Clone-environment interaction: agronomic and enological performances of 4 “Nebbiolo” selections in two wine districts of Piedmont (north-west Italy)

Interaction entre clone et environnement : performances agronomiques et œnologiques de 4 sélections de « Nebbiolo » dans deux terroirs piémontais (nord-ouest d’Italie)

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ABSTRACT
‘Nebbiolo’ (Vitis vinifera L.) is one of the most important wine red cultivars of north-west Italy and Piedmont is the district where ‘Nebbiolo’ is mainly cultivated (3713 hectares). ‘Nebbiolo’ population is well known for its genetic variability: up to now 33 clones are registered in the Italian Grapevine National Catalogue. The performances of 4 clones of ‘Nebbiolo’ (CVT 71, CVT 415, CVT 185, CVT CN 230), selected in different Italian grapevine-growing areas, were compared in two different environments of north-west Italy: Monforte d’Alba (CN) and Lessona (BI) where Barolo DOCG and Lessona DOC wines are produced respectively. The sites differed for altitude (hilly vs. flat country), soil composition (clayed vs. sandy) and climatic conditions. Agronomic controls, harvest and small-scale winemaking, wine chemical composition and sensory evaluations were performed for each clone and site to investigate the expression and the stability of different clonal aptitudes during two years (2008-2009). Soil and climatic conditions had a strong influence on the expression of clonal characters and consequently the wines produced were different in quality. In both grapevine-growing areas very good results were obtained with the grapes of clone CVT 71, its wines, in fact, were preferred for the good structure and the bright and intense colour; at the opposite the products of CVT 415 were penalized resulting lighter in body and less intensely coloured. In the hilly site with clayed soil of Monforte d’Alba, clone CVT 185 also provided good quality wines, characterized in particular by the intensity of bouquet. In the flat vineyard with sandy soil of Lessona, instead, floral and fruity fragrances have marked the wines obtained from the grapes of clone CVT CN 230. The results confirmed the important role played by different clones on the final quality of wines.

Keywords: environment, clone, wine quality, sensory profile.
Mots-clés : environnement, clone, qualité du vin, profil sensorielle.

1 INTRODUCTION
‘Nebbiolo’ (Vitis vinifera L.) is one of the most important wine red cultivars of north-west Italy and Piedmont is the district where ‘Nebbiolo’ is mainly cultivated (3713 hectares) and its famous wines, such as Barolo and Barbaresco, produced. The environments of the typical growing areas of ‘Nebbiolo’ in Piedmont are very different, with soils ranging from sandy to loamy and vineyard slopes ranging from flat to steep. In addition the genetic variability of the variety is rather wide, considering the several different traditional “types” of ‘Nebbiolo’ (Lampia, Michet, Picotener, etc.) and the 33 clones registered in the Italian Grapevine National Catalogue. In order to investigate the influence of the clone-environment interaction on the agronomic performances and the wine composition, a trial was carried out in two ‘Nebbiolo’ growing areas, monitoring for two vintages the yield and the enological performances of four widespread clones of the cultivar.

2 MATERIALS AND METHODS
2.1 ‘Nebbiolo’ clones and experimental vineyards
The clones chosen for the trial were: CVT 71, CVT 415, CVT 185, CVT CN 230. They were originally selected in different growing areas and differ according to selector descriptions for agronomic and enological features (table 1). The experimental vineyards were planted with a density of 5000 vines/hectare in two sites of Piedmont: flat country of Lessona (BI) on sandy-loamy and acid soil (planting year: 2000) and the hilly area of Monforte d’Alba (CN) on clayed and calcareous soil (planting year: 1999). Vines, grafted onto Kober 5BB rootstock, were vertically trained and Guyot pruned. Observations started when both vineyards were fully productive since several years.

2.2 Data collection
The main agronomic parameters (yield, number of clusters, cluster weight, pruning wood weight) and juice composition were assessed for two years (2008-2009) in both the localities, on two replicates of ten plants for each clones chosen along facing rows.
2.3 Wine chemical and sensory analysis
Around 60 kg of grapes per clone were collected for small-scale winemaking, which was conducted rigorously on the same basis at the experimental wine cellar. After stabilization, bottling and a four month rest, the chemical composition of the wines was evaluated. Tasting was then performed in order to rank the wines according to the preferences of a trained panel [2]. A characterization test was also applied to investigate the intensity of the different components of wine: color, bouquet and taste [3, 4].

