

# The sensory features of the landscapes

## Appréciation sensorielle du paysage

Diego TOMASI<sup>1\*</sup>, Paolo SIVILOTTI<sup>1</sup>, Domenico LUCIANI<sup>2</sup> and Marzio POL<sup>3</sup>

1: CRA-Istituto Sperimentale per la Viticoltura, Viale XXVIII Aprile 26, 31015 Conegliano (TV), Italy.

2: Fondazione Benetton Studi Ricerche, Treviso, Italy

3: Enologist, Treviso, Italy

\*Corresponding author: diego.tomasi@entecra.it, Tel. +39 0438 456733, Fax +39 0438 64779

**Abstract:** When someone watches a hilly landscape, the image beauty creates emotions and frames of mind not easily forgettable, but sometimes man's intervention by means of soil movement and reduction of the natural biodiversity can significantly modify the landscape and consequently the above-mentioned emotions. One speculates if sensory appreciation of a wine may be strongly affected by psychological factor: landscape beauty. Just before the beginning of the trial, an analysis of the territorial features (morphology, vineyard extension, biodiversity, etc.) was performed in order to well characterise the typical landscape of Conegliano and Valdobbiadene hills. Since 2004 sensory evaluations of Prosecco wines coming from the two above mentioned viticultural areas was carried out with the aim to evaluate how landscape emotionally influences wine appreciation. The results proved the important role of the frame of mind (created by the projected images) on wine perception: landscape becomes an added value for the wines. A change in the original morphology of the landscape will result in a different emotional acceptability, and also the wine quality perception will be affected. In this trial, both the chemical composition of the grapes (sugars and aroma compounds) and the sensory perception of the wines (olfactory notes) were shown to be significantly influenced by soil movement. There is a loss of vocation due to the soil disruption, and a comparison between natural and moved soils proved that there was a great difference in terms of microbial activity and root development probably due to the lack of organic matter.

**Key words:** Landscapes, earth movement, root distribution, grape composition, wine sensory analysis

### Introduction

Country landscape is a mixture of material aspects (easy to codify) and emotional aspects revealed by sensorial mediation (Deloire and Martin, 2002). It is well known that morphology (slope, exposure, etc.), soil characteristics and climate conditions may directly affect wine quality potential (Marais *et al.*, 1999; van Leeuwen *et al.*, 2004), while the landscape and its emotional component plays a not direct but significant role on the sensory assessment of a wine. Recently, we are discovering that this two-component-effect of the production area, are fundamental, and viticultural and enological efforts should match the « whole » quality of the wine in order to safeguard the « wine in the place where it is born ». By this way, wine will become a « mirror of the environment where grapevine has been produced » (Fregoni, 2003); the sensory assessment of this wine should recognise the whole puzzle of descriptors (both material and emotional) related with the native area. Sometimes, agriculture activity can be dangerous, directly for causing a reduction in soil fertility, but also could assault the landscape scenography of a place (Lisa *et al.*, 1999; Fregoni, 2003). As above remembered, some environmental components are easily measurable, some other take place from cultural and emotional elements (landscape) and, for some other else, could be more difficult to characterise their influence. Among the formers the hidden roots and soil environment are two important part in viticultural practice and can be directly related with soil movement and losing in landscape scenography. The « hidden half », as described by Box (1996), is important for plant growth: root distribution and density are related with physical-chemical composition of soils and the signals going to / coming from the aerial parts of the plants should be take place in the definition of terroir. Wine taste notes are quite complex, so that the aim of the present work, is try to explain the relative contribute of the soil and the territory landscape on the sensory assessment of a wine. Well ripe grape may affect wine quality (direct effect), but also the beauty of the landscape (indirect effects) are important for wine judgement. Levy Strauss said: « good to think, good to eat ». This landscape « waste » will negatively attempt against the qualitative perception of the wines. The landscape mediation should help to create new emotions in order to « whole »-describe the well-known olfactory and taste notes. Summarizing, the earth/soil planting movements could have a double effect: i) reduction in soil fertility and ii) reduction in landscape beauty.

## Materials and methods

### Experiment 1

The importance of the soil integrity and the attitude in maintaining its properties was evaluated measuring qualitative and quantitative parameters in two different situations: i) grapevine planted in an unaltered soil (unaltered by earth movements) and ii) grapevine planted in soil interested by earth movement where unfertile deep horizons were deposited in surface. In the years 2004-05, a trial was carried out in a 6-year-old vineyard of Cabernet sauvignon grafted on SO4 where earth movements (0.80 m of soil removal) and flattening works brought up in surface unfertile horizons in half vineyard, while the remaining portion of the field remained unaltered. Mineral/manure fertilisation and soil tillage were homogeneously made within the field.

