Published in Agriculture, Ecosystems & Environment 123, issues 1-3, 95-98, 2008
which should be used for any reference to this work

Comparative analysis of wild and cultivated grapevine (*Vitis vinifera*) in the Basque Region of Spain and France

Rafael Ocete [a], María Ángeles López [a], Antonio Gallardo [a], Claire Arnold [b,*]

[a] *Laboratorio de Entomología Aplicada, Facultad de Biología, Universidad de Sevilla, Avda. Reina Mercedes, 6, 41012-Sevilla, Spain*
[b] *NCCR Plant Survival, University of Neuchâtel, Emile Argand 11, Case postale 158, 2009 Neuchâtel, Switzerland*

Abstract

Twenty-six populations of *Vitis vinifera* subsp. *silvestris*, a wild dioecious relative of cultivated grapevine, were found in the autonomous Basque Region in Spain and the Department of the Pyrénées Atlantiques in France. Of these populations, 76% had less than 10 individuals. Similarly to most European populations of wild grapevines, these were found on forest edges, where human pressure is enormous. Despite considerable pest and pathogen loads on the surrounding vineyards, wild grapevines were not particularly affected. In some cases, ecological conditions were not sufficient for the development of the pests and pathogens, but in most cases this low infestation seemed to be due to different degrees of tolerance. The level of susceptibility varied between individuals of the same population. Additionally, tolerance of wild grapevine to salt and calcareous was detected.

Keywords: *Vitis vinifera silvestris*; Arthropods; Pathogens; Ferric chlorosis; Morphology; Ecology

1. Introduction

Vitis vinifera L. subsp. *silvestris* (Gmelin) Hegi is an autochthonous dioecious wild relative of cultivated grapevine growing in several natural reserves in southern and central Europe, North Africa, the Middle East and the southern Caspian Belt (Arnold et al., 1998). In Spain, until a few decades, its berries were used to produce homemade vinegar, to colour white wines red and to prepare medicines (López Martínez et al., 2001). Nowadays, this subspecies is threatened through direct and indirect human activities. In 1995, it was added to the IUCN list of endangered species. However, in most European countries wild grapevine is still not protected.

In southern Europe, wild grapevine populations are located along riverbanks, on screes (colluvial sites) of hilly humid slopes and occasionally on coastal sheers and beaches. The hermaphrodite individuals found in European forests are usually escaped cultivars. American rootstocks are also dioecious like the European wild grapevine, but easy to differentiate by vegetative characters.

The aims of the current paper were to provide a distribution map with the approximate size of populations, and to carry out a global ampelographic description of female and male individuals. The occurrence of arthropods and diseases, as well as ferric chlorosis, was given particular emphasis.

2. Material and methods

The coordinates of the located populations of wild grapevine were taken via GPS, and vegetation releves were performed and named according to Rallo (1992). Several plants of interest were marked for further studies. Close to the vines, a precise soil description was made according to Soil Survey Staff (1975).

The main ampelographic characters of female and male individuals, as well as the intensity of symptoms caused by

* Corresponding author. Tel.: +41 32 718 2503; fax: +41 32 718 2501.
E-mail address: claire.arnold@unine.ch (C. Arnold).

pests and diseases were described following the list of descriptors of IPGRI, UPOV and OIV (1997). These criteria were checked on between 3 and 24 individuals, according to the size of the population. In order to complete the information given by these descriptors, hundreds of berries from female plants were collected in the Deva River area, as well as in Sobrón and Saint Jean de Luz. Measurements were taken on the seeds (width/length). The ratio was used to calculate the index of Stummer (1911). Values of the three regions were compared using one-way ANOVA, with the average value (values of F) obtained from cv. Tempranillo (the most representative red grapevine variety in Spain).

To specify the phytophagous arthropods and pathogens affecting each grapevine, the roots were uncovered to a maximum depth of 50 cm and examined for the presence of *Phylloxera*, fungi and nematodes. In the aerial part of each plant, the first 2 m of the stem and 50 randomly chosen leaves from 10 shoots were studied.

In the case of the erineum strain mites, 10 erineum mite infestations per plant were randomly chosen to detect the presence of natural enemies of Eriophyidae. If present, they were identified in the laboratory.

Elisa tests were carried out on the collected leaves following the procedure of Guegerli et al. (1984). This allowed for the detection of the possible presence of Grape Fan leaf Virus (GFLV).

