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Relic wild grapevines in Extremadura (Spain)

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Summary

Relic wild grapevine populations (*Vitis vinifera* L. subsp. *sylvestris* (C.C.Gmel.) Hegi), were surveyed in Extremadura region (Spain). Twenty-two populations were found along river bank forests in Badajoz and Cáceres provinces. The main ampelographical characteristics and phenology of vines and the incidence of parasites were evaluated. Supporting flora has been botanically characterized. Results confirmed the dioecious characteristic of this grapevine subspecies and showed that *Colomerus vitis* (Pagenstecher) (*Acari, Eriophyiidae*) mite and powdery and downy mildews are the main parasites affecting their populations.

K e y w o r d s : characterization; conservation; diseases; pests; phenology; *Vitis sylvestris*.

Introduction

The Eurasian wild-grapevine is a dioecious woody liana (only few hermaphrodites have been found in nature). Using tendrils, it is able to grow up to 30 meters to vegetate on the top of the canopy of botanical supporters (Clemente 1807). Wild grapevine (*Vitis vinifera* L. subsp. *sylvestris* (C.C.Gmel.) Hegi), was a widespread plant in the early 19th century. It grew in Central and Southern Europe, and extends between 50°-30° N from Portugal to the Hindu Kush (Arnold, 2002). Palaeolithic humans already used wild vine products such as food or wine (Rivera and Walker 1989), but also as colouring material (Ramón y Vidal 1902), medicine (Rivera *et al.* 2012), condiment (Ocete *et al.* 1999), timber (Álvarez 1825), firewood (Schmid 2004), ropes and fishing traps (Quer 1784) and rootstocks (Zimmermann 1958). Tartaric acid, derived from grapes, was also found in ceramics remains (Carreño 2005).

Nowadays, wild grapevine is endangered and it is considered at risk of extinction (Arnold *et al.* 1998, Walter and Gillett 1998). Wild grapevine populations continuously deplete since the 19th century. The main causes are considered to be: the introduction of fungal diseases (powdery and downy mildews), and the damage of their habitats by intensification of forestry, urbanization and river management (Arnold *et al.* 2005). Furthermore, escaped individuals of exotic *Vitis* species (*V. riparia* Michx., *V. rupestris* Scheele*, V. vulpina* L.*,* etc.), and their hybrids with European cultivars, replaced autochthonous wild grapevine in Eastern-Central Europe (Terpó 1969, 1974; Arrigo and Arnold 2007). In the Iberian Peninsula, *Parthenocissus quinquefolia* (L.) Planch, and several Chinese *Vitaceae* also replaced native vines (Laguna 2003, Ocete *et al.* 2007).

Wild grapevines still conserve a high genetic diversity, depending on the population size and the geographical area (Grassi *et al.* 2003). However habitat fragmentations reduce the ecological adaptive changes (Arnold *et al.* 2005; Grassi *et al.* 2006). Wild grapevine is a genetic resource. Some characters could be considered of interest for rootstocks or wine and table cultivars (Ocete *et al.* 2007).

Wild grapevines in Extremadura (SW Spain) have been already described in 1964 by Rivas-Goday. They were found along the river banks in the *Crataego-Prunetea floral* association. The aim of the present paper is to locate the remaining wild grapevine sites in Extremadura and to consider the extinction threats, in order to carry out *in situ* and *ex situ* germplasm conservation programs. Moreover ampelographical phenological and sanitary characteristics have been described.

Material and Methods

We surveyed riverbank forests in Extremadura (Cáceres and Badajoz) between 1993 and 2008. Wild grapevines were observed at blooming (May-June), veraison (August-September) and ripening time (October). Each population was geolocalized with GPS. Sites were regularly checked at 15 d intervals to approximate the phenological calendar. Ampelographical description followed the OIV (2007) instructions. Pollen was sampled brushing mature anthers, introduced in DPX (Fluka) and observed under optical microscope Olympus BX 61. The most common botanical supporters (trees and shrubs) were identified following Rivas Goday (1964). Symptoms caused by pests and diseases were observed in spring and summer on aerial organs: shoots, leaves and bunches (up to 3 m of height). Roots were unearthed up to 40-50 cm depth to observe subterranean phytophagous pests and pathogens. Samples of capillary roots were observed under binocular Olympus SZ11. On leaves, the degrees of infestation were evaluated according: 0: absence; 1: 1-5 %; 3: 6-10 %; 5: 11-20 %; 7: 21-30 %; 9: > 30 %.

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Results

Wild grapevine grows in gallery forests on fluvisols in a proportion of 3-5 male / 1 female individuals.

