

THE ROMANIAN VITIS DATABASE: AN INFORMATIVE, MULTIMEDIA WEB-BASED PLATFORM FOR MANAGING GRAPEVINE GENETIC RESOURCES IN ROMANIA

ROMANIAN VITIS DATABASE : UN INSTRUMENT UTIL PENTRU INVENTARIEREA, PROTEJAREA ȘI VALORIFICAREA RESURSELOR GENETICE ALE COLECȚIILOR DE VIȚA-DE-VIE DIN ROMANIA, CA PATRIMONIU PENTRU GENERAȚIILE VIITOARE

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***Abstract.** Due to its geographic location and geological features, Romania has a rich history of grape cultivation and displays significant biodiversity, which is evident at both the ecosystem and species levels. Efficiently managing grapevine germplasm collections involves maintaining a database that records each country's viticultural heritage and complete descriptions based on relevant indicators. This strategy aims to effectively utilize biological material in breeding activities, ensure high-quality biological material for new vineyard plantations, and protect rare genotypes at risk of extinction. A complex characterization based on ampelographic, technological, and agrobiological descriptors, as well as SSR molecular marker genetic profiles, allows for the accurate fingerprinting of the cultivar and eliminates uncertainties caused by synonymy and homonymy. In this context, the Romanian Vitis Database will serve as a valuable source of information, accessible both nationally and internationally. It aims to effectively manage, protect, and utilize grapevine genetic resources in Romanian ampelographic collections as a legacy for future generations.*

***Key words:** grapevine inventory, fingerprinting, online platform*

***Rezumat.** Datorită poziției sale geografice și caracteristicilor geologice, România are o istorie bogată în cultivarea viței-de-vie și prezintă o biodiversitate semnificativă, vizibilă atât la nivel de ecosistem, cât și la nivel de*

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specie. Gestionarea eficientă a colecțiilor de germoplasmă de viță-de-vie implică menținerea unei baze de date care să înregistreze patrimoniul viticol al fiecărei țări și descrieri complete bazate pe indicatori relevanți. Această strategie are ca scop valorificarea eficientă a materialului biologic în activitățile de ameliorare, asigurarea unui material biologic de calitate superioară pentru noile plantații viticole și protejarea genotipurilor rare aflate în pericol de dispariție. O caracterizare complexă, bazată pe descriptori ampelografici, tehnologici și agrobiologici, precum și pe profile genetice determinate prin aplicarea de markeri moleculari SSR, permite identificarea precisă a soiului și eliminarea incertitudinilor cauzate de sinonimie și omonimie. În acest context, Romanian Vitis Database va reprezenta o sursă valoroasă de informații, accesibilă atât la nivel național, cât și internațional. Ea are ca obiectiv gestionarea eficientă, protejarea și valorificarea resurselor genetice ale viței-de-vie din colecțiile ampelografice românești, ca moștenire pentru generațiile viitoare.

Cuvinte cheie: *inventarierea vitei de vie, amprentare genetica, platforma online*

INTRODUCTION

In Romania, as in other viticultural regions, the practice of intensive grape cultivation has negatively impacted the genetic diversity of grapevine populations, resulting in the loss of local cultivars and intravarietal variability, a phenomenon known as genetic erosion. A key consequence of genetic erosion, apart from varietal uniformity, is the loss of genetic diversity within individual cultivars. More than 95% of vineyard plants produced in nurseries come from clonal selections chosen based on performance traits (quantitative or qualitative), while the original mother varieties, vital sources of genetic diversity, are facing extinction [Loureiro and Moreno Sanz, 2011; Gonçalves and Martins, 2022].

For these reasons, it has become necessary to preserve, within ampelographic collections, both old indigenous varieties, but also new autochthones genotypes, clonal selections, as well as foreign varieties introduced into the country through the international exchange of biological material. These collections, created and maintained in compliance with the specific internationally agreed norms, are located mainly in the research and development institutes, but also within the universities of agricultural sciences (Popescu *et al.*, 2018).

