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Sustainable use of genetic resources: the characterization of an Italian local grapevine variety (‚Grechetto rosso') and its own landscape

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Summary

Biodiversity and landscape are two tightly liked environmental traits, so that the loss in traditional agricultural landscapes imply the erosion of precious local germplasm. The on-farm conservation of local cultivars assure the preservation of optimized environment-genotype interactions, unique multifunctional agro-ecosystems and landscapes. Therefore, the safeguard of endangered genetic resources has to consider genotyping, phenotyping, but also the characterization of the related landscapes. The objective of this study was to provide the characterization of a local Italian grapevine, *i.e.* 'Grechetto rosso' through an integrated approach based on conventional ampelographic and molecular determinations and on the characterization of the landscape in the innate environment. 'Grechetto rosso' has affinity with 'Sangiovese', of which keeps the main ampelographic characters. Nonetheless, its diversity is prevalently expressed in berry characters, like the occasional presence of a not uniformly pigmented pulp, week epicuticular waxes and a red-coloured skin. This berry characters appeared to be related to the micro-environmental variables, *i.e.* the occurrence of cold-temperate nights during the ripening period and a rather temperate climate of the innate area. The 'Grechetto rosso' wine-grape-growing area is characterized by high naturality, and the 47 % of the 'Grechetto rosso' vineyards are still mixed with olive groves (traditional arrangement), while the remaining surface is represented by either specialized (46 %) or neglect (residual/relict) (7 %) vineyards. 'Grechetto Rosso' vineyards are distributed even in steep and extremely steep slope areas. The resulting description represents an example of useful information for promoting a sustainable use of grapevine genetic resources based on the in situ conservation on farm.

K e y w o r d s : agro-biodiversity*; in situ* conservation; traditional agricultural landscape; *Vitis vinifera*.

Introduction

Among the cultivated species of the Mediterranean area, grapevine (*Vitis vinifera* L.) is one of the most subjected to erosion phenomena at different levels, *i.e.* surfaces, genetic resources, vineyard agroecosystem complexity. The *in situ* conservation may represent a strategic tool for safeguarding unique germplasm, viticultural surfaces, environments of high ecological meaning. In fact, on-farm conservation of local genetic resources ensure the retention of the evolution and adaptation processes of crops to their innate environments (Jarvis *et al.* 2000) and implies sustainable production because environmentally adapted crops have low dependency on outside-farm inputs (Altieri and Merrick 1987) and better adapt to climate change. In many sensible area subjected to multiple environmental risk factors, the *in situ* preservation of local genetic resources beside counteracting land consumption assure the maintenance of multifunctional agricultural landscapes (Biasi *et al.* 2010a, Weibull *et al*. 2003). The goal of a sustainable agriculture as promoted by new Rural Development Programme (2014-2020) in accordance to the European 2020 Horizon objectives will also imply the safeguard of agro-biodiversity and landscape, and the reduction of habitat fragmentation or simplification. In the Latium region (central Italy) many local grapevine cultivars are endangered together with their own landscapes (Biasi *et al.* 2007). This study focuses on a local grapevine genotype, *i.e.* 'Grechetto rosso', and provides the characterization of its molecular and ampelographic traits together with the synthetic classification of the innate environment and aims the production of an example of cultivar classification for a sustainable use of genetic resources based on the respect of the vocationality principle.

Material and Methods

M o l e c u l a r c h a r a c t e r i z a t i o n : the genetic analysis was performed on a virus-free biotype of 'Grechetto rosso', a red grapevine variety listed in the Italian grapevine cultivar register, recently treated for clonal selection. Total DNA was extracted according to a modified Doyle and Doyle (1990) protocol. Varietal identity was established by analysing 14 microsatellite regions, including the nine recommended by the European project GENRES 081. PCR reactions and detection of amplified products were carried out according to Martinez *et al. (*2006). A 'Sangiovese' clone corresponding to the accession characterized in Bowers *et al*. (2000) was used as control. Cluster analysis (R package version 3.1.1) was performed among allele sizes of 'Grechetto rosso' and four 'Sangiovese' ac-

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cessions, respectively obtained from molecular analysis and available in different databases, in order to test reciprocal genetic distance.

Phenotyping: morphological and phenological data, according to OIV Grape Descriptor List, were recorded for five years on vines grown in an homologation and comparison vineyard sited in the area of origin (Gradoli, Viterbo-Italy).

