Scientific Papers. Series B, Horticulture. Vol. LXIX, No. 1, 2025
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

APPLICATION OF WEB-BASED TOOLS FOR DOCUMENTATION OF HORTICULTURE LOCAL VARIETIES - BULGARIAN AND SLOVAKIAN EXAMPLE

Nikolaya VELCHEVA[1], Asya STOYANOVA-DOYCHEVA[2], Pencho MALINOV[2], Sebiha MADANSKA[2], Ľubomír MENDEL[3], René HAUPTVOGEL[3]

[1]Agricultural Academy, Institute of Plant Genetic Resources, 2 Druzhba Str., Sadovo, Bulgaria
[2]Plovdiv University, Department of Computer Systems, 24 Tzar Asen Str., Plovdiv, Bulgaria
[3]National Agricultural and Food Centre, Research Institute of Plant Production, 122 Bratislavská cesta Str., Piešťany, Slovak Republic

Corresponding author email: nikolaya_velcheva@abv.bg

Abstract

Plant genetic resources play an important role in maintaining global food security, conserving biodiversity and promoting sustainable agriculture. The paper aims to explore the data management, digitization and cataloguing the horticulture traditional varieties conserved ex situ/on farm. The approaches include development of optimised databases and web-based tools in accordance with FAO/Bioversity descriptors. Intelligent technologies are used for creating public access under the Nagoya Protocol and equitable sharing of benefits from the use of gene pool under the International Treaty on Plant Genetic Resources for Food and Agriculture. The interdisciplinary approach for promoting the local varieties is a part from their valorisation as biocultural heritage. The results have an impact to the modernisation of genebank documentation systems and for reintroduction of plant diversity to the home gardens and farms. The study contributes to environmental protection and sustainable preservation of gene pool, according to the national conservation strategies of Bulgaria and Slovakia.

Key words*: plant diversity, horticulture crops, genebanks, information systems, European networks.*

INTRODUCTION

Plant diversity is essential for food security, sustainable agriculture and environmental protection (Rocchi et al., 2016). The European Strategy for Genetic Resources highlights the need to preserve the gene pool for the present and future of humanity and emphasizes the obligation of gene banks to provide free access to information on the biological potential of the stored gene pool (EC, 2020). In recent decades, more and more old varieties have been replaced by new ones, and although the demand for traditional products is increasing, they are threatened with extinction, due to both climatic and anthropological factors (Britwum and Demont, 2022). In these circumstances, combining *ex situ* and *on farm* conservation approaches to protect biodiversity is a research priority (Arndorfer et al., 2009). International cooperation between genebanks is crucial to ensure the global conservation and sustainable use of genetic resources within the framework of interoperability in the European Research Area. The Green Deal promotes environmental practices, some of which are the inclusion of cereals and legumes in crop rotation, the search for solutions for natural enrichment of soils with nitrogen, limiting mineral nutrition, green manure, conservation agriculture, which have a positive impact on the protection of natural resources. Genetic resources are a tool that, if used sustainably, has the potential to create innovations and support the green transition (Reidsma et al., 2010; Halewood et al., 2018). The European Strategy for the Promotion of Protein Crops aims to support the production of legumes in the European agricultural sector (Brezeanu et al., 2021). There is a wide diversity of old and traditional horticulture varieties contributing to the households and accessible at the local markets in the rural areas in some European countries as Bulgaria, Romania, Slovakia (Benková et al., 2017; Ivanova et al., 2023; Stan et al., 2024).

According to the authors Smyth et al. (2020) the digitization of biological information for genetic resources with proven and potential

value means online publicly available information resources, described by a standardized descriptor, allowing data processing through the application of statistical models for automated processing and intelligent technologies. These data are characterized by high public value, having the potential to discover valuable traits and qualities for breeders in the stored samples that can help create genetic diversity and new varieties that respond to modern climatic and social challenges (Vinatoru et al., 2024).

The European electronic catalogue EURISCO aims to expand the possibilities of users by providing open access not only to passport description, but also to characterization and evaluation data of accessions, stored in the European genebanks (Weise, 2021; Kotni et al., 2023). The process of digitizing the plant gene pool is part of the overall transformative technological change that is being observed in all spheres of the global economy (Darnala et al., 2022; Shaw et al., 2023; Shelef et al., 2017; Tienhaara et al., 2019; Weise et al., 2025).