The use of SSR genetic profiling for both traditional local varieties and newly developed cultivars functions as a molecular passport, enabling the verification of varietal authenticity. This method is crucial for the precise documentation and long-term conservation of grapevine genetic resources, especially for heritage varieties that face the risk of misidentification or genetic erosion [Popescu and Crespan, 2018].

Molecular authentication also plays a critical role in breeding programs by ensuring the traceability of parental lines and maintaining the genetic integrity of newly created cultivars. Furthermore, it facilitates the management of germplasm

collections and contributes to the implementation of strategies aimed at protecting plant breeders' rights and promoting sustainable viticultural development.

In recent years, Romania has seen several attempts, as part of research projects, to develop and maintain publicly accessible databases, online or on paper, in the fields of agriculture and horticulture (PN II PT PCCA 168/2014 GERMPUM; Popescu *et al.*, 2018). These initiatives aimed to collect, organize, and share valuable information on plant species, cultivation practices, genetic resources, and agro-technical data. Despite their potential to support research, education, and sustainable development, many of these projects faced challenges such as limited funding, lack of long-term institutional support, and insufficient integration with international data systems.

Open access to existing *Vitis* databases has enhanced the global exchange of information. By linking microsatellite profiles with ampelographic, technological, and agrobiological descriptors, accurate varietal fingerprinting becomes possible, helping to resolve also some confusions caused by synonymy and homonymy (Maul *et al.*, 2015; Popescu *et al.*, 2017; Popescu and Crespan, 2018).

At European level, the inventory of grapevine varieties is carried out through some of the following databases:

- Vitis International Variety Catalogue (VIVC) - since 1983, the Institute for Grapevine Breeding Geilweilerhof (Germany) has been involved in the inventory of species, varieties, and other genotypes of *Vitis* found in grapevine collections worldwide. This effort led to the establishment of the Vitis International Variety Catalogue (VIVC) in 1984 [Alleweldt, 1988]. The database represents an inventory of *Vitis* species, varieties and clones maintained in Europe in germplasm collections, characterized in accordance with OIV Resolution no. 2/82 (Maul and Töpfer, 2015; <https://www.vivc.de/>);

- The European Vitis Database (<http://www.eu-vitis.de/>), was developed in 2007 by the Julius Kühn-Institut -Federal Research Centre for Cultivated Plants (JKI), Siebeldingen, Germany. This database was created within the European project Genres081, and completed within the European projects GrapeGen06 and COST Action FA1003.

- PlantGrape (<https://plantgrape.plantnet-project.org/en/>) originated as one of several case studies within the Pl@ntNet platform (plantnet.org), created in 2009 by the Agropolis Fondation to advance agronomic research and sustainable development. Dedicated to grapevine data, the project was initially led by UMT Géo-Vigne®, a Joint Technological Unit, bringing together the expertise of IFV (French Institute for Vine and Wine) and INRAE (National Research Institute for Agriculture, Food and Environment). PlantGrape's mission is to offer accessible, validated, and regularly updated information on grapevine varieties, rootstocks, and clones used in France, as well as throughout Europe and globally.

Several European countries have established national databases dedicated to the conservation and characterization of grapevine genetic resources. These

systems are essential for safeguarding viticultural biodiversity, advancing grape breeding efforts, and promoting the long-term sustainability of wine production.

Bulgaria - The *Bulgarian Vitis Database (BVD)* is a web-based repository that compiles genotypic data on grapevine cultivars and accessions originating from Bulgaria. It is managed by the Institute of Viticulture and Enology in Pleven, while microsatellite profiling has been conducted at the AgroBioInstitute in Sofia. Developed within the framework of the INNOVINE project, the BVD supports sustainable viticulture by linking innovative vineyard management practices with the conservation of grapevine genetic diversity (BVD).

Czech Republic - The *GRIN Czech database* serves as the central system for managing plant genetic resources, including grapevine accessions. It provides detailed passport, characterization, and evaluation data. Maintained by the Crop Research Institute, the system facilitates the conservation and utilization of grapevine germplasm in national breeding and research programs (GRIN Czech).

France - France maintains one of Europe's most comprehensive grapevine germplasm collections, coordinated through a national network of over 50 field repositories. These collections contain extensive data on cultivar identity, sanitary status, and agronomic performance. The system is a cornerstone of French viticultural conservation, supporting both scientific research and practical viticulture (PNDB).