3 RESULTS AND DISCUSSION
3.1 Agronomic data
In this paper only the most important data obtained during the two years of experimentation (2008-2009) are shown.
In both years, the yield was on average higher for the clones grown in the vineyard of Monforte (especially in 2008), nevertheless in both sites the CVT CN 230 produced a greater amount of grape than the other clones (due to higher number and weight of bunches), confirming the aptitudes reported in the official description (table 1 and figure 1) as well as the higher pruning wood weight. The grape sugar content, about 230 g/L, was comparable for all the clones, sites and years, while the titratable acidity resulted higher in 2008, in general for the clones grown in Monforte and specifically for the CVT 185 in both the vineyards (11.08 g/L Lessona e 12.9 g/L Monforte in 2008; 7.10 g/L Lessona e 8.4 g/L Monforte in 2009). The phenol and the anthocyanin contents indicated a good level of grape maturity for all the clones regardless the sites and the vintages (total phenols: from 3000 to 3900 mg/kg; total anthocyanins: from 800 to 1100 mg/kg), although the values of CVT 415 grapes were always lower than those of the other selections.

Table 1. Official description of the 4 ‘Nebbiolo’ clones in the trial [1].

<table>
<thead>
<tr>
<th>Clone</th>
<th>CVT 71</th>
<th>CVT 415</th>
<th>CVT 185</th>
<th>CVT CN 230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biotype</td>
<td>Michet</td>
<td>Picotener</td>
<td>Lampa</td>
<td>Lampa</td>
</tr>
<tr>
<td>Origin</td>
<td>La Morra (CN)</td>
<td>Pont S. Martin (AO)</td>
<td>Barbaresco (CN)</td>
<td>Neive (CN)</td>
</tr>
<tr>
<td>Registration year</td>
<td>2001</td>
<td>2001</td>
<td>2003</td>
<td>1990</td>
</tr>
<tr>
<td>Vigor</td>
<td>medium/high</td>
<td>moderate</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>Yield</td>
<td>moderate</td>
<td>moderate</td>
<td>medium</td>
<td>high</td>
</tr>
</tbody>
</table>

Figure 1. Yield of ‘Nebbiolo’ clones grown in Lessona and Monforte (2008-2009).
3.2 Enological data

In the 2008 ranking tests, the histograms of Lessona wines are placed in the non significant range meaning that the wines of the four clones had no remarkable differences (figure 2a), whereas among the wines of Monforte, CVT 415 was the least appreciated (figure 2b). The sensorial evaluation of 2009 wines showed more differences: CVT 415 was again penalized by the tasters, while CVT 71 was the most preferred. Among the wines of Monforte also the one of CVT 185 obtained a positive evaluation. The low appreciation of CVT 415 wines was due to its colour hue, garnet red with slight orange tint, and to the lighter colour intensity compared to other wines (table 2 and figure 3 a-b). The colour is a critical parameter for the wines made with ‘Nebbiolo’ grapes. Chemical analysis showed that composition among wines did not differ so much for alcohol degree or dry extract (in general good for all wines), but for the acidic contents. It is well known that a good acidity concurs to the brightness of wine colour, on the contrary the CVT 415 wines were characterized by moderate acidity, high potassium concentration and high pH. These characteristics, in addition to the moderate content of phenols, determined an unsatisfactory wine colour. CVT 71 provided high quality products in both sites, with good alcohol degree, important phenols content and a balanced acidic profile; in the sensory assessments, they obtained the best score for descriptors such as ruby red colour, violet tint, fruity nose, degree of alcohol, body and taste length. Interesting enological results were also provided by CVT 185 when grown in Monforte: its wines were characterized by an intense ruby red colour with a bright violet tint (the 2008 wine resulted statistically preferred for colour in the ranking test), and rich bouquet (spicy in 2008 vintage; flowery and fruity in 2009, when the appreciation for smell resulted statistically significant). CVT CN 230, one of the most propagated clone of ‘Nebbiolo’ (it was registered in 1990), despite its heavy crop, provided wines of good quality in all sites, though characterized by lower colour intensity, lighter body and shorter taste length than CVT 71 wines and than the CVT 185 wines produced in Monforte. Tasters found in CVT CN 230 wines fine flowery-fruity bouquet, especially in 2008 vintage in Monforte (appreciated significantly in the ranking test for the smell).
Figure 2 (a-b). Ranking test on clonal wines of Nebbiolo produced in Lessona (a) and Monforte d’Alba (b) (2008-2009). The higher the histogram the less the wine appreciated (non significant range p>0.05).

4 CONCLUSIONS
This study indicated a strict interaction between clone and environment and that clonal aptitudes may have a different stability depending on different areas of cultivation. Some clones better preserve their own agronomic and qualitative expression regardless the environment (good environmental stability), others are much sensitive to this interaction (low environmental stability). A better knowledge about the clone stability could be very useful to grapegrowers when choosing propagation material at the moment of vineyard planting. In the present trial, CVT 71 provided in both localities high quality products with an excellent structure suitable for aging, as required for Nebbiolo wines. It showed a good environmental stability. Instead, CVT 185 wines emerged for colour, body and intensity of bouquet only in the hilly site with clayed and calcareous soil of Monforte d’Alba. In the flat vineyard with sandy-loamy and acid soil of Lessona, floral and fruity fragrances have marked the wines obtained from the grapes of clone CVT CN 230. The products of CVT 415 did not excel in any sites resulting always lighter in body and less intense coloured.
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REFERENCES