Environmental and landscape characterization: through the GIS technology, cadastral maps and data, topographical data and aerial-photo interpretation were integrated in order to assessed the distribution of 'Grechetto rosso' vineyard patches in the typical cultivation area and to provide thematic maps of the physical environment. Local climate data of the last 10 years have been used for climate classification (Tonietto and Carbonneau 2004) of the studied area.

Results and Discussion

The biotype 'Grechetto rosso' presented the following molecular profile based on the below-listed microsatellite markers: VVS2 130-130; VVS5 91-147; VVMD7 239-263; VVMD5 223-233; VVMD25 241-241, VVMD27 176-182; VMD28 231-237,VVMD32 257-253; VrZAG62 193-195; VrZAG79 242-258; ISV2 143-151; ISV3 133-139, ISV4 169-177, EVA2 158-162.

The cluster analysis has demonstrated the affinity of 'Grechetto rosso' with 'Sangiovese', being its genetic profile similar, although different, from those available for 'Sangiovese' (Fig. 1). 'Sangiovese' is known to be characterized by great genetic and morphological intra-cultivar heterogeneity, and suspected of polyclonal genetic origin (Di Vecchi Staraz *et al.* 2007). That would explain the differences between the 'Sangionvese' and the tested 'Grechetto rosso' biotype, that keeps the main ampelographic and phenological characters of the former (Fig. 2, right).

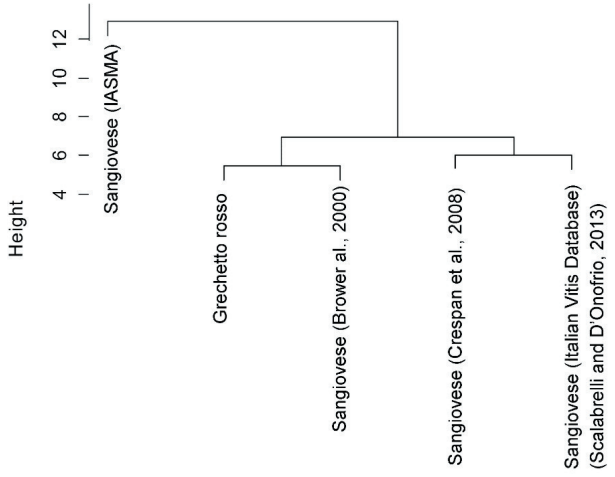

Fig. 1: Dendrogram generated by cluster analysis of molecular profiles of 'Grechetto rosso' and some accession of 'Sangiovese'.

Traits of distinction are represented by some berry characters, like the occasional presence of a not uniformly pigmented pulp, week epicuticular waxes and a red-coloured skin. This berry characters appeared to be related to the micro-environmental variables, like the occurrence of cold-temperate nights and a rather temperate climate of the innate area (Fig. 2, left). According to the data of the Italian viticultural cadastre (2012), nearly 90 % of the 'Grechetto rosso' vineyards (37.5 ha slightly increasing) are located in the sole Gradoli territory (Bolsena lake basin, Viterbo, Italy), which represents 40 % of the whole vineyards (6.8 % of Utilised Agricultural Area). This area is characterized by agro-ecosystems strictly integrated with natural and semi-natural habitats or remnants (hedges, tree rows, scrubs and woodlands). In particular, agro-ecosystems and natural ecosystems represent the 50 % and the 41 % of total land area respectively. Approximately 47 % of the 'Grechetto rosso' vineyards are still mixed with olive groves (traditional arrangement), while the remaining surface is represented by either specialized (46 %) or neglected (residual/relict vineyards) (7 %) vineyards. Two traditional sub-areas have been identified for the distribution of 'Grechetto rosso', *i.e.* the localities S. Antonio-La Fratta (northern area) and Monte Maggiore-Pian del Rosso- (southern area) (Fig. 2). The 50 % of the vineyards are distributed between 350 and 450 m.a.s.l., the recommended altitude in the technical disciplinary of 'Colli Etruschi Viterbesi' PDO (Protected Denomination of Origin), that admit 'Grechetto Rosso' vinification. Two-thirds of vineyards have East-West exposure, that ensure optimal sunlight distribution. Moreover, both traditional and specialized 'Grechetto Rosso' vineyards proved to be distributed even in steep (specialized) and extremely steep (traditional) slope areas, where preservation of the environmental soil erosion is highly requested. The 'Grechetto rosso' wine-grape-growing area has been classified as warm-temperate with a thermal regime, and, particularly in the grape-ripening period, with cold-temperate nights.

