Analysis of some environmental factors and cultural practices that affect the production and quality of the Manto Negro, Callet and Prensal Blanc varieties

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Abstract

45 non irrigated vineyards were used to investigate the characteristics of production and quality and their relationships with certain environmental factors and cultural practices. The grape varieties investigated are autochthonous to the island of Mallorca, Manto Negro and Callet as red and Prensal Blanc as white. All plants were measured for four consecutive years in the main production and quality parameters. Among the environmental factors, the type of soil has been studied, more specifically its water retention capacity, the planting density, the age of the vineyard and the level of viral infection. The presence or absence of virus seems to have no effect on any component analysed in the varieties studied. For the white variety Prensal Blanc age is negatively correlated with yield and the number of clusters, nevertheless it does not cause any effect on the required quality parameters. However, for the red varieties Callet and Manto Negro, the age of the plantation is the variable that best correlates with the quality parameters.

Introduction

It is widely referenced that yield and quality parameters are strongly dependent on climatic conditions, soil and cultural practices. While very high quality wines are grown in various climates, it is impossible to define the ideal climate for fine wines in terms of temperature, rainfall (amount and distribution), or solar radiation. Nor can one define the best possible soil for growing high-quality wines in terms of pebble, clay or lime content, soil depth or mineral content. These factors of the natural environment have to be considered in terms of their interaction with the vine (van Leeuwen, 2009). In spite of the recent improvements in winemaking technologies, wine quality is determined mainly by the chemical composition of the fruit (Bravdo, 2001).

Materials and methods

The table 1 shows the number vineyards and plants included in the study The vineyards were distributed in the Protected Designations of Origin (PDO) Pla i Llevant and Binissalem. The main productive and quality parameters were measured during four consecutive years like described by (Cifre J. et al., 2005) All the plants were tested for detection of the viruses included in certification programs (GFLV, GFkV, GLRV 1,2,3) following the Sanchez-Vizcaino and Cambra method (Cambra et al., 1983)

Table 1. Number of plants and the number of vineyards included in the selection process in each variety and PDO

	Fields	Prensal Blanc	Manto Negro	Callet
Binissalem PDO	16	87	133	76
Pla I Llevant PDO	29	61	56	137

Environmental factors studied:

- The type of soil, more specifically its water retention capacity, as described in (Rossello et al., 2018)
- Plant density
- The age of the vineyard.
- The level of viral infection: only the absence or presence of virus has been considered (any of the viruses as well as double and triple infections).

Results and discussion

Table 2. Correlation matrix among the studied components of the Prensal Blanc variety.

	Yield per plant	Weight of 100 b	N. clusters	Plant density	Virus	Soil	Grapevine Age	° Brix	Ravaz Index	Total acidity	Total Poliphenols	pH
Yield per plant	1,00	-0,39	0,85	-0,44	0,22	0,64	-0,64	0,14	0,47	0,30	-0,16	-0,05
Weight of 100 b.		1,00	-0,32	0,41	-0,09	-0,06	0,05	-0,37	-0,18	-0,43	0,23	-0,20
N. clusters			1,00	-0,42	0,06	0,49	-0,74	-0,21	0,21	0,53	-0,16	-0,05
Plant density				1,00	0,52	-0,34	0,70	0,29	-0,40	-0,27	0,04	-0,14
Virus					1,00	0,18	0,34	0,32	-0,19	0,18	0,00	-0,26
Soil						1,00	-0,57	0,12	0,08	0,08	0,59	0,09
Grapevine Age							1,00	0,47	-0,31	-0,25	-0,05	-0,15
° Brix								1,00	0,32	-0,15	0,17	0,00
Ravaz Index									1,00	-0,05	-0,34	-0,13
Total acidity										1,00	-0,14	-0,54
Total Poliphenols											1,00	0,26
pH												1,00

In Prensal Blanc, the yield is positively correlated with the number of clusters and the water classification and negatively with the age of the plantation. The weight of 100 berries is not significantly correlated with any other variable, indicating that a possible increase in yield would not affect berry size.

The number of clusters presents a positive correlation with acidity (r=0.53) but causes a slight drop in ºBrix (r =-0.21). This value seems to indicate that an excess of clusters delays the ripening of the grape, as has been previously described by different authors (Jackson & Lombard, 1993).

