Ervi, the intraspecific Barbera x Croatina crossbreed: first growing and winemaking experiences in Lombardia (north-west of Italy)

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Abstract. Barbera and Croatina are the two most important grapevine varieties characterizing wines from several districts in North-West of Italy; they coexist on the hilly territories sited south of the Po river (historically known as “western-cispadana” area) where they are also blended together to obtain local wines such as Buttafuoco and Rosso Oltrepò Pavese in Lombardia, and Gutturnio in Emilia Romagna. Ervi is an intraspecific crossbreed between Barbera and Croatina performed in the 70s and selected over the last decades in order to improve some agronomical traits of both parents. The present study represents the first characterization of development, production and enological performance of the cv. Ervi in Lombardia and, more specifically, in the Oltrepò Pavese wine district. Long-term results related to a field-based assessment as well as the sensory profiling of wines produced at a micro scale are reported. When compared to Barbera and Croatina, Ervi shows improved productivity respect to Croatina and a better composition as compared to both its parents. Results recommend the introduction of the cv. Ervi in Lombardia for the production of high quality red wines.

1 Introduction

The controlled intraspecific hybridization between two cultivars and the following selection among the progeny is a method traditionally used to obtain new grapevine genotypes [1]. Aiming for the selection of new grapevine varieties for traditional red wine production, a breeding program by intraspecific crossing was set up in 1970 by combining cvs. Barbera (♀) and Croatina (♂) [2,3,4,5]. The selection was performed in the Piacenza area leading to the registration of a new cultivar named “Ervi” in 1999. In the early 2000s, Ervi was planted at the regional experimental station “Riccagioia” (Lombardia Administrative Region, Pavia Province, North-West of Italy) in order to study the adaptability of the new grapevine variety in Oltrepò Pavese, the biggest wine-producing area in Lombardia.

Several wine districts from North-West of Italy extend over the hills rising from the southern banks of the Po River to the Apennine Range, including the territories belonging to the provinces (from west to east) of Cuneo, Asti, Alessandria, Pavia and Piacenza. A large part of this area shares common origins as well as the most recent history. As a matter of fact, this zone was the northern part of the IX Roman Region (the ancient Liguria of the Imperial Rome) and, in the century preceding the Unification of Italy (from 1743, treaty of Worms to 1861), was part of the “Vecchio Piemonte” territory. Romans named lands sited on the southern banks of the Po River as Cispadana area. The westernmost part of this region can be referred to as “Cispadana Occidentalis”; in recent years (2010) [6] the area has become home to an important viticultural development (about 63,000 ha corresponding to almost 10% of the national acreage (Tab. 1 and Fig. 1). Barbera and Croatina represent the most important red varieties; the former is mostly concentrated in the western area whilst the latter is primarily grown in the easternmost side of the region.

Fig. 1. Barbera and Croatina are traditionally grown in the hilly areas between the southern banks of the Po River and the Apennine Range; from West to East in the Provinces of Cuneo=CN, Asti=AT, Alessandria=AL, Pavia=PV and Piacenza=PC.
Table 1. Comparison between the total area under vines and the Barbera and Croatina acreage in Italy and in the Western-Cispadana zone. Data 2010 from the 6th General Census of Agriculture [6].

| Region            | Total acreage (ha) | Barbera (ha) | Croatina (ha) |
|-------------------|--------------------|--------------|---------------|
| Italy             | 625,699            | 20,524       | 6,120         |
| Cuneo             | 16,065             | 2,238        | 16            |
| Asti              | 15,559             | 6,935        | 67            |
| Alessandria       | 12,328             | 4,299        | 82            |
| Pavia             | 13,193             | 2,284        | 3,851         |
| Piacenza          | 5,906              | 1,779        | 1,690         |
| Western Cispadana | 63,051             | 17,535       | 5,706         |

According to the 6th General Census of Agriculture (2010) [6], Barbera is grown over 20,524 ha representing the most widespread grapevine variety in the North-West of the country and ranking 6th at national scale; as a matter of fact, partitioning the Italian acreage per cultivar, Barbera is only surpassed by Sangiovese (71,628 ha), Montepulciano (34,824 ha), Catarratto (34,794 ha), Merlot (28,041 ha) and Trebbiano toscano (22,702 ha). Although the planted area is not as extensive as Barbera, Croatina is grown on approximately 6,100 ha, similar to plantings of other relevant national varieties such as Nebbiolo. In the Pavia Province and, more specifically in Oltrepò Pavese (Lombardia), Croatina is the main variety at the base of several local wines such as Bonarda dell’Oltrepò Pavese, the 8th most produced Italian red wine by volume [7]. When the survey was performed, Ervi vineyards were almost non-existent and the first plantings in Emilia Romagna Region were in 2008. Ervi is currently grown in the Piacenza Province where 20 ha are registered (data 2018).