The effects of earth movement (flattening operations) on the physical-chemical-microbiological properties of the soil were evaluated studying the root distribution both in unaltered (not significantly moved) and in moved soils (with important earth movements); in order to analyse root distribution, 1.00-m-soil-trenches were dug 1.40 m and 0.70 m far from the grapevines trunk, and the root number at both distances was registered. The parameters that were measured in both soils are reported in table 1.

**Table 1 - Parameters measured/analysed at soil, grapevine, root and wine level for both soil conditions.**

Soil analysis	0-0.30 m depth	physical analysis	coarse - texture
	0.30-0.50 m depth	chemical analysis	pH, organic matter, N, P, K, Na, Ca, Mg, C.E.C.
		microbiological analysis	microbial biomass (Sparluig and West, 1988)
viticultural measurements	berry set 2005 véraison 2004	leaf diagnosis	N, K, P, Mn, Mg, Ca, Fe, Zn, B
	véraison harvest	qualitative analysis	soluble solids (Brix), titratable acidity, pH, anthocyanins
	harvest	quantitative analysis	yield/vine, cluster weight, Ravaz index
root analysis	root density	number of roots (< 1 mm; 1-3 mm; > 3 mm)	
	root distribution	vertical root distribution	2.6 m width x 1.04 m deep vertical trenches
wine analysis	sensory analysis	panel test	

### Experiment 2

As regard to the effect of landscape on sensory perception of wines, Prosecco wine samples were tasted watching different landscapes. In a first phase, several wines were tasted by the researchers of the Istituto Sperimentale per la Viticoltura that selected three wines (produced with grapes collected in the hills) with the following judgement:

- Prosecco 1: wine with an excellent olfactive and taste overall judgement;
- Prosecco 2: wine with a poor quality (fair olfactive persistence and intensity, normal taste quality and intensity);
- Prosecco 3: wine with a good olfactive fineness and intensity, mouth-fell fullness and pleasure.

These three wines were then proposed to a panel taste that was composed by 6 students, 8 winegrowers, 14 customers and 4 enologists (32 people in total).

#### Sensory assessment a

In order to look at the differences linked with landscape perception, Prosecco 1 (excellent quality) was tasted twice watching different hilly images:

- first image: a beautiful vineyard well inserted inside a pleasant hilly environment;
- second image: a hilly area with a too big vineyard, with exaggerated concrete poles and a careless grapevine management.

Panel was prior informed that the two wine tasted came from the two places respectively. They did not know that they were tasting the same wine (Prosecco 1).

### Sensory assessment b

Prosecco 2 (poor quality) was tasted looking at an image of a particularly beauty hilly landscape (with a close winegrower/vineyard connection), while Prosecco 3 (good quality) was tasted with an image of a huge and homogeneously squared plan vineyard (without any other woody crop around and with several tractors working in the vineyard).

As see below, panel was prior informed that the two wines tasted came from the two projected places respectively. They did not know that they were tasting a poor quality wine (Prosecco 2) and a good quality wine (Prosecco 3).

The sensory descriptors used to depict wines were: visual pleasure, olfactory elegance, taste balance and retronasal richness

## Results and discussion

### Experiment 1

**Soil level.** Soil flattening did not significantly affect soil texture at both depths (figure 1), but the chemical composition was changed (table 2). The nutrient concentration was dramatically reduced in the upper layer of the soil altered by earth movements (see organic matter, N, P, Mg and Ca). In this part of the vineyard, the deep horizon layers re-emerged in surface were characterised by lower pH thus limiting mineral absorption through the roots. Moreover also microbial biomass was reduced in this vineyard site (47 mg C/kg soil) in comparison with the unaltered one (244 mg C/kg soil), which means that there was a less important amount of fungi, bacteria and other useful micro-organisms.