Regarding the density of vines per hectare, it should be noted that most of the older vines are also those with a higher density, so this result must be taken with caution. Thus, the vines planted until the mid-1980s have a goblet formation, with densities greater than 3,500 vines/ha, while the vines planted from the mid-1980s are mostly in bilateral cordon formation with densities lower than 3,400 vines /ha. This value correlates with age, which seems to indicate that younger plantations are planted at lower water densities.

The presence or absence of virus seems to have no effect on any component studied.

The age is negatively correlated with the production and the number of clusters, however it does not cause any effect on the required quality parameters.

Bearing in mind that the quality variables most desired by the Balearic wine sector for this variety are a high sugar content in the berry, high acidity and small berry weight (Carambula et al., 2006). By statistically analyzing the above values, it can be deduced that high water retention values in the soil do not correlate with quality parameters.

In Callet, yield is positively correlated with the number of clusters and the Ravaz Index and negatively with age and Brix degrees. The water classification of the soil, contrary to expectations, is not correlated with any production or quality parameter except the weight of 100 berries, which has a positive correlation. It would be necessary to analyse in more detail the health status of the plants. The high incidence of wood diseases can influence the parameters studied.

Table 3. Correlation matrix among the studied components of the Callet variety

	Yield per plant	Weight of 100 b	N. clusters	Plant density	Virus	Soil	Grapevine Age	Total Tannins	° Brix	Total Antocians	Ravaz Index	Total acidity	Total Poliphenols	pH
Yield per plant	1,00	0,48	0,82	-0,23	0,00	0,02	-0,58	0,23	-0,57	-0,12	0,79	0,33	-0,04	-0,26
Weight of 100 b.		1,00	0,27	-0,39	-0,05	0,56	-0,26	-0,04	-0,44	-0,16	0,53	0,21	-0,19	-0,37
N. clusters			1,00	-0,09	-0,29	-0,12	-0,44	0,07	-0,21	-0,07	0,58	0,06	0,08	-0,02
Plant density				1,00	0,30	-0,41	0,22	0,06	0,25	0,50	-0,13	-0,39	0,32	-0,08
Virus					1,00	-0,10	0,24	0,46	-0,16	-0,07	0,23	0,30	0,00	-0,37
Soil						1,00	0,21	-0,27	0,07	-0,02	0,21	0,05	0,15	-0,37
Grapevine Age							1,00	-0,01	0,70	0,49	-0,31	-0,52	0,51	0,21
Total Tannins								1,00	-0,01	-0,03	0,44	0,32	0,20	-0,05
° Brix									1,00	0,47	-0,44	-0,65	0,58	0,55
Total Antocians										1,00	0,07	-0,79	0,77	0,32
Ravaz Index											1,00	0,24	0,22	-0,43
Total acidity												1,00	-0,44	-0,60
Total Poliphenols													1,00	0,08
pH														1,00

Regarding the density of vines per hectare, since Callet and Manto Negro are varieties with a long tradition of cultivation in the two DOs, there is not such a sudden change between planting age and density of vines per hectare; thus these two variables are not correlated. Some farmers continue to plant these varieties at high planting densities and in goblets. Regarding the Callet variety, a high density is positively correlated with the content of anthocyanins (r=0.50) but not with tannins.

As for the Prensal Blanc, the presence or absence of virus seems to have no effect on any component studied for the Callet variety.

At Callet, vineyard age is the parameter that best explains a decrease in production (r=-0.58) and an increase in quality parameters: Brix degrees (r=0.70), total polyphenols (r=0.51) and anthocyanins. (r=0.49), although it also causes a decrease in acidity (r = -0.52). Total Polyphenols are positively correlated with anthocyanins. (r=0.77) but very weakly with the tannins.

The results obtained for the Manto Negro variety are similar to those observed for the Callet variety. Thus, the yield is positively correlated with the number of clusters (r=0.88), weight of 100 berries (r= 0.66) and the Ravaz index (r=0.6) and negatively with those of quality such as Anthocyanins (r=-0.69). Brix degrees (-0.35) and Total Polyphenols (-0.3), but positively with acidity (r=0.61).

