UDC: 634.8

ECOLOGY OF THE EURASIAN WILD GRAPEVINE IN THE SOUTHERN CAUCASUS

Rafael Ocete[1], David Maghradze[2,3], Gagik Malyan[4], Vugar Salimov[5], Ramaz Chipashvili[6], Carlos Alvar Ocete[1] and Osvaldo Failla[7]

[1]Laboratory of Applied Entomology. University of Seville, Spain.
[2]Scientific – Research Center of Agriculture, Tbilisi, Georgia.
[3]National Wine Agency of Georgia, Tbilisi, Georgia.
[4]Armenian Academy of Viticulture and Wine-making, Yerevan, Armenia.
[5]Institute of Viticulture and Winemaking, Baku, Azerbaijan.
[6]Institute of Viticulture and Oenology, Agricultural University of Georgia, Tbilisi, Georgia.
[7]University of Milan, Milano, Italy.

ABSTRACT

The Eurasian wild grapevine, *Vitis vinifera* subsp. *sylvestris* (Gmelin) Hegi, from the South Caucasus region played a significant role in the domestication of grapevine. Due to this fact a holistic prospection on wild grapevine populations was carried out in several zones of this, including the countries of Georgia, Armenia and Azerbaijan. Results show the different types of natural habitats, ampelographic differences between male and female individuals and the main species of the accompanying vegetation. On the other hand, they show the presence of infestation caused by eriophyid mites and infection caused by the North American fungi, powdery and downy mildews. The presence of invasive *Vitaceae* from North American origin, escaped from cultivation, as Isabella and rootstocks, is also indicated. It is concluded, that a legal figure of preservation for wild grapevine, the parental of cultivars, which constitutes one of the most important natural legacy in Southern Caucasus, should be promulgated by competent authorities in each country.

Key words: accompanying vegetation, habitats, legal figure of preservation, sanitary status, *Vitis vinifera* subsp. *sylvestris* (Gmelin) Hegi

INTRODUCTION

In Eurasia the only actual native grapevine is *Vitis vinifera* subsp. *sylvestris* (Gmelin) Hegi. Their populations are disseminated in natural ecosystems between the Iberian Peninsula and the Hindu Kush mountain range (Arnold, 2002). Some populations are also conserved in Norhthen Africa (Maghreb). An approximation of the latitude range could be limited by the parallels 49° (Rhine river, Germany) and 30° (Ourika river, Morocco) of the North Hemisphere (Ocete *et al.*, 2007).

These wild exemplars are dioecious and heliophillous woody lianae which climb by tendrils on some ~~botanical species,~~ trees and bushes from the accompanying vegetation, in order to get an adequate intensity of light (Ocete *et al.*, 2007). They constitute the ancestor of cultivars, which are mainly hermaphrodites and belong to the taxon *Vitis vinifera* L. subsp. *sativa* (D.C.).

The South Caucasian region, situated between the Black and Caspian seas, was an important refugee for several botanical species in the different ice ages (Gunz, Mindel, Riss and Würm) along the *Pleistocene* (Ramishvili, 2001). However, several parental of fruit producers, including grapevine, used in the wild and cultivated later by man were present in those survivor phytoassociations refugees by the High Caucasian mountain range (Huglin and Schneider, 1986). This geographical area actually belongs to Georgia, Armenia and Azerbaijan ~~and Turkey,~~ where the presence of fossils of grapevine is registered from the Miocene (Negrul, 1938). It constitutes the territory with the highest Eurasian grapevine diversity of wild exemplars

and also cultivars (Vavilov, 1926). They exhibited, mainly, the chlorotypes C and D, meanwhile in Western Europe the A is the most frequent Arroyo García *et al.* (2006). The study carried out on plastidial DNA by Pipia *et al*. (2012) confirms the relevance of the Caucasus wild populations in the process of domestication of grapevine.

It is interesting to remark that in natural wild populations could appear mutations affecting male vines which can originate hermaphrodite individuals with self-fartilization (Picq *et al*. 2014). These vines were selected by man, due to higher production of berries to establish by plantation of selected canes the first vineyards outside river-bank forests (Forni, 2006, This *et al.* 2006).