Spain - Spain has established germplasm banks, such as the one in Aragón, *Spanish Grape Germplasm Bank*, in order to explore and preserve the genetic diversity of grapevine cultivars. These banks play a crucial role in maintaining the country's viticultural heritage and supporting breeding programs [Ghrissi et al., 2022].

Italy - The *Italian PlantA-Res database* documents the collection, conservation, and utilization of plant genetic resources, including *Vitis vinifera*. It serves as the national inventory, integrating information from regional repositories and research institutions. The database underpins Italy's commitment to preserving agricultural biodiversity and supporting sustainable viticulture practices [Palombi et al., 2015].

Greece - The *Greek Vitis Database (GVD)* is an extensive web-based platform that integrates multimedia resources to aid in the conservation and study of grapevine genetic resources in Greece. Initially developed by the Laboratory of Plant Physiology and Biotechnology at the University of Crete, the GVD combines molecular, morphological, and ampelographic data to support both germplasm management and viticultural research. [Lefort et al., 2010]

These systems provide passport data, morphological descriptors, genetic profiles, and photographs, supporting breeding programs and biodiversity studies across borders.

In Romania, the absence of a current open access grapevine germplasm database highlights the need for the development of an online information system. Such a platform would serve as a key instrument for the conservation and

sustainable use of biodiversity, offering continuous access to genetic resources and related data for researchers and growers.

MATERIALS AND METHODS

Plant material characterization

Ampelographic characterization was conducted in accordance with the standardized descriptor methodology detailed in the 3rd Edition of "OIV Descriptor list of grapevine varieties and *Vitis* species" (OIV, 2023). The methodology of ampelographic descriptors was developed by the OIV (International Office of Vine and Wine), UPOV (International Union for the Protection of Plant Varieties) and IPBGR (International Committee for Plant Genetic Resources), in order to harmonize the methodologies for describing varieties. Thus, since 1984 a standardized methodology has been in place for the ampelographic description of grapevine varieties, utilizing numerical codes to represent each trait. These descriptors are assigned by comparing traits to those of reference varieties.

To validate the accession's identification, nine *Vitis*-specific passport descriptors were utilized, including information related to varietal authenticity such as "variety name", "synonyms", "country of origin", "variety pedigree", "utilization", "biological status" and "accession origin".

For the characterization and evaluation of the accessions, a total of 54 descriptors were selected from the "OIV Descriptor list of grape vine varieties and *Vitis* species", covering the following categories: young shoot (OIV 001–004), mature shoot (OIV 006–016), young leaf (OIV 051–053), mature leaf (OIV 067–094), flower (OIV 151), grape (OIV 202–209), berry (OIV 220–241), phenological descriptors (OIV 301–303), agrobiological descriptors (OIV 351), and technological descriptors (OIV 502–506).

Microsatellite profile

Molecular analyses were performed using a standardized protocol based on the recommendations of the OIV 2nd Edition (2009). A set of nine SSR loci was employed in order to determine the genetic profile: VVS2 [Thomas & Scott, 1993]; VVMD5 and VVMD7 [Bowers et al., 1996]; VVMD25, VVMD27, VVMD28, and VVMD32 [Bowers et al., 1999]; and VrZAG62 and VrZAG79 [Sefc et al., 1999].

Technical infrastructure

The *Romanian Vitis Database* was designed and implemented as a modern web-based platform, aimed at providing open access to structured and validated information on grapevine genetic resources. The system was developed using ASP.NET Core, a cross-platform, high-performance framework well-suited for building scalable web applications.

The relational database management system (RDBMS) selected for the project was MySQL, chosen for compatibility with ASP.NET environments. MySQL facilitated efficient management of structured datasets, including passport data, morphological descriptors, genetic profiles, and multimedia files such as images.

Front-end development leveraged HTML5, CSS3, and JavaScript to ensure a responsive, user-friendly interface, compatible with various devices and browsers (Figure 1).