The approximate phenological calendar is (differences depend on latitude and altitude): Bud swelling, March 21 - April 23; Flowering time, May 23 - June 6; Veraison, July 21 - August 19; Berries ripe for harvest, September 30 - October 23; End of leaf fall: November 2 - November 18.

The incidence of phytophagous arthropods and diseases is shown in Tab. 1. No symptoms of infestation or infection attributable to phylloxera, nematodes or mycelium of rot causing fungi, were detected. Powdery mildew, *Uncinula necator* (Schweinitz) Burrill, had an irregular effect, but it was detected in all the sampled populations, on leaves, sarments and, sometimes, bunches. Symptoms caused by downy mildew, *Plasmopara viticola* (Berkeley and Curtis) Berlease and de Toni, were much more occasional: they were only detected in rainy years in leaves and, more rarely, bunches. The extent of damage, caused by both fungal species, varies from one vine to another within the same population. A list of the main supporting flora of wild grapevine populations is displayed in the Figure. The main ampelographical descriptors based on the analysis of the 22 populations studied are shown in Tab. 2.

Discussion

The main problem in surveying wild grape populations in Extremadura is reduced accessibility because of dangerous animals (toros bravos) and fences impeding access to the plots. Wild grapevines dioeicy was confirmed at blooming for each site. All female plants produced red berries. Male plants presented leaves remarkably smaller than those of female ones, the contrary of the observed

Table 1

List of the 22 populations with *Vitis vinifera* L. subspecies *sylvestris* (C.C.Gmel.) Hegi, in Extremadura (Spain). Codes: Pr. (Province). B. Badajoz. C. Cáceres. AL: Altitude m.a.s.l. (average)

Population code	Pr.	Place name	AL	Coordinates (longitude, latitude)	Main pest and diseases				
					Colomerus vitis	*Tetranychus urticae*	*Jacobiasca lybica*	*Uncinula necator*	*Plasmopara viticola*
Hervás/1	C	Ambroz river	730	5º52’25” W, 40º18’43” N	5-7	0	0	3	1
Hervás/2	C	La Higuera creek	554	5º55’00” W, 40º16’09” N	5-7	0	0	3	1
Hervás/3	C	Fuente Blanca creek	567	5º54’12” W, 40º16’33” N	5-7	0	0	3	1
La Granja/1	C	Garganta ancha creek	404	5º58’51” W, 40º13’19” N	5-7	0	0	3	1
La Granja/2	C	Near "Granja de Granadillo"	410	5º58’58” W, 40º14’9” N	5-7	0	0	2	3
Zarza de Granadilla/1	C	Garganta Madrigala creek	388	6º0’0” W, 40º12’37” N	5-7	0	0	2	3
Guadalupe/1	C	Guadalupejo river	362	5º10’04” W, 39º16’09” N	1	0	0	1	2
Robledillo de Gata/1	C	Robledillo de Gata	774	6º21’04” W, 40º41’04” N	1	0	0	1	1
Toril/1	C	Porquerizo creek	244	5º48’54” W, 39º53’57” N	1	0	0	1	0
Villareal de San Carlos/1	C	Villareal de San Carlos	421	6º18’06” W, 39º12’09” N	1	0	0	1	0
Fregenal de la Sierra/1	B	Alamo creek	565	6º38’15” W, 38º08’45” N	3	1	0	3	1
Fregenal de la Sierra/2	B	La Parrilla creek	576	6º37’58” W, 38º13’27” N / 6º38’02” W, 38º13’35” N	3	1	0	3	1
Jerez de los Caballeros/1	B	La Cabra creek	388	6º47’30” W, 38º14’20” N / 6º48’05” W, 38º15’00” N	3	1	1	3	1
Jerez de los caballeros/2	B	Ardila river	233	6º48’22” W, 38º15’20” N / 6º45’00” W, 38º16’30” N	3	1	1	3	1
Jerez de los caballeros/3	B	La Bazana settlement	267	6º44’15” W, 38º16’20” N	3	0	0	3	1
Jerez de los caballeros/4	B	La Albuela creek	277	6º47’30” W, 38º16’15” N/ 6º48’15” W, 38º17’35” N	3	0	0	3	1
Cabeza la Vaca/1	B	Towards Fregenal de la Sierra	740	6º31’52” W, 38º05’23” N / 6º30’08”W, 38º05’47”N	1	0	0	0	0
Herrera del Duque/1	B	Provincial limit with Ciudad Real	849	5º33’01” W, 39º23’00” N	1	0	0	1	0
La Codosera/1	B	Gévora river	331	7º2’1” W, 39º10’47” N	1	0	0	1	1
Monesterio/1	B	Mountainous country of Tentudía	779	6º16’35” W, 38º05’25” N / 6º15’18” W, 38º05’52” N	1	0	0	0	1
Valle de Santa Ana/1	B	Los Molinos creek	519	6º47’32” W, 38º22’21” N / 6º47’40” W, 38º23’12” N	1	0	0	1	1
Puebla del Maestre/1	B	García creek	495	6º03’55” W, 38º04’30” N	3	0	0	1	1