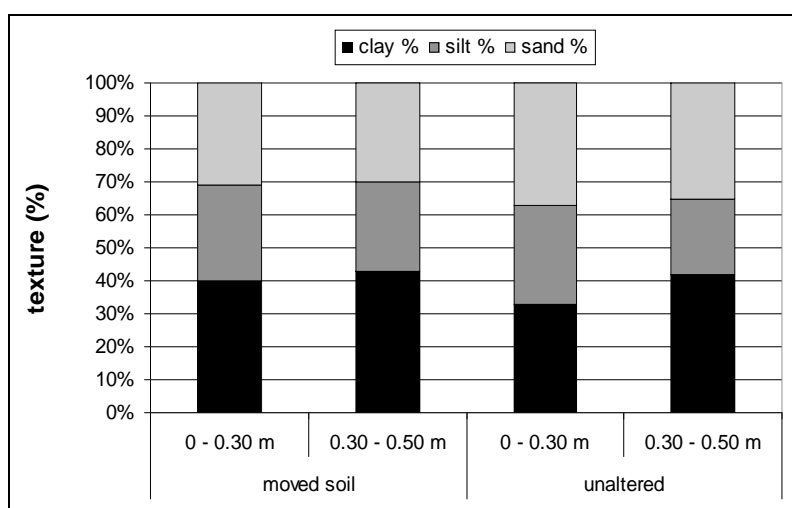


Figure 1 - texture changes at different depth and soil types

Table 2 - chemical composition of the soils at the different depth

soil depth	Unaltered soil		Moved soil	
	0-0.30 m	0.30-0.50 m	0-0.30 m	0.30-0.50 m
pH	6.8	5.5	5.1	5.1
organic matter (%)	1.9	0.9	0.8	0.7
N (g/kg)	1.4	0.8	0.8	0.5
P (mg/kg)	7.5	1.4	2.0	0.7
K (mg/kg)	250	20.2	229	20.5
Mg (mg/kg)	190	163	87.5	108
Na (mg/kg)	43.6	41.6	50.1	44.0
Ca (mg/kg)	1498	867	627	612

**Root and aerial development.** The mineral and microbial deficiency significantly affected the « whole » plant growth. By comparing the two soil situations, roots number were lower and the disposition were confined in a surface layer in the moved soil while were much better distributed along the profile in the unaltered one (figure 2). In the moved soil, grapevine roots clearly suffered because of the unbalanced

chemical and microbial composition, and this resulted in a much more exposure to seasonal trends and growth/production equilibrium changes.

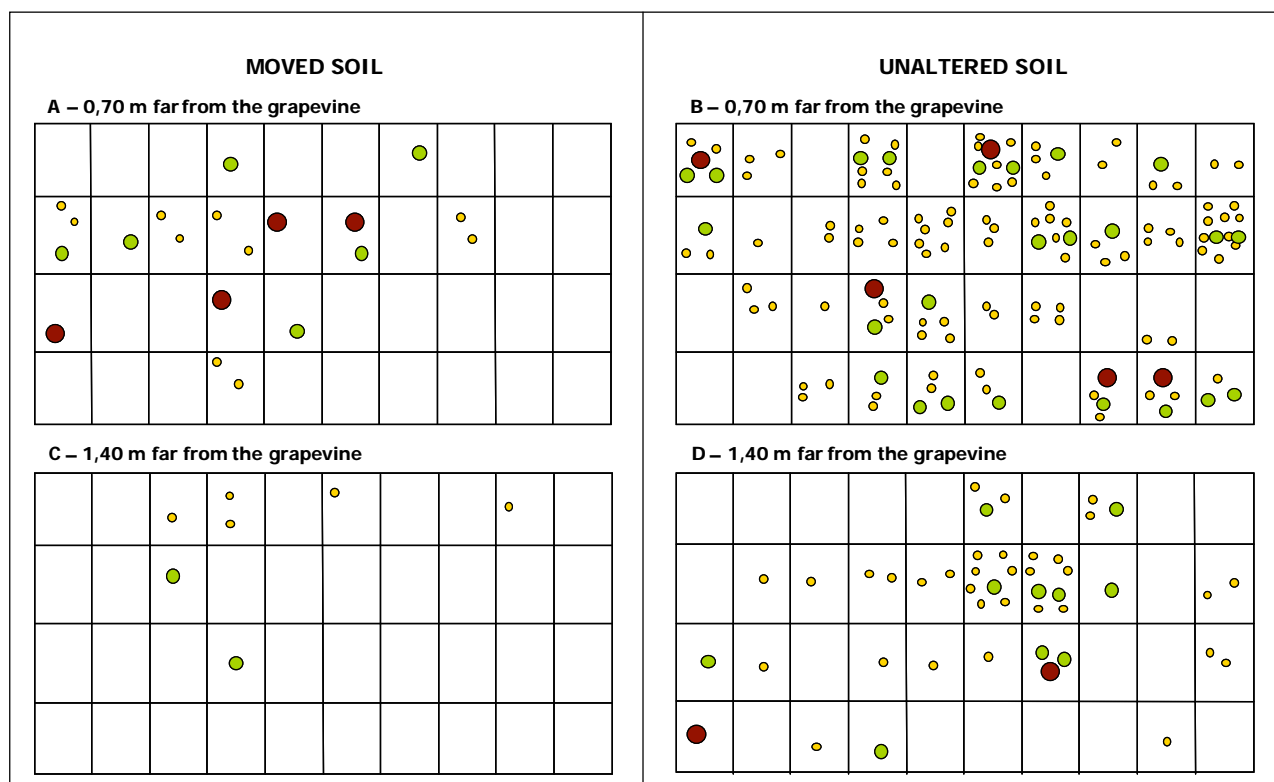
As compared with the other site (table 3), shoot length, leaf area x shoot and pruning weight were half-reduced in the moved soil together with a 65% yield contraction (year 2004).