Five leaf-discs from 20 different wild grapevines (10 males and 10 females) were inoculated with *Uncinula necator* (Schw.) Burr. and *Plasmopara viticola* (Berk. and Curt.) Berl. and de Toni. Two cultivars were taken as control (Hondarrabi zuri and Tempranillo).

3. Results

Twenty-six populations were identified and studied. Fig. 1 shows the distribution of populations in the region. Five of the 26 populations studied contained more than 10 individuals, and only 1 of these had more than 20 individuals. Most of the remaining populations were located on forest edges dominated by shrubs. Fluvisols and regosols represented the main substrates on which wild grapevine populations were found. These soils were calcareous with a high percentage of active limestone (on average 40%). Despite these high values, no sign of ferric chlorosis could be detected. One population was found on arenosol, which also suggests tolerance to salt.

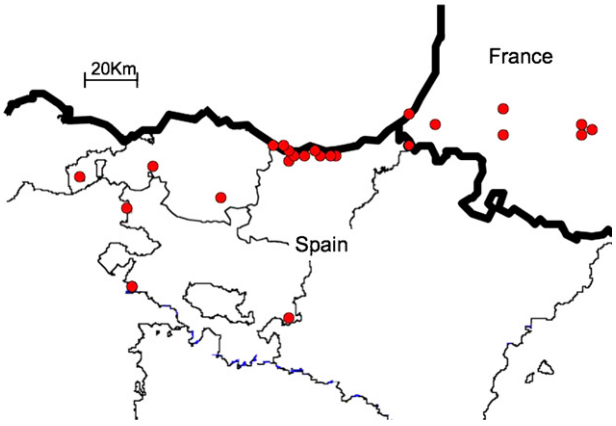

Fig. 1. Map of the distribution of the wild grapevine populations in the autonomous Basque Region in Spain and the Department of the Pyrénées Atlantiques in France.

Within populations, the morphological characters varied but were still significantly different from cultivars of the same region. Differences between male and female individuals were not significant. However, in the population of Sobrón (Ebro River), female plants had significantly smaller leaves than male plants.

The number of seeds/berries varied widely, between 1 and 3. The average values of width, length and Stummer's index were inside the limits indicated by Stummer (1911) for wild varieties. The F values indicated a statistically significant difference between wild grapevine and cv. Tempranillo (Fig. 2).

On roots, no symptoms of *Phylloxera*, no actions of dagger or needle nematodes, and no root rot were detected, although some roots of black poplar trees serving as a support to the vines in the Ega riverbanks, near Santa Cruz de Campezo, showed a large amount of whitish mycelial plates of *Armillaria mellea* Vahl.

On the aerial part *Colomerus vitis* (Pagenstecher) (Acari, Eriophyidae), *Calepitrimerus vitis* (Nalepa) (Acari, Eriophyidae), *Tetranychus urticae* Koch (Acari, Tetranychidae), *Empoasca vitis* (Göthe) (Homoptera, Cicadellidae), *Bemisia tabaci* Gennadius (Homoptera, Aleyrodidae), *Thrips angusticeps* Uzel (Thysanoptera, Thripidae) were observed. On the other hand, natural enemies of the above-mentioned pests were systematically found in each population (*Typhlodromus* species (Acari, Phytoseiidae) and eggs and larvae of *Chrysoperla carnea* (Stephens) (Neuroptera, Chrysopidae)).

No malformations and syndromes caused by grapevine fan leaf virus (GFLV), were observed. Those field observations were confirmed in the laboratory. The absence of GFLV can be due to the absence of vectors in wild populations even if it is common in cultivated vineyards of the area.

After 7 days in the laboratory, the leaf-discs of wild and cultivated grapevines that were inoculated with *U. necator* and *P. viticola* were examined. There were no differences in infection between males and females; however, the infection was significantly lower in wild grapevines than in cultivars.

4. Discussion

According to the map, the distribution of populations of wild grapevine was patchy. The size of the populations appeared to be reduced and confined to forest edges. More than 76% of the populations had less than 10 individuals.

