison suivante.

Introduction

In South Africa appreciable climatic differences can occur over small distances, mainly on account of changes in the topography. Furthermore, a large variety of soil types often occur in small areas. Wine quality is known to be largely affected by the interaction between soil and climate. In order to quantify these effects a multidisciplinary project was started in 1993.

Materials and Methods

The investigation is being carried out using Sauvignon blanc, currently the most important cultivar for the production of quality white wine in South Africa. The character of Sauvignon blanc wine is also known to be readily affected by climatic changes. Six commercial vineyards were identified at six different localities, five in the Stellenbosch district and one in Durbanville. Vines were approximately 10 years old in all cases, cultivated under dryland conditions and trained on a hedge system (1 wire for the cordon arms and two to four wires for vegetative growth.)

Two different soil types were identified at each locality, normally not more than 60 m apart. Twenty vines, representing an experimental plot, were selected on each soil type. Measurements (soil water, leaf water potential, cane mass, yield) were done separately for each plot, while experimental wines were also prepared separately for each plot. An automatic weather station was erected halfway between the two plots. With climate, pruning practices, planting material etc. being comparable, it was only soil type that differed between plots at the same locality.

The first Stellenbosch weather station (L 1) was situated only 13 km from False Bay (warm Indian Ocean), while the fifth (L 5) was 26 km away. The distance to Table Bay (col-der Atlantic Ocean) ranged from 24 km to 41 km. The station at Durbanville (L 6) was only 12 km from Table Bay and 27 km from False Bay. Details are shown in Table 1.

Briefly the different localities can be described as follows:

L 1 : Open to both oceans. Sea-breezes expected.

L 2 : Sheltered from False Bay by low ridge.

L 3 : Low altitude, sheltered by hills.

L 4 : High altitude, sheltered by mountains on three sides. Open to False Bay in S/W direction.

L 5 : Sheltered from False Bay. Open to Table Bay (36 km).

L 6 : Sheltered by low ridge from Table Bay (12 km). Open to False Bay (27 km).

Soils were classified according to the South African binomial system. The names of the soils, in Table 2, refer to this system. At L4 water holding capacities of the two soils appear to be fairly similar, but the deeper layers (1200 - 1800 mm) of No.1 (not shown) had a higher water holding capacity, resulting in the available water of soil No.1 exceeding that of No.2 by 20mm, when the whole profile down to 1800 mm is taken into consideration. The second soil at L6 contained a high percentage of gravel, resulting in a lower water holding capacity. However, the deeper soil layers (1100 - 1800 mm) contained a high percentage of clay (not shown), thus acting as a water reservoir.

Basically the soils can be described as follows:

L3 (Soils developed from shale)

Soil 1 (Avalon): Medium textured, yellow-brown, very weakly structured, mottled subsoil.

Soil 2 (Tukulu): Medium textured, yellow-brown, weakly sturctured, signs of wetness in subsoil.

L4 (Soils developed from granite)

Soil 1 (Oakleaf): Medium textured, yellow-brown, weakly sturctured, slight signs of wetness with depth.

Soil 2 (Hutton): Medium textured, reddish-brown, very weakly structured, well drained.

L6 (Soils developed from shale)

Soil 1 (Tukulu): Medium textured, dark coloured, weakly structured, signs of wetness in subsoil.

Soil 2 (Gravelly Tukulu): Medium textured, gravelly, yellow brown, weakly structured, signs of wetness in subsoil.

Results

Climate:

Annual rainfall amounted to approximately 700 mm for all localities. Most rain fell in winter, while total precipitation during the summer months (December to March) rarely exceeded 100 mm. From 1994 to 1998 average maximum temperatures (Table 3) during summer ranged from 27,8 °C (L 3) to 25, 7 °C (L 6). Night temperatures were highest at L1, due to the temperate effect of the sea. Most wind (probably sea breezes) was experienced at L1 and L6. Least wind was experienced at the sheltered localities (L 3 and L 4). Data in Table 3 indicate that L1 and L6 are the coolest and L3 (lowest altitude, sheltered from wind) the warmest. The locality at the highest altitude (L4) was also relatively cool. Localities showed more pronounced differences when number of hours above 30 °C were calculated. (Table 4). During the hot summer of 1994/95, this value ranged from 273 to 101, and from 121 to 7 during the cool summer of 1996/97. Localities could be ranked in an identical sequence each year, from cool to warm, irrespective of the summer being hot or cold. The rest of the paper paper will deal only with L6 (coolest), L3 (warmest) and L4 (cool due to high altitude).