Leaf diagnosis in both years confirmed a mineral deficiency (mainly N, P and B) in the leaves collected in the moved soils. This probably caused an early decrease of the leaf functionality.

**Grape and wine quality.** In the year 2004, the occurrence of soluble solids at harvest was much higher in the moved soil because of the great yield difference that was assessed (table 3). The best grape quality ascertained in the moved soil was probably to be associated both with the production decrease and with advanced over-ripening. In the following year 2005, cluster thinning was performed on the grapevines of the unaltered soil in order to obtain a comparable yield between the two theses.

**Table 3 - Comparison of growth and productive parameters in the different soils**

	year 2004		year 2005	
	unaltered soil	moved soil	unaltered soil	moved soil
shoot length (m)	1.50	0.48		
leaf area x shoot (m <sup>2</sup> /shoot)	0.60	0.21		
pruning weight (kg/vine)	1.30	0.25		
cluster weight (g)	169	39.0	173	40.1
yield/vine (kg/vine)	4.10	1.50	2.21	1.35
yield/he (t/he)	19.1	6.78	10.3	6.28
soluble solids (Brix)	19.3	21.6	21.8	21.4
Titrateable acidity (g/L)	9.60	7.91	6.25	5.79



**Figure 2 - Roots distribution profile at two distances from the grapevine in the two soils (moved/unaltered).**

The great yield reduction verified for the moved soil, did not successfully result in a comparable sensory appreciation of the wines, since they emerged more appreciated but with more astringency. Moreover, panel was expected to taste wines with more elegance, balance and harmony characteristics that are recognisable when grape yield is very low like in this case. The comparison between wines in the 2005 (figure 3) was more realistic because grape yield was almost the same in the two sites (unaltered/moved soils; table 3). The

wine produced with grapes coming from the unaltered soil were preferred by the panel, having a better olfactory elegance, body and balance as compared with the ones obtained in the moved soil.

### Experiment 2

Earth movement and flattening operations significantly affect also landscape scenography. The visual appreciation of the landscape beauty lacks when vineyards are too big, with an unnatural geometry, or if natural biodiversity of the place diminishes or disappears (figure 4).

Wine sensory appreciation was shown to be better when a pleasant frame of mind was evocated. In the sensory assessment A (figure 5A) the same wine was associated twice with a really beauty and with a fair landscape. Within the panel, only 3 people recognised that the two wines were the same. 20 preferred the wine when associated with the first beauty landscape and 9 gave an opposite appreciation. Thus, landscape played a highly significant effect on sensory appreciation. Vinegrowers and customers emerged as more influenced by the landscape viewing.

In the sensory assessment B, a wine with a poor quality was associated with a beautiful landscape while one with a good quality was tasted viewing a unnatural and less beauty landscape. The first wine associated with the beautiful landscape was more appreciate by the panel (preference test,  $P < 0,001$ ; fig. 5B). This result was in opposition with the sensory assessment made by the researchers of the Istituto Sperimentale per la Viticoltura that tasted wines without any projected image. Thus also in this case, the frames of mind evocated by the landscape played an important role in the wine appreciation, and the true quality of the wine was not recognised. Winegrowers, customers and enologists were equally influenced by the landscape viewing. Within the 6 students, 2 of them preferred the second wine (the good one) demonstrating to be less affected by the landscape viewing.