Wines from Western Cispadana region produced with Barbera and Croatina meet two main styles: varietal wines (in which the wine designation corresponds to the cultivar’s name) and territorial wines (in which the wine designation corresponds to its geographical origin).

In Oltrepò Pavese (Pavia Province, PV, Lombardia) and Colli Piacentini (Piacenza Province, PC, Emilia Romagna), Barbera and Croatina are blended together also to produce high-quality red wines with Protected Designation of Origin. Depending on grape geographical origin, wines may be designated as Buttafuoco or Rossa Oltrepò Pavese (PV), Gattinoro Classico or Gattinoro dei Colli Piacentini (PC). Barbera and Croatina are used in comparable proportions in all of these regional wines. If Gattinoro can be made only by using these two main cultivars, the Buttafuoco also contains other local varieties such as Ughetta di Canneto and Uva rara.

Ervi was selected in Piacenza (Emilia Romagna) as part of a program aiming to renovate the local ampelographic platform by selecting new genotypes improving some negative traits of its parents [2]. Among the disadvantageous traits, high acidity level and poor anthocyanin accumulation of Barbera grapes, especially when from high vigour zones [8], as well as wine astringency and low basal-bud fruitfulness of Croatina [9] still represent the most critical issues of these traditional varieties. Ervi shows relatively constant yield and small berries, it ripens earlier than both its parents, and achieves higher soluble solids and total anthocyanin concentration than Barbera. The emergent interest on Ervi is also due to the optimal basal-bud fruitfulness and low berry detachment force (BDF) at harvest, enhancing its suitability to vineyard mechanization especially as it concerns spur pruning and mechanical harvesting [10].

The research aims to determine if the new crossbreed Ervi can represent a resource for the ampelographic platform of Oltrepò Pavese (Lombardia) where the Ervi’s parents are the most representative varieties for producing red wines (about 6,000 ha, Tab. 1). For the three varieties, plant yield and fruit composition will be assessed. A wine sensory profile of the three varieties will be presented. The results will support the application process required to include Ervi into the regional list of grape varieties allowed to be cultivated in Lombardia.

2 Material and methods

The experimental vineyard was planted in 2002 in Oltrepò Pavese wine district at the “Riccagioia” experimental station (Lombardia Administrative Region,) sited in Torrazza Coste (44°58'40"44 N, 09°54'56" E, 150 m asl). Barbera, Ervi and Croatina grafted onto SO4 rootstock are 1.1 m and 2.5 m spaced within and between the rows, respectively. Vines are long-cane (simple Guyot) pruned and trained to a vertical shoot positioning (VSP) trellis; 12-14 nodes per vine are kept at winter pruning. During the period 2008-2013, 15 vines per cultivar were tagged and the following variables were annually assessed: bud fruitfulness (number of clusters/node), cluster weight (g), total soluble solids (“Brix), titratable acidity (g/L, as tartaric acid equivalents); the grape concentration of anthocyanins and polyphenols was measured in 2011. At harvest, fruit from each cultivar was hand-picked and processed in stainless-steel micro-ferments (two replicates per cultivar with a maximum capacity of 80 L each) according to standard guidelines for red winemaking. Wines were then bottled and sensory analysis was carried out after six month the following spring; the paper reports results only from 2011.

The ampelographic characterisation of the three grapevine varieties was performed in 2011 according to the OIV descriptor list for grape varieties and Vitis species [11].