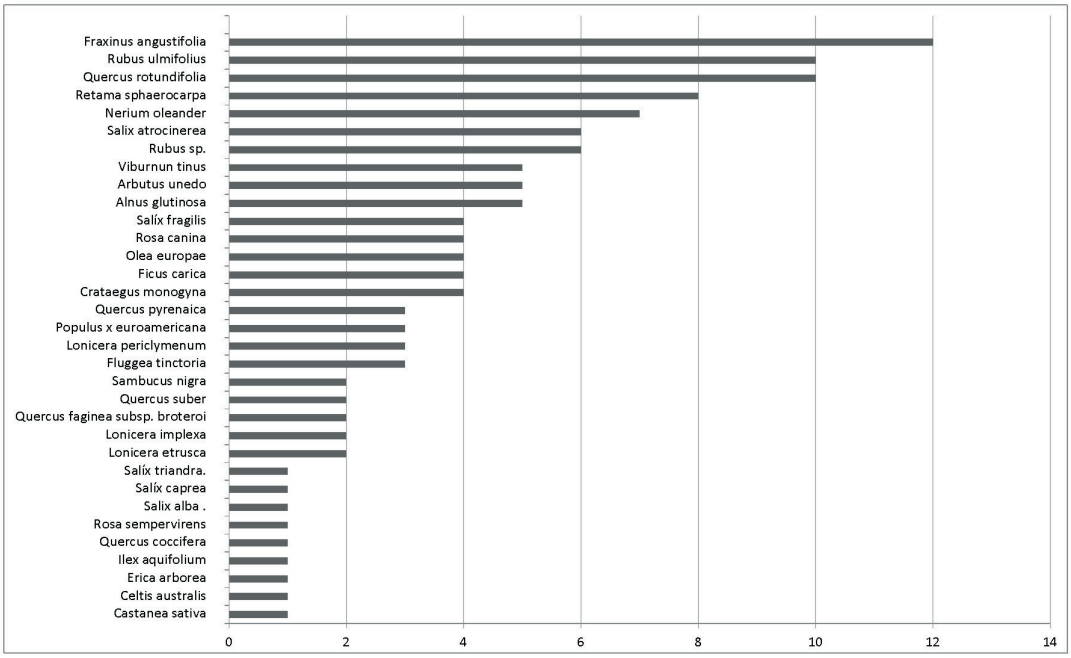

Figure: Trees and shrubs supporting climbing grapevine *Vitis vinifera* L. subspecies *sylvestris* (C.C.Gmel.) Hegi, in Extremadura (Spain). Bar length equal to number of localities (out of 22).

Table 2

Main descriptors (OIV 2007) for relic wild grapevines in Extremadura (Spain). Summarized from populations in Tab. 1

Descriptor	Female	Male
Young shoot: form of tip	5 (fully open)	=
Young shoot: intensity of anthocyanic coloration of tip	3 (weak)-5 (medium)	=
Young shoot: density of prostrate hairs on tip	3 (sparse)	=
Shoot: colour of ventral side of internodes	1 (completely green)-2 (green and red striped)	=
Young leaf: colour of upper surface	4 (yellow with bronze spots)-7 (reddish)	=
Mature leaf: size of blade	3 (small)	5 (small)
Mature leaf: shape of blade	2 (wedge-shaped)	3 (pentagonal)
Mature leaf: number of lobes	1 (entire leaf)	2 (three)-3 (five)
Mature leaf: anthocyanic coloration of main veins on blade upper surface	1 (very weak)-3 (weak)	=
Mature leaf: shape of teeth	1 (both sides concave)-2 (both sides straight)	=
Mature leaf: length of teeth	3 (short)-5 (medium)	=
Mature leaf: length of teeth compared with their width at the end of the base	3 (small)-5 (medium)	=
Mature leaf: general shape of petiole sinus	2 (wide open)	1 (very wide open)
Mature leaf: density of prostrate hairs between veins	5 (medium)-7 (dense)	=
Mature leaf: density of erect hairs between veins	3 (sparse)	=
Mature leaf: density of prostrate hairs on main veins	3 (sparse)	=
Mature leaf: density of erect hairs on main veins	0 (absent)-1 (very sparse)	=
Mature leaf: size of blade	5(medium)	1 (very small)-3 (small)
Sex of flower	5 (female, with reflexed stamens)	1 (only male)
Bunch: size	1 (very small)-3 (small)	-
Bunch: density	1 (very loose)-3 (loose)	-
Bunch: lenght of peduncle	5 (medium)-7 (long)	-
Berry: size	1 (very small)	-
Berry shape	4 (round)	-
Berry: presence of seeds	3 (well developed)	-
Berry: skin color	6 (blue-black)	-
Berry: anthocyanin colouration of flesh	1 (Very slightly coloured)	-
Berry: particular flavour	1 (none)	-