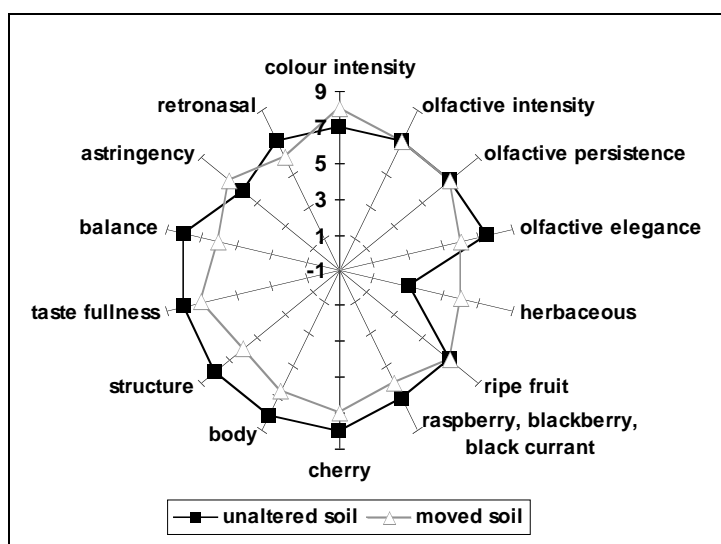


Figure 3 - Sensory analysis of the wines produced with the grapes collected in the two soils (2005).



Figure 4 - Changing in landscape geometry due to vine growing activity

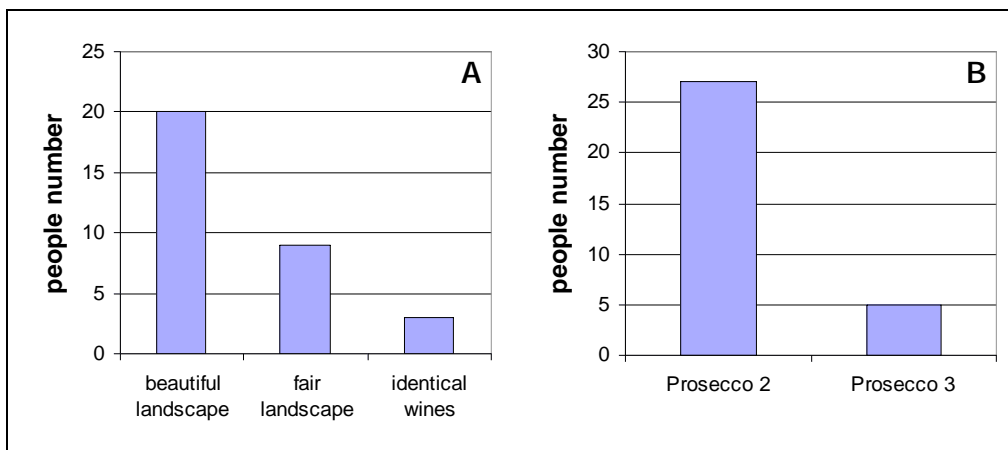


Figure 5 - Sensory analysis of the wines while landscapes images were projected

## Conclusions

Every operation that changes the natural morphology of a place, compromises the agronomical properties of the soil and the emotional features of the landscape. This double aspect was here clearly depicted, suggesting that earth movement should be thought prior to make them. Chemical and microbial deficiencies in the moved soil resulted in a significant yield and growth reduction (shoots and roots). Moreover, this yield reduction did not successfully result in a comparable sensory appreciation of the wines. In the 2005, wines made with grapes collected in the unaltered soils (where cluster thinning was performed to reduce yield) were significantly preferred. So that the soil maintenance has been recognised fundamental in order to obtain high quality wines, important feature for the winery successful.

In the second part of the work, landscape played a crucial role in the wine appreciation: landscape becomes an added value for the wines. The results proved the important role of the frame of mind (created by the projected images) on wine perception. The « whole » wine perception will overcome the traditional sensory assessment because of a « psychic » perception which is of utmost importance.

In future, the results here reported should be reported in other places and other wines in order to discover the hidden effect of the landscape perception on wine quality.

## References

- BOX E.B., 1996. Modern methods for root investigations. 193-234. In: *Plant roots: the hidden half*. ed. Marcel Dekker Inc., New York 1002 p.
- FREGONI M., 2003. La fragilità dei paesaggi viticoli. *Vignevini*, **30**, 4-6.
- LISA L., GAY G. and LISA L., 1999. Sistemazione del terreno nei vigneti collinari. *Informatore Agrario*, **55**, 79-83.
- MARAIS J., HUNTER J.J., and HAASBROEK P.D., 1999. Effect of canopy microclimate, season and region on Sauvignon blanc grape composition and wine quality. *S. Afr. J. Enol. Vitic.*, **20**, 19-30.
- SPARLING G. P. and WEST A.W., 1988. Modifications to the fumigation-extraction technique to permit simultaneous extraction and estimation of soil microbial C and N. *Commun. Soil Sci. Plant Anal.*, **19**, 327-344.
- VAN LEEUVEN C., FRIANT P., CHONÉ X., TREGOAT O., KOUNDOURAS S. and DUBOURDIEU D. 2004. Influence of climate, soil, and cultivar on terroir. *Amer. J. Enol. Vitic.*, **55**, 207-217.