Field-based data were processed according to the two-way analysis of variance (ANOVA) by considering variety (V) and year (Y) as main sources of variability. In case the F test was significant, mean values were compared by the SNK test (Student Neuman Keuls) at p≤0.05. Data from sensory analysis were processed according to the Friedman test [12]. Within each descriptor, wine scores were compared by LSD at p=0.05.
3 Results

3.1 Ampelographic characterization

The varietal characterization based on leaf and fruit description is reported in table 2. When compared to Barbera and Croatina, Ervi showed shorter vein N1 (code OIV 601) and dissimilar teeth; the cluster was looser as compared to both its parents and smaller than Barbera. Single cluster weight generally showed “low values” according to OIV 502 notes; however, a deeper characterisation is reported in table 3. In effect, the OIV 502 considers clusters of about 500g as “medium” because determined as the mean value of the largest cluster of 10 shoots. In addition, the classification proposed by OIV is referred to all the grapevine varieties including wine grapes, table grapes and other Vitis spp. resulting in lower efficacy to discriminate the three cultivars considered as part of the present study.

Table 2. Ampelographic characterization of the three grapevine varieties based on OIV descriptors observed in 2011 at the experimental station “Riccaglia” (Torrazza Coste, Lombardia). Codes from OIV065 to OIV84 and OIV601 are referred to mature leaves.

| CodeNo | Barbera | Croatina | Ervi |
|--------|---------|----------|------|
| OIV 155 -Shoot: fertility of basal buds (buds 1-3) | medium | very low | medium |
| OIV 065 – size of blade | medium | medium | medium |
| OIV 067 – shape of blade | pentagonal | pentagonal and elongated | Pentagonal and short |
| OIV 068 – number of lobes | five | five and three, cup shape | five |
| OIV 069 -colour of the upper side of blade | dark green | Medium dark green | medium green |
| OIV 077 - size of teeth in relation to blade size | large | small | small |
| OIV 078 – length-width comparison of teeth | medium | alternate short and medium | short |
| OIV 079 – opening of petiole sinus | closed and overlapped | open | open (little) |
| OIV 080 – shape of the base of petiole sinus | U shaped | V shaped | V shaped |
| OIV 084 - density of hairs on lower side blade | high | medium | medium |
| OIV 202 – Bunch length (peduncle excluded) | medium | long | medium |
| OIV 204 - Bunch: density | dense | medium | loose-medium |

| Bunch: shape | cylindrical | conical | conical |
|---------------|--------------|---------|---------|
| Berry size    | medium-big (~2.2g) | medium-small (~2.0g) | medium-small (~2.0g) |
| OIV 223 - Berry shape | Ellipsoid | globose | globose |
| OIV 601 – length of vein N1 | Medium | medium | short |

3.2 Yield and fruit composition

Yield per vine significantly differed among the three genotypes (Tab. 3). With highest shoot fruitfulness (1.46) and heaviest clusters (298 g), Barbera was the most productive variety with a yield corresponding to 4.4 kg/vine. When compared to Barbera, Ervi presented similar shoot fruitfulness (1.41 vs 1.46), smaller clusters (218g vs 298 g) and berries (1.65 g vs 2.17 g). Contrariwise, cluster and berry mass were similar to Croatina. As a consequence of relationships among the above mentioned yield components, yield per vine in Ervi was 3.47 kg -- 37% higher than Croatina, and 28% lower than Barbera. The TSS concentration in must was lower in Barbera (21.8 °Brix) than Ervi and Croatina which both exceeded the threshold of 24 °Brix. All the varieties were different as a function of titratable acidity. The highest of which being Barbera (10.05 g/L), followed by Ervi (7.58 g/L) and Croatina (5.78 g/L). The must concentration of tartaric and malic acids varied according to variations in titratable acidity and three statistically significant separate groups were identified (Tab. 5).

In more detail, Barbera presented the highest tartrate and malic concentrations (7.81 vs 3.98 g/L, respectively) followed by Ervi (6.88 vs 2.92 g/L), and Croatina (5.75 vs 1.99 g/L). Despite the intermediate development of organic acids, Ervi showed the highest anthocyanin concentration in grapes (1.79 mg/g) followed by Croatina and Barbera. Ervi’s attitude to accumulate pigments in fruit is also demonstrated when compared to its parents being 60% and 143% higher than Croatina.
and Barbera, respectively. Total phenolics were also significantly higher in Ervi and Croatina (2.54 mg/g) than Barbera (1.05 mg/g).