There are morphological differences between seeds from cultivars and wild grapes. At present tridimensional scanner procedures can be used to discriminate both kinds of pips (Terral *et al*., 2010). So it is possible to determinate if a sample of them found in archaeological sites belongs to whichever of the both cited groups. According to the actual information available, the first cultivated seeds were found in the excavations of the archaeological site of "*Shulaveri Gora*" in the South part of Georgia. In this place fragments of vessels with chemical ~~rests~~ residue of must or wine were also collected. Their antiquity is about 8.000 years B.P. (McGovern, 1999, Chilashvili, 2004). Based on this facts and on other numerous archaeological, historic and botanical evidences and the cited high biodiversity of grapevine turn the South Caucasus into the oldest Cradle of the Viticulture and Winemaking (McGovern, 2003, 2004).

At present, the Eurasian wild grapevine is considered a threatened phytogenetic resource due to diverse anthropocentric actions (Arnold, 2002). On the other hand, the importation of fungal diseases from North America, such as downy and powdery mildews, played a very important role to reduce population levels. Furthermore, after *Phylloxera* infestation, there was a massive incorporation of North American *Vitis* species in Eurasian vineyards. They were used as root-stocks, and also to produce grape fruit in the case of direct producer hybrids (French-American hybrids). Both kinds of plants escaped from cultivation showed a heavy invasive character as feral plants in wild habitats, highly competitive for the autochthonous wild grapevine (Ocete *et al*., 2007).

According to the above paragraphs, an expedition to know the ecology of wild grapevine in the South Caucasian region, mainly habitats, parasitic species and accompanying vegetation, was carried out inside the research program of the COST Action FA1003 on 'East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding'. The present article constitutes a resume on the results of that prospective activity.

MATERIAL AND METHODS

A prospecting of the main ampelograpic descriptors of the vines, natural habitats, pest, diseases and accompanying vegetation of the Eurasian wild grapevine, was carried out on 13 natural populations from three country of the South Caucasus Armenia, Azerbaijan and Georgia in 2013.

To carry out the study of ampelographical descriptors and symptoms caused by pests and diseases aerial organs were observed up to 3 m of high. Roots were observed up to a maximum depth of about 40 cm. The main species of the accompanying vegetation was determined with usage of botanical keys. On the other hand, there has been a special effort in the identification of exotic invasive *Vitaceae* from North American origin.

RESULT AND DISCUSSION

Habitats

The studied populations were situated along river bank forests, floodplains and colluvial positions. Data on the regional distribution, coordinates, type of habitat of each population are compiled in Table 1.

List of populations prospected in Southern Caucasus region

Table 1.

Site name	District	River	Interval of latitude N	Interval of longitude E	Alt.	P *
Georgia						
Nakhiduri	Marneuli	Ktsia	41º29′26″ - 41º29′13″	44º40′ 51″ - 44º41′22″	445	C
Tsitsamuri	Mtskheta	Aragvi	41º52′28″ - 41º52′38″	44º43′51″ - 44º43′ 57	469	C
Tedotsminda	Gori	Liakhvi	42º2′4″- 42º2′20″	44º3′19″- 44º3′42″	639	C
Gardabani	Gardabani	Mtkvari	41º22′10″- 41º22′19″	45º4′6,3″ - 45º4′37″	274	F
Skra	Gori	Mtkvari	41º59′11″ - 41º59′13″	44º2′47″ - 44º2′47″	609	C
Lagodekhi	Lagodekhi	Matmiskhevi	41º48′2″- 41º48′45″″	46º19′12 - 46º20′24″	501	A
Azerbaijan						
Guruchai-1	Quba	Guruchai	41º24′1″	41º26′37″	680	F
Guruchai-2	Quba	Guruchai	41º26′3″- 41º26′3″	48º33′ 41″ - 48º33′50″	404	F
Rostov road Qusarchai 1 & 2	Quba	Qusarchai	41º28′6″ - 41º28′9″	48º33′57″ - 48º33′59″	385	F
Dellekkend**	Quba	Guruchai	41º24′37″	48º35′13″	413	F
Ağbil**	Quba	Qusarchai	41º25′32″ - 41º25′35″	48º33′54″ - 48º34′4″	415	F
Armenia						
Akhtala	Akhtala	Debed	41º6′18,3″- 41º7′15,8″	44º42′23 - 44º45′16,3″	644	C
Getahovit	Tavoush	Getik	40º54′6″- 40º54′ 8,7″	45º7′5 – 45º7′ 9,6″	719	C

Alt. altitude . P* (Position): A: riverbank forest; C: colluvial position (slope of a hill); F: flood plain.