Digitization in Bulgarian and Slovakian agriculture and, in particular, in the management of plant genetic resources significantly improves the efficiency of the process of storing and using the gene pool (AEGIS, 2022a; AEGIS, 2022b; Mendel et al., 2019). The initial selection of accessions from genebanks for conducting scientific experiments is carried out on the basis of available passport information, such as taxonomic description and ecological-geographical characteristics, especially important for local populations (Thormann et al., 2012).

The aim of the study is to evaluate the development and use of web-based tools for inventory and digitization of local diversity of horticulture traditional varieties as an innovative solution to climatic and social challenges.

MATERIALS AND METHODS

The explored data was generated using information techniques for sortation of the national registers of Bulgarian and Slovakian genebanks, curators` data and interviews of local farmers via questionnaire.

Slovakian (https://griss.vurv.sk/) and Bulgarian (https://genbank.uni-plovdiv.net/) plant germplasm information systems are fully compatible with the passport descriptors standard of FAO/Bioversity (2017).

Information systems are conceptually, methodically and methodologically compatible with the *online* search systems in Europe – EURISCO (https://eurisco.ipk-gatersleben.de/) and GRIN (https://www.ars-grin.gov/) of USA.

For the survey local varieties were collected from rural areas and accessions from the genebank collections of both countries were exchanged by Standard Material Transfer Agreement.

RESULTS AND DISCUSSIONS

During 2024-2025 a qualitatively new cooperation between the Bulgarian and Slovakian genebanks by sharing experience and good practices in the field of conservation, characterization, evaluation and documentation of plant genetic resources is established. The information services are improved focused on the quality, management and sharing the data through digitization of local diversity according to descriptors of FAO/Bioversity. The interdisciplinary approach combines agricultural sciences and information technologies to modernize the documentation systems of the genebanks in both countries. As a result, through the exchange of new knowledge and experience, the quality of the digitization and computerization of the national information systems of the plant gene pool for food and agriculture in Slovakia and in Bulgaria is increased and improves the standardization of information flows in the framework of maintaining compatibility and interoperability in the European area.

The inventory of the *ex situ* collections stored in the genebanks via EURISCO catalogue shows that the Bulgarian collection in the National genebank in Sadovo consists 66,798 accessions with diverse geographical origin and biological status. The *ex situ* collection of Slovakian genebank includes 21,240 accessions in active collection and 5,529 accessions in basic collection. In the EURISCO catalogue, the National Agricultural and Food Centre in Piešťany presents data on 17,614 accessions.

European and international policies, standards and good practices for documentation of the plant gene pool are followed. The partners are working on enrichment the diversity of *ex situ* collections in Bulgaria and Slovakia.

As a result of germplasm exchange the Bulgarian collection is enriched with 66 new accessions with Slovakian origin, including 12 acc. cereals, 18 acc. beans, 10 acc. pea, 13 acc. pepper, 4 acc. pumpkin, 3 acc. tomato, leafy vegetables and spices (Figure 1).

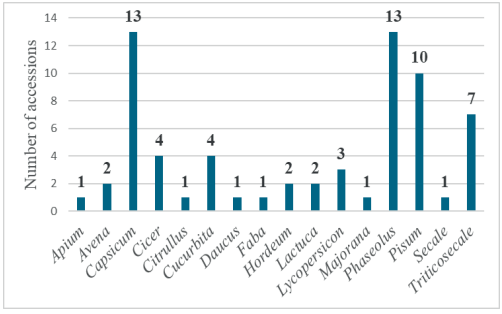

Figure 1. Enrichment of Bulgarian genebank through DIGIVALPGR project *with* new germplasm accessions

The Slovakian genebank has been enriched with seed materials from 40 local accessions from the curators` collections in Sadovo and with 17 traditional Bulgarian varieties (Figure 2).

