

The relevance of grapevine varietal diversity for the adaptation of organic viticulture to climate change

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Abstract

Autochthonous varieties are often the best-adapted genotypes to their local environments. In viticulture, this makes local cultivars particularly suitable for organic systems and enables growers to produce wines with a strong identity linked to local traditions and regional character. However, PDO and PGI appellations (DOC, DOCG, and IGT in Italy) were defined based on the most suitable varieties identified in the second half of the 20th century, under environmental conditions that differ substantially from today's.

Within the framework of the ValorInVitis and SaViBio projects, 28 underrepresented local grapevine cultivars were evaluated over six years (2017–2022) in the Colli Piacentini area. The locally widespread grape varieties Ortrugo (white) and Barbera (red) were used for control purposes i.e. sensory and wine chemical comparison.

Among the genotypes assessed, Barbesino emerged as the variety maintaining the highest grape titratable acidity, a key trait for white and sparkling wine production, and therefore may have compensatory potential for Ortrugo, which is prone to comparatively strong malic acid degradation at elevated average temperatures. Molinelli was identified as one of the least susceptible to bunch rot, thanks to its loose cluster architecture and thick berry skin. Duraguzza stood out among red cultivars for its high anthocyanin concentration and skin thickness, conferring tolerance to both sunburn and bunch rot. Ervi showed the most promising enological profile among the red varieties, due to high phenolics and sugars accumulation. Malvasia Rosa displayed the rare combination of a pink berry color and geraniol-based aromatic terpenes. Lisöra exhibited early ripening and good tolerance to downy and powdery mildew, making it particularly suitable for cooler, upland areas.

Currently, local growers are considering including Ervi in the Gutturnio DOC red wine appellation, while Barbesino and Malvasia Rosa are already cultivated more widely. In collaboration with growers' associations, the process for the registration of Molinelli and Lisöra in the national and regional lists of cultivable varieties is ongoing.

Keywords: Viticulture, autochthonous varieties, ripening, biodiversity, pathogen tolerance, global warming.

Introduction

In Italy, criteria of grapevine cultivar selection for local appellations (DOC/DOCG) date back to the second half of the 20th century. As a result, the most common varieties suffer the current climate change adversities, and are significantly susceptible to grapes sunburn, organic acids depletion, and drought in general, resulting in low yield and poor fruit quality, especially in organic production (Antolin et al. 2020).

In north-western Emilia, like in most of the Italian wine districts, in addition to the grapes currently being cultivated, a large number of old, historical, and rare varieties were grown. The characters for which these varieties were formerly marginalized are often the same for which today they represent an opportunity for the local industries to seek new vineyard adaptation and wine valorisation strategies. Late ripening and thick skin to avoid sunburn and rot, high grape titratable acidity, vigour and good yield are some examples of such traits (Frioni et al. 2018).

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In this work, the activity of the EIP-AGRI ValorInVitis and SaViBio is presented as a case-study for the preservation and reintroduction of local minor varieties in the current climate context.

Materials and methods

28 underrepresented autochthonous varietals of the Colli Piacentini wine districts were evaluated vs the two local references Ortrugo and Barbera. Yield, fruit composition and enological traits were monitored during ripening in order to determine the varieties less susceptible to climate change pressures.

Results and discussion

Ortrugo produced 2.37 kg/vine, with an average of 10 bunches per vine and a bunch weight of 233 g. The genotypes having higher productive performances than Ortrugo were Verdea (3.37 kg/vine), Bianchetta di Diolo 3.97 kg/vine) and Bervedino (3.54 kg/ vine). No difference in yield was found between Ortrugo, Molinelli, Barbesino, Colombina, Sticiucaera bianca and Malvasia rosa. The productivity of Bianchetta di Bacedasco (3.19 kg/vine), Marsanne (locally known as Sciampagnino, 2.94 kg/vine) and Calōra (2.94 kg/vine) was not statistically different from either Bianchetta di Diolo, the highest producing genotype, or Ortrugo.

Useful information arises from the analysis of the relationship between total soluble solids (TSS) and titratable acidity (TA) across the progression of ripening. The correlations were described by an exponential decay function, with consistent R^2 values (0.97 to 0.99). Three genotypes, Barbesino, Molinelli and Bucalò showed very consistent ratios during the whole process, if compared to Ortrugo (Fig. 1). All the three cultivars had a similar ratio between sugars and acidity, with consistently higher TA values than Ortrugo, independently of the TSS content. In detail, Barbesino, Molinelli and Bucalò had a TA about 10 to 15 g/L higher than Ortrugo for TSS between 5° and 10° Brix. This difference was reduced to ~5 g/L for TSS between 20° and 25° Brix, but still consistent and evident, as confirmed by harvest parameters.

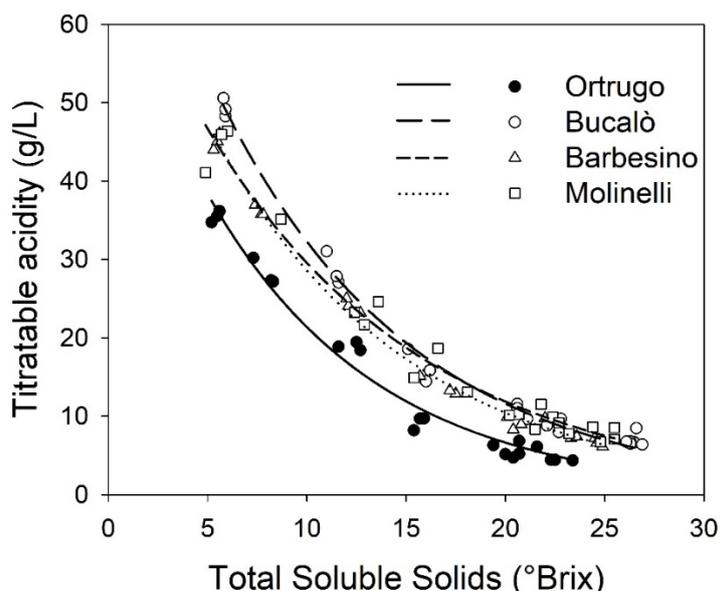


Figure 1: Correlation between juice total soluble solids and titratable acidity during ripening for vines cvs. 'Ortrugo', 'Bucalò', 'Barbesino', and 'Molinelli' cultivated in Albareto (Ziano Piacentino, PC) in 2017.

Molinelli proved to be among the least susceptible cultivars to bunch rot, a trait largely attributable to its loose cluster structure and thick berry skin. Duraguzza distinguished itself among the red varieties due to its elevated anthocyanin content and substantial skin thickness, traits that enhance tolerance to both sunburn and bunch rot. Ervi emerged as the red cultivar with the most balanced overall enological profile. Malvasia Rosa was notable for the uncommon combination of pink-colored berries and geraniol-rich aromatic terpenes. Lisöra, characterized by early ripening and solid tolerance to both downy and powdery mildew, appears particularly well suited to cooler, upland environments.

Conclusions

This work illustrates how grapevine intra-specific diversity can support the adaptation of viticulture and agricultural production to changing environmental conditions. Underrepresented grapevine varieties often possess valuable adaptive traits and can therefore serve both as direct tools for enhancing the resilience of rural communities and as genetic reservoirs for future breeding programs.

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