Main ampelographical characters

There is a great diversity of foliage in size and contour. Male plants generally have smaller and more divided leaves than female ones, as occurs in Western European relict populations (Ocete et al., 2007). On the other hand, there is a great variety of sizes of the petiolar sinus, which, in general, tends to oscillate between open (female individuals) and very open (male ones). Bunches show always red berries with subspherical shape.

Symptoms caused by phytophagous and pathogen agents

Any symptoms caused by the American phylloxera (*Daktulosphaira vitifoliae* (Fitch) (Homoptera, Phylloxeridae) have been detected on leaves and roots, as it happens in the European wild populations. Although the vines are sensitive to this root phase of the homopteran. It is due to the edaphic characteristics of the soil which are waterlogged several months each year. The insect was detected on cultivars from Southern Russia in 1863 (Negrul, 1952). A little bit later (1870) its symptoms were described in the Georgian province of Abkhazeti, near the town of Sokhumi. Between 1889 and 1891, this sanitary problem had spread to almost all the vineyards in Western Georgia. In the Eastern part of the country it was observed from 1893 in the province of Kartli. Between 1906 and 1910 the first root infestations were found in Kakheti (Kantaria and Ramishvili, 1983).

On leaves, symptoms caused by the mite of the erineum strain of *Colomerus vitis* (Pagenstecher) (Acari,

Eriophyidae) are very abundant in all the populations, affecting almost the totality of the vines. Less common are the symptoms of caused by *Calepitrimerus vitis* (Nalepa) (Acari, Eriophyidae).

The presence of symptoms caused by powdery mildew, *Erysiphe necator* (Schwein.) Burriel, known as *natsari* and downy mildew, *Plasmopara viticola* (Berlease and de Toni), called *tchraki*, appear in all populations, mainly on leaves and canes. They are not frequent on bunches. The presence of powdery mildew has been documented since the 1850s in the provinces of Guria and Samegrelo (Western Georgia). The mildew began to be sighted at the end of the s. XIX (Encyclopedia, 1986).

No symptoms caused by root-rot fungi and root knot nematodes were detected.

Botanical supporters

These vines take as supporters to several species of the accompanying vegetation, such as *Carpinus betulus, Cornus mas*, *Corylus avellana*, *Crataegus caucasica, Mespilus germanica, Paliurus spina-christi, Prunus divaricata, Punica granatum, Cydonia oblonga, Pyrus caucasica, Quercus iberica, Salix capreae* and *Ulmus minor*.

Invasive exotic vines

North American species, such as *Vitis rupestris*, *Vitis riparia*, *Vitis berlandieri* and also hybrids between European and American vines, as well as French-American direct producer hybrids, are frequents in several ditches and mounds with remains of native vegetation in Black sea surroundings, near Batumi, and also in several of the populations cited in this article. Observations indicate that Isabella variety is the most frequent. It is also the most widespread in the traditional vineyard of the archipelago of the Azores (Portugal) and several South American regions. Throughout Georgia, vines of this variety are often used as ornamental plants in gardens and houses, grape of which is used to make a wine for domestic use, due to its resistance to American parasites. In any case the cited vines should be controlled in wild areas.

Final conclusion

A legal figure of preservation for wild grapevine, the parental of cultivars, which constitutes one of the most important natural legacy in Southern Caucasus, should be promulgated by competent authorities in each country.