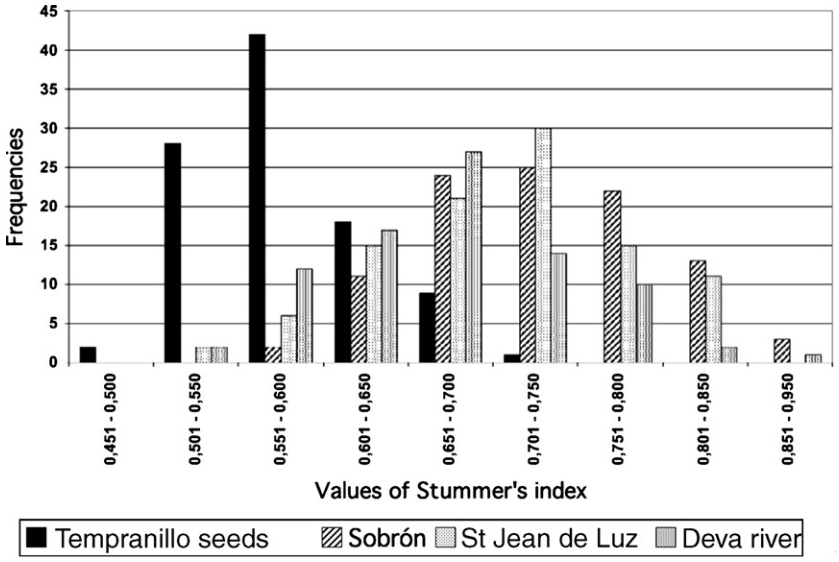

Fig. 2. Frequencies of length/width ratios from samples of wild and cv. Tempranillo seeds.

Forest edges are linked to a high human impact, and the survival of grapevines in such environments is rather compromised as already shown in an ecological analysis of wild grapevines in Europe (Arnold, 2002).

The dioicy of European wild grapevine was already assessed and the morphological criteria supported our identification. The morphological analysis of leaves showed high variations among individuals of each population in its natural habitat. The average of the values did not show significant differences between female and male individuals compared to the populations of central Europe (Arnold et al., 1998). Seed morphology was comparable between wild grapevine populations of Spain. Stummer's indexes were inside the limits indicated by Stummer (1911) for wild plants. The morphological characters were obviously different from cultivars of the same region. Several individuals were included in the genetic study of Arroyo-García et al. (2006) which confirmed their wild origin.

During summer in coastal populations, several leaves of the grapevines showed symptoms of infestation by the grape rust mite, *C. vitis* and *T. angusticeps*. This was the first detection of these species on wild grapevine. Chlorotic areas caused by the two-spotted spider mite, *T. urticae*, were only present in three locations on shoots situated in zones of low humidity and high sun exposure. This kind of damage did not exceed 20% of the foliar area.

On the edges of the riverbank forests of the Ega and Deva rivers, a few grape leaves were found mottled with yellow margins due to the injury of leafhoppers, belonging to the *Empoasca* genus. No "*Flavescence dorée*" symptoms transmitted by another leafhopper, *Scaphoideus titanus* Ball. were detected. This yellow disease has caused problems since 1996 and 1997 in vineyards of Cataluña (López, 1997) and La Rioja (Pérez Marín and Baroja, 1998), respectively. Therefore, special attention was given to these pests.

The presence of *B. tabaci* was only confirmed in some populations near the coast of the Cantabrian Sea.

Sporadically, gnawed areas caused by Lepidopteran larvae were present in some new leaves of small vines. In the majority of the cases, damage was produced by *Agrotis* sp. (Lepidoptera, Noctuidae), whose larvae remained hidden under the soil surface during the day. In the Deva Valley, some injuries caused by the first larval instar of *Hippotion celerio* L. (Lepidoptera, Sphingidae) were also detected at the beginning of October. This is a migratory species that may be found feeding on cultivated vines in the southern part of the Iberian Peninsula, but in the Magreb (North Africa) it is considered as a significant pest.

The erineum strains of *C. vitis* and the powdery mildew, *U. necator* were present in all Basque wild grapevine populations (Ocete and Lara, 1994; Ocete et al., 1995, 2000).

Despite a considerable pathogen load, the populations situated along the coast were only slightly affected by powdery and downy mildews. By comparison, the cultivated grapevines of the same area, Hondarrabi zuri and Hondarrabi beltza varieties, need about seven treatments per year to control downy mildew and six to control powdery mildew. The laboratory tests also suggested a relative tolerance of these wild populations to both diseases.