**Table 4.** Variation of technological maturity parameters as a function of grapevine variety. (Data 2008-2013). Mean values and F test, ns = not significant; * and ** = significant per p≤0.05 and p≤0.01, respectively. Within each column, values with different letters are significantly different at SNK test (p<0.05).

| Cvs and sources of variation | °Brix  | Titratable acidity (g/L) | pH |
|------------------------------|--------|---------------------------|----|
| Croatina                     | 24.23 b| 5.78 a                    | 3.36 b|
| Ervi                         | 24.94 b| 7.58 b                    | 3.38 b|
| Barbera                      | 21.80 a| 10.05 c                   | 3.05 a|

**Table 5.** Variation of tartrate, malate (2008-2013), total anthocyanins (Anth.) and Phenols (2011) concentration as a function of grapevine variety. (Data 2008-2013). Mean values and F test, ns = not significant; * and ** = significant per p≤0.05 and p≤0.01, respectively. Within each column, values with different letters are significantly different at SNK test (p<0.05).

| Cvs and sources of variation | Tartrate (g/L) | Malate (g/L) | Anth. (g/L) | Phenols (g/L) |
|------------------------------|----------------|--------------|-------------|---------------|
| Croatina                     | 5.75 a         | 1.99 a       | 1.11b       | 2.54b         |
| Ervi                         | 6.88 b         | 2.92 b       | 1.79c       | 2.54b         |
| Barbera                      | 7.81 c         | 3.98 c       | 0.73a       | 1.05a         |

**3.3 Wine sensory analysis**

The sensory profile of Barbera, Croatina and Ervi wines is showed in table 6. All the varietal wines are described by intense red colour with deep purple hues, fruit smell dominant on spicy and floral notes and very light herbaceous and vegetative hints. However, experimental wines from 2011 when tasted the following spring showed significant differences in some important sensory descriptors such as colour intensity, floral and fruity aromas and taste. More precisely, the colour intensity in Ervi wine was similar to Croatina and deeper than Barbera. Intensity of dark fruit aromas (cherry and blackberry) as well as hints of violet and plum were higher in Ervi and Croatina as compared to Barbera wines. Ervi and Croatina were similar also in terms of wine taste (higher body and lower acidity respect to Barbera) and retro-olfaction perception with longer persistence and higher fruity hints as compared to Barbera. However, moderate astringency and distinctive spicy retro-olfaction perception allowed tasters to distinguish Ervi from Croatina. Furthermore, Croatina ranked first regarding the olfaction agreeableness (Fig. 2) whilst both Ervi and Croatina registered the higher scores as based on global agreeableness (Fig. 3).

According to these results, Ervi wines show a distinctive aromatic profile that is compatible and complementary with Barbera and Croatina. As a matter of fact, Ervi introduces distinctive taste by smoothing and balancing the main enological issues associated to its parents; more specifically, the astringency related to low-weight flavanols in Croatina, and the distinctive acidity in Barbera. Ervi wines show lower astringency than Croatina and moderate acidity when compared to Barbera. This set of characteristics allows considering Ervi as a possible solution to the oenological improvement of traditional wines produced by blending cvs. Croatina and Barbera in north-west of Italy.

![Fig. 2. Olfaction agreeableness of Barbera (BA), Croatina (CRO) and Ervi wines produced in 2011. Wine scores are compared by LSD at p=0.05.](https://doi.org/10.1051/bioconf/20191302009)

![Fig. 3. Global agreeableness of Barbera (BA), Croatina (CRO) and Ervi wines produced in 2011. Wine scores are compared by LSD at p=0.05.](https://doi.org/10.1051/bioconf/20191302009)
vine is very low in depending on bud-fertility, the number of clusters per Barbera (Lombardia 4 Conclusions to basal nodes), while the must acidity of Lombardia very high sugar concentration. The main clones tested in frequently too high even in case of optimal ripening and traditional territorial wines, the new crossbreed productivity and to preserve the typical style of most wine quality. For these reasons, in order to maintain the not seem a solution for improving vine productivity and establishing new vineyards show the same issues and do