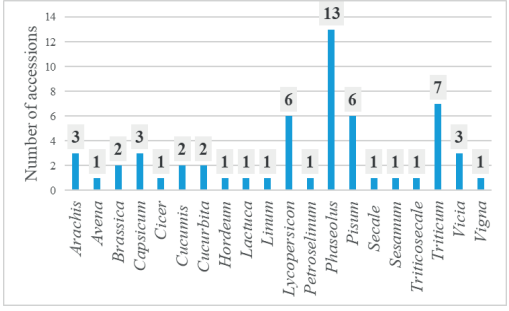

Figure 2. Enrichment of Slovakian genebank through DIGIVALPGR project with new germplasm accessions

Although the majority of horticultural production in Europe currently depends on formally registered, genetically uniform cultivars, local varieties are still cultivated *on farm*. In 2024 seven local varieties from traditional crops, including four common bean accessions, two tomato accessions and a pumpkin from home gardens in two different localities in the Rhodope Mountains (Bratsigovo, Pazardzhik region and Sarnitsa near Velingrad) have been collected and conserved in the Bulgarian genebank (Table 1). The climate conditions in Sadovo region are suitable for regeneration and multiplication of vegetable crops. The temperature and precipitation values are within the limits of their biological requirements or deviate insignificantly from them.

Table 1. Collected local horticulture varieties from mountain and semi-mountain regions in South Bulgaria

COLLNUMB	GENUS	SPECIES	ACCENAME	LOCALITY	ELEVATION
C4E0223	*Phaseolus*	*vulgaris*	Prevren	Bratzigovo	450 m
C4E0224	*Lycopersicon*	*esculentum*	Local pink	Bratzigovo	450 m
C4E0225	*Lycopersicon*	*esculentum*	Local red	Bratzigovo	450 m
C4E0226	*Cucurbita*	*moschata*	Barunche	Sarnitsa	1250 m
C4E0227	*Phaseolus*	*vulgaris*	Rancha	Sarnitsa,	1250 m
C4E0228	*Phaseolus*	*coccineus*	Pehlivan	Sarnitsa	1267 m
C4E0229	*Phaseolus*	*vulgaris*	Bashev	Sarnitsa	1259 m

A questionnaire for collecting passport and ecological-geographic characteristics has been developed and is being filled out (Figure 3). Partners agreed on the use of appropriate templates to collect occurrences data.

	QUESTIONNAIRE for collecting data during the collecting missions for farmer's variety/landrace by DIGIVALPGR project
1	Accession number
2	Collection date
3	Researcher who collected the accessions
4	Collection site/place 1) Country/city/village/locality 2) Latitude 3) Longitude 4) Altitude 5) Characteristics of the area - flat, mountainous, semi-mountainous, etc. 6) Climatic features - temperatures, precipitation during the growing season
5	Farmer information 1) Name and surname 2) Age 3) Main activity
6	Crop/taxonomic description
7	Local accession name
8	Biological status 1) Wild / Crop wild relatives 2) Local / traditional variety, population 3) Old variety (with reduced use)
9	Characteristics of the accession 1) Agronomic - cultivation technology, early maturity, yield, etc. 2) Product quality – shape, color, taste, etc. 3) Resistance to diseases, enemies, drought, etc. 4) Irrigated / non-irrigated conditions 5) Specific features – distinguishing qualities and signs 6) Where the accession was obtained from and how long it has been grown on the farm
10	Farm information 1) Total area of used agricultural land in the farm 2) Area on the farm occupied by the accession 3) Reasons for growing the accession – traditional, cultural/religious, market, palatability, early maturity, disease resistance, etc. 4) Direction of production – for domestic consumption, local market, ecotourism, for the country/abroad, direct market/through an intermediary, etc. 5) How do they get seeds - do they collect themselves, from neighbors or from the local market
11	Traditional recipes for using the accession and other additional information
12	Photo of accession

Figure 3. Questionnaire for collecting data during collecting missions via interviewing of local farmers

The upgrade of the genebank information system in the Institute of Plant Genetic Resources in Sadovo was aimed at achieving two main objectives: (1) Expanding, increasing the quality and updating the database with information on expeditions for the *ex situ* collections and (2) Ensuring *open access* to these resources for all users.

The created register with *open access* to the plant genetic resources is focused on the local gene pool as an effective approach for its valorization. The use of smart technologies in support of the cause of public responsibility for the preservation of plant biodiversity for current and future generations attracts many followers and young people with ecological civic position. A convenient application for *open access* to the genebank has been developed (Figure 4).