The relative degree of susceptibility of each plant to both pest and disease was different for each population. This fact compared with the variability of ampelographic characteristics strongly suggested a high genetic diversity of the populations and a genetic tolerance of some individuals to both pest and disease.

Acknowledgements

This project was partially supported by the SNF project 3100-043307-95. Kind thanks to Agnes Minnery and

Carmen Peralta for their critical reading of this manuscript. The authors would like to thank Rita Stewart for the revision of this document.

References

Arnold, C., Gillet, F., Gobat, J.M., 1998. Situation de la vigne sauvage *Vitis vinifera* L. ssp. *silvestris* (Gmelin) Hegi en Europe. Vitis 37 (4), 159–170.

Arnold, C., 2002. Ecologie de la vigne sauvage en Europe (*Vitis vinifera* L. ssp *nestris* (Gmelin) Hegi.). Geobotanica Helvetica 76, 256.

Arroyo-García, R., Ruiz-García, L., Bolling, L., Ocete, R., López, M.A., Arnold, C., Ergul, A., Söylemezo Lu, G., Uzun, H.I., Cabello, F., Ibáñez, J., Aradhya, M.K., Atanassov, A., Atanassov, I., Balint, S., Cenis, J.L., Costantini, L., Gorislavets, S., Grando, M.S., Klein, B.Y., Mcgovern, 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. Mol. Ecol. (Published article online: 25 July 2006).

Guegerli, P., Brugger, J., Bovey, R., 1984. L'enroulement de la vigne: mise en évidence de particules virales et développement d'une méthode inmunoenzymatique pour le diagnostic rapide. Revue Suisse Vitic. Arboric. Hort. 16 (5), 299–304.

IPGRI, UPOV, OIV, 1997. Descriptors for Grapevine (*Vitis* spp.). International Union for the Protection of New Varieties of Plants, Geneva, Switzerland/Office International de la Vigne et du Vin, Paris, France/ International Plant Genetic Resources Institute, Rome, Italy.

López, M.A., 1997. Incidencia de *Kalotermes flavicollis* (Fabr.) (Isoptera, Kalotermitidae) en el Marco del Jerez/Ensayos de Técnicas Blandas de Control sobre Plagas del Viñedo. Tesis Doctoral. Univ. de Sevilla.

López Martínez, M.A., Ocete, R., Pérez Izquierdo, M.A., 2001. El impacto antrópico sobre las poblaciones de vid silvestre: características sanitàrio-agronómicas y aprovechamiento de este recurso. In: Vine and Wine in European Culture. II International Symposium of the History and Civilisation of Vine and the Wine, Porto-Lamego-Vila Real, Portugal, September 10–12th.

Ocete, R., Lara, M., 1994. Consideraciones sobre la ausencia de síntomas de ataque por filoxera en poblaciones autóctonas de *Vitis vinifera sylvestris* (Gmelin) Hegi. Bol. San. Veg. Plagas. 20 (3), 631–636.

Ocete, R., Del Tío, R., Lara, M., 1995. Les parasites des populations de la vigne sylvestre, *Vitis vinifera sylvestris* (Gmelin) Hegi, des Pyrénées Atlantiques (France). Vitis 34 (3), 191–192.

Ocete, R., López, M.A., Pérez, M.A., Arnold, C., Ferragut, F., 2000. Prospección de artrópodos fitófagos, auxiliares y enfermedades en poblaciones europeas de vid silvestre. *Vitis vinifera* L. *sylvestris* (Gmelin) Hegi. Bol. San. Veg. Plagas. 26, 173–186.

Pérez Marín, J.L., Baroja, E., 1998. Flavescencia dorada y fuego bacteriano, grave amenaza a los cultivos riojanos. Cuadernos de Campo 5, 32–35.

Rallo, A., 1992. Caracterización hidrobiológica de la red fluvial de Álava y Gipuzkoa, Vitoria-Gasteiz, Gobierno Vasco, 511 pp.

Soil Survey Staff, 1975. Soil taxonomy. US Dept. Agric. Handbook. US Government Printing, Washington, DC.

Stummer, A., 1911. Zur Urgeschichte der Rebe und des Weinbaues. Mitteilungen der Anthropologischen Gesellschaft in Wien 41, 283–296.