** = significant per p<0.05 and p<0.01, respectively. Within each row, values followed by different letters are significantly different p=0.05. ro = retronasal olfaction.

| Descriptors                      | T   | s    | Ervi | CRO | BA  |
|---------------------------------|-----|------|------|-----|-----|
| Colour intensity                | 7.773 | *    | 8.88 b | 8.25 b | 6.50 a |
| Purple hues                     | 0.776 | ns   | 6.50  | 6.63  | 6.25  |
| Smell intensity                 | 1.720 | ns   | 6.00  | 6.38  | 4.88  |
| Smell complexity                | 7.362 | *    | 3.62 b | 4.00 b | 2.25 a |
| Floral                          | 6.810 | *    | 3.00 b | 3.25 b | 1.75 a |
| Violet                          | 1.428 | ns   | 1.75  | 2.50  | 1.63  |
| Rose                            | 1.928 | ns   | 1.00  | 1.25  | 1.75  |
| Red fruits                      | 10.867 | *    | 4.00 b | 4.75 b | 2.87 a |
| Plum                            | 0.241 | ns   | 2.88  | 3.25  | 2.88  |
| Cherry                          | 6.501 | *    | 3.62 b | 4.62 b | 2.87 a |
| Blackberry                      | 6.918 | *    | 3.37 b | 3.12 b | 1.75 a |
| Jammy                           | 1.546 | ns   | 2.63  | 3.13  | 3.00  |
| Spicy                           | 0.414 | ns   | 2.63  | 2.75  | 2.75  |
| Vanilla                         | 0.344 | ns   | 1.88  | 1.50  | 1.50  |
| Cinnamon                        | 2.017 | ns   | 1.00  | 1.00  | 1.25  |
| Dried fruit                     | 0.930 | ns   | 1.50  | 1.50  | 2.38  |
| Herbaceous or vegetative        | 1.144 | ns   | 1.88  | 1.75  | 1.88  |
| Body                            | 8.188 | **   | 6.75 b | 6.87 b | 6.25 a |
| Acidity                         | 2.742 | *    | 5.87 a | 5.28 a | 6.75 b |
| Astringency                     | 2.759 | *    | 3.25 a | 4.5 b  | 3.25 a |
| Bitterness                      | 0.907 | ns   | 2.25  | 2.50  | 2.13  |
| Sweetness                       | 0.211 | ns   | 1.75  | 1.75  | 1.88  |
| Taste balance                   | 1.870 | ns   | 5.50  | 5.63  | 5.50  |
| Persistence                     | 3.802 | *    | 6.37 b | 6.25 b | 5.62 a |
| Floral (ro)                     | 1.786 | ns   | 2.88  | 2.75  | 2.88  |
| Fruity (ro)                     | 5.307 | *    | 4.25 b | 4.00ab | 3.12 b |
| Spicy (ro)                      | 3.887 | *    | 3.37 b | 2.75 a | 2.25 a |
| Vegetative (ro)                 | 1.440 | ns   | 1.75  | 1.25  | 1.25  |

4 Conclusions

The current experiment has confirmed some negative traits affecting Croatia's yield components as well as Barbera's fruit and wine composition. In effect, depending on bud-fertility, the number of clusters per vine is very low in Croatia (especially when referring to basal nodes), while the must acidity of Barbera is frequently too high even in case of optimal ripening and very high sugar concentration. The main clones tested in Lombardia [13] that are currently available for establishing new vineyards show the same issues and do not seem a solution for improving vine productivity and wine quality. For these reasons, in order to maintain the productivity and to preserve the typical style of most traditional territorial wines, the new crossbreed Ervi (Barbera x Croatia) was tested for the first time in Lombardia (Oltrepò Pavese wine district).

Results collected over a 6-year period show that agronomical and enological performance of Ervi are most frequently better than parental varieties; its bud fertility (1.41 clusters/vine) was significantly higher than Croatia (0.79) and similar to Barbera (1.46); the titratable acidity of Ervi (7.58 g/L, tartaric acid equivalent) was lower than Barbera (10.05 g/L), and higher than Croatia (5.78 g/L). In addition, Ervi shows a more balanced acid profile, with lower malate than Barbera. In conclusion, Ervi is a good candidate to foster innovation of the ampelographic platform in Lombardia.

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