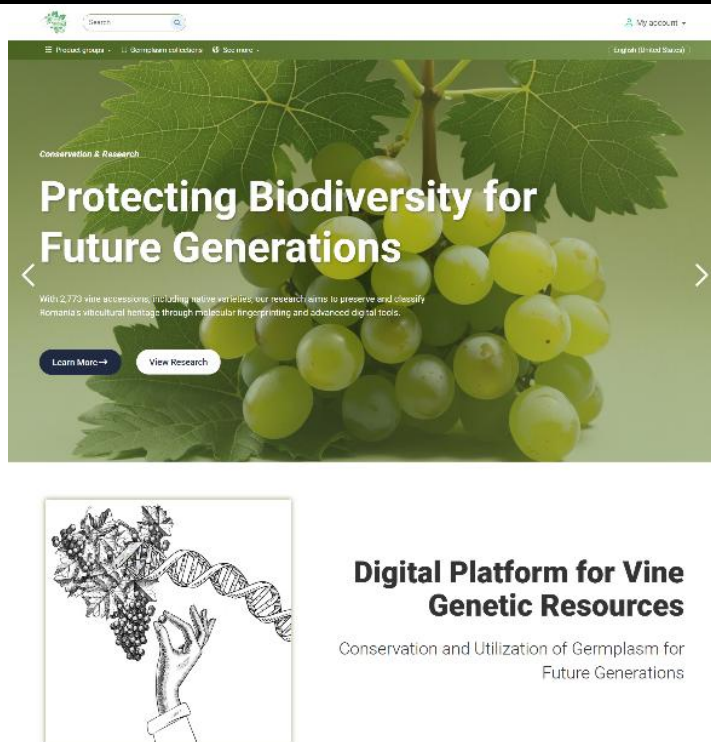


Figure 1. Aspects from *Romanian Vitis Database* front-end interface

Ajax (Asynchronous JavaScript and XML) was integrated to enable seamless, real-time data updates and dynamic page content without requiring full-page reloads, improving performance and user experience.

For server-side logic and data access, C# was used in conjunction with Entity Framework Core, enabling efficient communication between the application and the MySQL database

The architecture was also designed to support future integration with external germplasm databases (e.g., VIVC, EURISCO) and the adoption of standard descriptors as defined by OIV and FAO/IPGRI.

RESULTS AND DISCUSSIONS

A total of 2,773 grapevine accessions are currently documented in the *Romanian Vitis Database*, comprising cultivars, clones, and rootstocks. These entries were contributed by multiple research and academic institutions, including: Research and Development Institute for Viticulture and Enology Valea Călugărească, Research and Development Station for Viticulture and Enology Iasi, Research and Development Station for Viticulture and Enology Murfatlar, Research and Development Station for Viticulture and Enology Odobești, National Research and Development Institute for Biotechnology in Horticulture Stefanesti,

University of Life Sciences *Ion Ionescu de la Brad* Iasi, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, University of Agricultural Sciences and Veterinary Medicine of Bucharest.

To date, 35 grapevine varieties from the total registered entries have been characterized but updates will be still made until the publicly release of the platform.

This effort represents an initial phase in the ongoing process of database enrichment, with the number of characterized varieties expected to increase on a yearly basis as part of a long-term strategy for comprehensive documentation and conservation.

A critical factor influencing the development of the database is the significant workload and financial resources required to sustain technical support and conduct molecular analyses. These efforts are often constrained by infrastructure-related challenges, such as limited access to high-throughput genotyping platforms, insufficient laboratory equipment, and the need for specialized personnel, all of which can hinder the pace and scalability of characterization activities.

CONCLUSIONS

The conservation and utilization of genetic diversity in viticulture, both for production and breeding, are matters of national interest, playing a crucial role in mitigating the loss of genetic variation within the *Vitis* genus and preventing the homogenization of viticultural heritage.

The existence of publicly accessible platforms that provide comprehensive datasets—including passport information, morphological descriptors, genetic profiles, and photographic records—is essential for advancing collaborative research and breeding efforts across national borders.

Romanian Vitis Database framework constitutes a robust, scalable, and interoperable platform, developed using industry-standard technologies to ensure the long-term preservation, accessibility, and efficient management of grapevine genetic resources.

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