In general, wines from the coolest localities received highest scores for intensity and quality of aroma. As an example values obtained during 1995/96 are shown in Table 5. These figures refer to the best wine from each locality. Wine from the coolest locality (L6) was the best, while that from the warmest locality (L3) scored the lowest. This was the picture during most seasons, even though differences were sometimes less pronounced. It should also be stressed that wines from L3 (warmest) were often better than those from slightly cooler localities. (L2 & L5). This was probably due to good soil preparation practices, resulting in a well distributed root system, thus preventing undue water stress.

Soil:

Leaf water potentials (not shown) at L3 (measured between 12:00 and 14:00) illustrated higher water stress for soil no. 2. Similarly, soil with the lower water holding capacities also induced higher water stress at L4 and L6. Grapes were harvested at 22 °B, and this value was usually attained at an earlier date for vines subjected to higher water stress.

Wine quality often differed for soils at the same locality. For example, at L3 (Table 6) less vegetative and more tropical character occurred in wine from soil No.1 (less water stress), in comparison to high vegetative character and less tropical character for wine from soil no. 2 (higher water stress) during 1995/96. During this specific season vines which suffered less water stress, thus produced a more complex wine.

In general, wines from soils with higher water supplying capacities showed higher aroma intensity during dry summers, while this was not necessarily the case during milder summers. Results for Locality 4 (Table 7) show that soil no.1 (higher water holding capacity) produced a vastly superior wine during 1993/94. This situation was reversed during 1994/95, with a better wine being produced on soil with a lower water holding capacity. These results point towards the harmony between the textural nature/water regime of a soil and the climate experienced during a specific season. Superior performance during one season is not necessarily repeated in the following season.

Table 1 : Description of the six localities used in the study.

Number	Altitude (m)	Distance from False Bay (km)	Distance form Table Bay (km)
L1	220	13	24
L2	210	20	32
L3	160	18	33
L4	413	24	41
L5	260	26	36
L6	220	27	12

Table 2 : Some physical properties of soils identified at three different localities.

Locality	Soil	Clay (%)		Grit (%)*		Available water (mm)
		0-300mm	300-1000mm	0-300mm	300-1000mm	0-1000mm
L3	No.1 (Avalon)	25	35	<1	5	93,0
	No.2 (Tukulu)	30	33	6	32	62,5
L4	No.1 (Oakleaf)	30	31	3	4	98,5
	No.2 (Hutton)	26	35	<1	14	94,7
L6	No.1 (Tukulu)	10	9	3	3	119,0
	No.2 (Gravelly Tukulu)	15	15	32	40	80,3

* Fraction > 2 mm

Table 3 : Climatic parameters measured during the summer months (December to March) over four years (1994-1998)

Locality	Average Minimum Temperature (°C)	Average Maximum Temperature (°C)	Windspeed (m/s)	Evaporation (mm/day)
L1	15,27	25,86	2,61	4,95
L2	14,85	26,92	2,37	4,93
L3	14,76	27,76	1,77	5,38
L4	14,44	26,26	1,57	4,93
L5	14,47	26,62	1,63	4,88
L6	14,47	25,73	2,34	4,74

Table 4 : Number of hours > 30 °C over the summer months (December to March), as measured during a hot (1994/95) and a cool (1996/97) season.

Locality	Season	
	1994/95	1996/97
L1	140	17
L2	205	53
L3	273	121
L4	228	44
L5	226	60
L6	101	7

Table 5 : Quality of wine aroma, as affected by different localities (1995/96)*

Locality	Quality of wine aroma (%) **
L3	64,8
L4	72,2
L6	79,5

* Values in Table refer to the best wine from each locality.

** Experimental wines evaluated by a panel of at least 14 judges.

Table 6 : Aroma profiles of wines from two soils at Locality 3, as found in 1995/96.

	Aroma distribution (%)	
Aroma component	Soil No. 1 *	Soil No. 2 **
Vegetative	52	68
Tropical	32	19
Spicy	2	2
Caramel	7	3

* Lower water stress

** Higher water stress

Table 7 : Overall quality of wines form different soils at Locality 4, as found in 1993/94 and 1994/95.

Soil	Description	Wine quality (%)	
		1993/94	1994/95
No.1	Highest water holding capacity	62,2	59,0
No.2	Lowest water holding capacity	48,9	64,4