As with the Callet and contrary to expectations, the water classification does not correlate significantly with production or quality parameters, except for Brix degrees, which in this variety has a correlation of 0.53. Also in this variety, the age of the vineyard is the parameter that best explains the decrease in production (r=-0.53) and the increase in quality parameters such as degrees Brix (r=0.51), Anthocyanins (r=0.46) and Polyphenols. (r=0.48), although these correlation values are lower than those observed in the Callet variety.

Conclusion

The presence or absence of virus seems to have no effect on any component analysed in the varieties studied. For the white variety Prensal Blanc age is negatively correlated with yield and the number of clusters, nevertheless it does not cause any effect on the required quality parameters. However, for the red varieties Callet and Manto Negro, the age of the plantation is the variable that best correlates with the quality parameters, therefore the old vines should be the object of preservation by the viticulturists and winemakers in order to guarantee its contribution to the quality of the wines made with these varieties.

Table 4. Correlation matrix among the studied components of the Manto Negro variety

	Yield per plant	Weight of 100 b	N. clusters	Plant density	Virus	Soil	Grapevine Age	Total Tannins	° Brix	Total Antocians	Ravaz Index	Total acidity	Total Poliphenols	pH
Yield per plant	1,00	0,66	0,88	-0,02	-0,18	-0,06	-0,52	-0,34	-0,35	-0,69	0,60	0,61	-0,30	-0,53
Weight of 100 b.		1,00	0,57	0,04	0,07	0,15	-0,30	0,04	0,07	-0,37	0,52	0,51	-0,06	-0,18
N. clusters			1,00	0,10	-0,42	-0,26	-0,42	-0,41	-0,29	-0,41	0,52	0,48	-0,13	-0,55
Plant density				1,00	-0,29	-0,36	0,02	-0,06	0,22	0,16	-0,25	-0,30	0,16	0,09
Virus					1,00	0,32	0,40	0,39	0,10	-0,02	0,29	0,02	0,39	0,18
Soil						1,00	0,24	-0,04	0,53	-0,09	0,26	0,19	0,12	0,03
Grapevine Age							1,00	0,08	0,51	0,46	0,14	-0,25	0,48	0,29
Total Tannins								1,00	0,18	0,02	-0,09	0,13	-0,02	0,35
° Brix									1,00	0,28	-0,10	-0,15	0,31	0,21
Total Antocians										1,00	-0,42	-0,55	0,61	0,41
Ravaz Index											1,00	0,46	0,07	-0,32
Total acidity												1,00	-0,19	-0,50
Total Poliphenols													1,00	0,09
pH														1,00

References

Bravdo, B. A. (2001). Effect of Cultural Practices and Environmental Factors on Fruit and Wine quality. In *Agriculturae Conspectus Scientificus* (Vol. 66, Issue 1).

Cambra, M., Llácer, G., Pérez De San Román, D., Moreno, P., & Durbá, V. (1983). *Diagnóstico rápido de virus en frutales de hueso mediante la técnica inmunoenzimática ELISA-DAS*.

Carambula C., Cretazzo E., Moreno M.T., Riera D., Tomas M., Escalona J.M., Martorell A., Medrano H., & Cifre J. (2006). Clonal selection of the main autochthonous varieties of Balearic Islands. . *XXIX World Congress of Vine and Wine OIV*.

Cifre J., Moreno M.T., Riera D., Carambula C., Escalona J.M., & Medrano H. (2005). Clonal selection of the main Majorcan grapevine varieties: the influence of virus infection on production and quality parameters. *GESCO*, 820–825.

Jackson, D. L., & Lombard, P. B. (1993). *Environmental and Management Practices Mfecting Grape Composition and Wine Quality-A Review*.

Rossello, J., Escalona, J. M., Cifre, J., Vadell, J., & Medrano, H. (2018). Soil typologies in the wine-growing areas of Mallorca, with special emphasis on available water content. *E3S Web of Conferences*, *50*. https://doi.org/10.1051/e3sconf/20185001011

Van Leeuwen, C. (2009). Soils and terroir expression in wines. In *Soil and Culture* (pp. 453–465). https://doi.org/10.1007/978-90-481-2960-7_28