Conclusions

Autochthonous grapevine germplasm characterization is essential for preventing genetic resources erosion as well as the loss of local oenological products tightly linked to the territory tradition. Nonetheless, beside conventional molecular and ampelographic analysis, information of the innate environment is also necessary in order to evaluate growth conditions that optimize the relationship environment-genotype. Furthermore, the knowledge of the spatial distribution of the local biodiversity within the innate territory can provide information both on the erosion risk grade, that is inversely related to diffusion area wideness, and on the importance of the on-farm conservation when local germplasm-based vineyard abandonment would result in landscape loss and land degradation. The paper provides a proposal of adopting integrated criteria for local varieties evaluation and valorisation.

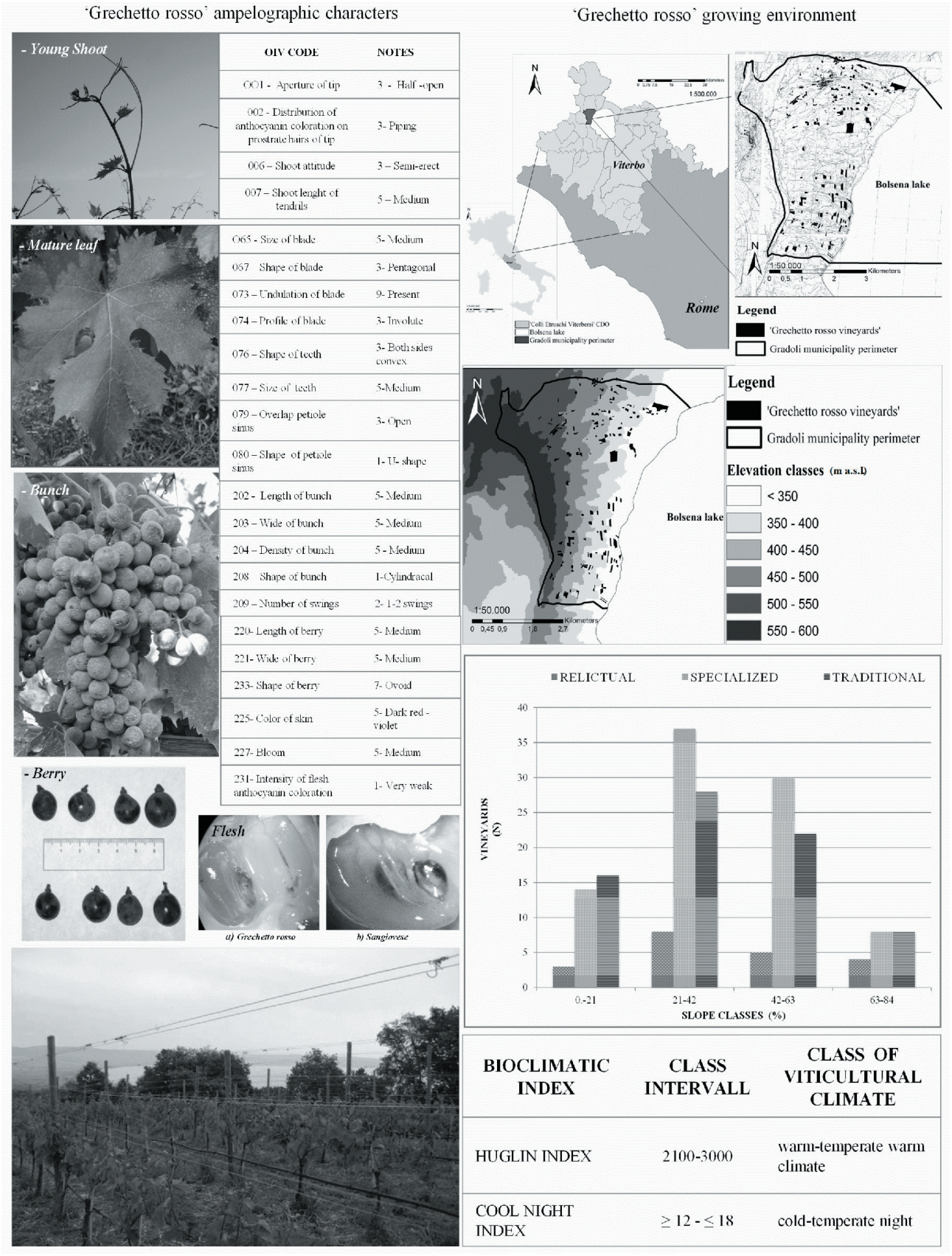

Fig. 2: Ampelographic and amplelometric characters (right), distribution of 'Grechetto rosso' vineyard patches (left) in the native growing area, and environmental classification.

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