References

1. Arnold, C., 2002. Écologie de la vigne sauvage en Europe (*Vitis vinifera ssp. silvestris*). *Geobotánica helvetica*, 76.
2. Arroyo-García, R., Ruiz-García L., Bolling, L., Ocete, R., López, M.A., Arnold, C., Ergul, A., Söylemezo, G., Lu, H., Uzun, I., Cabello, F., Ibáñez, J., Aradhya, M.K., Atanassov, A., Atanassov, I., Balint, S., J.L. Cenis J.l., Costantini, l., Gorislavets, S., Grando, M.S., Klein, B.Y., Mc Govern, P.E., Merdinoglu, D. Pejic, I., Pelsy, F., Primikirios, N., Risovannaya, V, Roubelakis-Angelakis, K.A., Snoussi, H., Sotiri, P., Tamhankar, S., This, P., Troshin, L., Malpica, J.M., Lefort, F. & Martinez-Zapater, J.M. (2006). Multiple origins of cultivated grapevine (*Vitis vinifera* L. ssp. *sativa*) based on chloroplast DNA polymorphisms. *Molecular Ecology* 15 (12): 3707-14**.**
3. Chilashvili, L. 2004. The vine, Wine and Georgians. Authors of the idea. L. Gachechiladze, T. Kandelaki Tbilisi (In Georgian).
4. Encyclopedia, 1986. Encyclopedia of viticulture. Chisinau. In 3 volume (in Russian)
5. Forni, G., 2006. Dall'origine della viticoltura alla sua introduzione in Italia. En: La vite e l'uomo. II Ed. F. Del Zan, O. Failla & A. Scienza (eds.) Ersa, Gorizia.
6. Huglin, P., and Scheneider C., 1986. Biologie et écologie de la vigne. Tec and Doc. ed., Lavoisier, Paris, p. 220-227.
7. Kantaria V and Ramishvili M (1983) Viticulture. Tbilisi: 'Ganatleba' (In Georgian).
8. McGovern P.E., 1999. *Georgia as homeland of winemaking and viticulture*. in "National teasures of Georgia, ed. O.Z. Soltes. London: P. Wilson and Foundation for international Arts and Education. Pp. 58-59.

9. McGovern, P.E. 2003. Ancient Wine: The Search for the origins of Viniculture. Princeton University.
10. McGovern, P.E. 2004. Wine and Eurasian grape: Archaeological and chemical perspectives on their origins. *Actas do III simpósio da Associaçao International de História e Civilizaçao da Vinha e do Vinho*. Funchal, Madeira: 291-307.
11. Negrul, A.M., 1938. Evolution of cultivated forms of grapes. *Comptes Rendus (Doklady), Académie Sciences USSR*, **18** (8), 585-588.
12. Negrul A.M. 1952. Viticulture with basic ampelography and breeding. Moscow: 'Agricultural Literature'. 427p. (In Russian)
13. Ocete, R., Cantos, M., López, M.A., Gallardo, A., Pérez, M.A., Troncoso, A., Lara, M., Failla, O., Ferragut, F. J., Liñán, J. 2007. *Caracterización y conservación del recurso fitogenético vid silvestre en Andalucía*. Ed. Consejería de Medio Ambiente, Junta de Andalucía. Sevilla.
14. Picq S., Santoni S., Lacombe T., Latreille M., Weber A., Ardisson M., Ivorra S., Maghradze D., Arroyo-Garcia R., Chatelet P., This P., Terral J.-F., and Bacilieri R., 2014. A small XY chromosomal region explains sex determination in wild dioecious *V. vinifera* and the reversal to hermaphroditism in domesticated grapevines. *BMC Plant Biology*, **14** (1), p. 229
15. Pipia, I., Gogniashvili, M., Tabidze, V., Beridze, T., Gamkrelidze, M., Gotsiridze, V., Melyan, M., Usayev M., Salimov, V., Beck, J., Schaal, B. 2012. Plastid DNA sequence diversity in wild grapevine samples (*Vitis vinifera* subsp. *sylvestris*) from the Caucasus region. Vitis, 51(3), 119-124.
16. Ramishvili R., 2001. History of Georgian grape and wine. Tbilisi. 240p. (in Georgian).
17. Terral, J.F., Tabard, E., Bouby, l., Ivorra, S., Pastor, T., Figueiral, I.,Picq, S., Chevance, J.P., Jung, C., Fabre, L., Tardy, C., Compan, M., Bacilieri, R., Lacombe, T. y This, P. (2011). Evolution and history of grapevine (*Vitis vinifera*) under domestication: new morphometric perspectives to understand seed domestication syndrome and reveal origins of ancient European cultivars. *Ann Bot.* 2010 March; 105(3): 443–455.
18. This P., Lacombe T. and Thomas M.R., 2006. Historical origins and genetic diversity of wine grapes. *Trends in Genetics*, **22** s, 511-519.
19. Vavilov, N.I., 1926. Cemtry proiskhozhdenia kulturnikh rastenii (The centres of origin for cultivated plants). Trudi poprikladnoi botanike, genetike i selektsii (Proceedings of Applied Botany, Genetics and Breeding) 16: 133–137 (in Russian).