* Note: in the case of the male description, only differential characters are remarked.

characteristics in Northern Spanish populations (Ocete *et al.* 2004). Male leaves were similar to those observed in 'Antao Vaz', from the nearby Alentejo (Portugal). Concerning the pollen grain dimorphism, male flowers produced tricolporate pollen grains, and functionally female flowers produced unaperturate ovoid sterile pollen, as formerly described for Andalusian populations by Gallardo *et al.* (2009). Seed morphology was characteristic of *Vitis vinifera* subsp. *sylvestris* as recorded in other populations from Spain and France (Ocete *et al*. 2007, Rivera *et al.* 2007, Terral *et al.* 2010).

Trees and shrubs supporting climbing grapevine up to 35 different species, were typical Mediterranean plants of river bank forests (Rivas-Goday 1964): *Fraxinus angustifolia* Vahl, *Rubus ulmifolius* Schott*, Quercus rotundifolia* Lam*., Retama sphaerocarpa* (L.) Boiss*., Nerium oleander* L*., Salix atrocinerea* Brot*., Viburnun tinus* L*., Arbutus unedo* L*., Alnus glutinosa* (L.) Gaertn., and others (Figure).

Wild grapevine was sensitive to phylloxera under laboratory conditions (Ocete and Lara 1994; Gallardo 2005). The absence of symptoms on roots into the wild is probably due to the edaphic conditions of their habitats, where there is flooding for several months in the year. This would also explain the absence of symptoms caused by root-knot nematodes (galls and secondary rootlets), similar to those caused by *Meloidogyne.*

Some populations presented very low levels of infestation caused by *Bemisia tabaci* (*Gennadius*) (*Hemiptera, Aleyrodidae*), as already described in Basque Country (Ocete *et al.* 2002) and Andalusia (Ocete *et al.* 2007). *Thrips angusticeps* Uzel (*Thysanoptera, Thripidae*), was also found on wild grapes in Cantabric Coast (Ocete *et al.* 2004). Occasionally, symptoms caused by *Jacobiasca lybica* (Bergevin & Zanon) (*Hemiptera, Cidellidae*) were found. The last one is an important pest damaging vineyards in Southern Extremadura (Tierra de Barros), and Andalusia (Sherry area), especially in organic viticulture.

Colomerus vitis (Pagenstecher) (*Acari, Eriophyiidae*) is widespread in the Iberian peninsula (Ocete *et al.,* 1999), and it was found also during this work. Notably, several specimens, with a low level of infestation, present erinea on the upper leaf surface.

Symptoms caused by *Calepitrimerus vitis* (Nalepa), another eriophid, were much less frequent. The presence of this pest on wild grapevine was already described by Ocete *et al.* (2002, 2004, 2007) in the coast of Guipúzcoa, in the Ebro valley and in Andalusia.

The frequent presence of *Colomerus vitis* and *Calepitrimerus vitis* suggests they are obligatory and monophagous parasites which have cohabited with wild vines since remote times without provoking serious problems to the plants. On the contrary, damages caused by North American parasites are heavier probably due to their independent evolutions.

In spite of the absence of mycelium of *Armillaria mellea* (Valh:Fr) Kummer in the vine roots, the fungal disease was present affecting roots of botanical supporter. The main affected species in Extremadura was *Populus nigra*, where subcortical whitish plaques were frequent. In Extremadura, in the Guadiana River and its tributaries, the artificial system of irrigation (Plan Badajoz), the eucalyptus plantations and the public works destroyed the natural gallery forests. Thus, wild grapevine habitats alarmingly disappear, as in the rest of Europe (Issler, 1938; Schaumann, 1971; Arnold *et al*. 1998).When wild vines are destroyed by human actions, there are other losses of biodiversity, like the communities of natural enemies of pests living also on them: several species of predatory mites, mainly *Phytoseiidae*, *Tydeidae* and some species of *Oribatidae*. Also insects, such as *Coccinellidae* and *Cecidomyiidae* (Ferragut *et al.* 2008). Furthermore, composition of indigenous yeasts and mycorrhizal fungi are not yet studied in the wild.

Relic wild vines could be used in breeding programs to overcome the loss of diversity. This grapevine subspecies constitutes a rare endangered plant in Extremadura, and it is necessary to immediately start activities addressed to its *in situ* and *ex situ* protection.

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