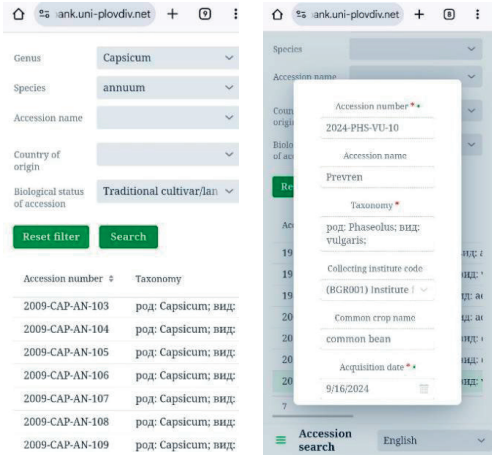

Figure 4. Mobile application of the *open access information* system of Bulgarian genebank

The main search criteria are based on the passport data of the plant genetic resources. After performing a search, users can view detailed information about the selected accession (Figure 5).

Figure 5. Detailed information for accession in *open access* in system of Bulgarian genebank

This information includes the complete set of its passport data. In the future, the *open access* search will be expanded to include more commonly known plant names, which will make it easier for farmers and other non-expert users to navigate the system. To support the implementation of this feature, a study was conducted on the plant genetic resources information system in Slovakia.

Inventory, collection, conservation and documentation of localities are of considerable importance for promoting actions aimed at enhancing the preservation and utilization of horticulture diversity. The Expeditions Module has been developed and includes key information about the conducted collecting missions, the participants involved, the funding organizations, as well as data on the new accessions (Figure 6).

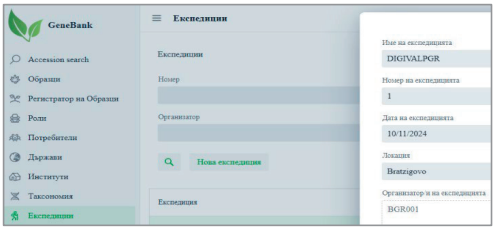

Figure 6. Expedition module in the information system of *Bulgarian* genebank

The necessity of keeping information for distribution of local varieties gives advantages for authorities to effectively plan and implement systematic conservation and utilization strategies for biodiversity (Raggi et al., 2024).

To facilitate user access in the Expedition module we developed search filters by various criteria - such as sample, participant, or funding project. The expedition data has been imported into the system's database, and relevant information has also been integrated into the GenBank Ontology, which was developed under the BGPLANTNET project (Stoyanova-Doycheva et al., 2020). As a part of the development process, an analysis of the genebank information system in Slovakia was carried out to adopt best practices and encourage information exchange between the two systems.

Slovakian information system GRISS is designed for complex information management

of the National genebank and supports all conservation processes. An information system is accessible through the web interface as searchable catalogue used by the curators of collections of plant genetic resources and from breeder's institutions, universities, public institutions and others. GRISS offers an online web portal solution for ordering germplasm materials in accordance with the international principles and the National Programme.

CONCLUSIONS

Digitization and the developed web-based applications increase and optimize the use of the gene pool in breeding programs for the adaptability of genetic materials to changing climatic factors and satisfy the needs of farmers to return the traditional varieties to practice.
The study is in line with the EU 2030 strategy for the conservation of biodiversity, is addressed to the implementation of national programs on Plant Genetic Resources for Food and Agriculture in Bulgaria and Slovakia.
The results of the study find their application in the overall process of protecting biodiversity and nature, increasing the resilience of crops to dynamic environmental conditions in order to guarantee the production of healthy and high-quality food.

ACKNOWLEDGEMENTS

This research work was carried out under the SVK-BGR cooperation project DIGIVALPGR "Digitalization and valorisation of local plant genetic resources in Bulgaria and Slovakia in the framework of maintaining compatibility and interoperability in the European area" with the support of Bulgarian National Science Fund, Contract number KP-06-Slovakia/9/13.08.2024 and Slovak Research and Development Agency, Contract number SK-BG-23-0005/17.09.2024.

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