Journal of Molecular Biosciences and Engineering

Research Article

Harmonization and Integration of Azerbaijan National GeneBank Passport Data into Genesys

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Received: 21.09.2026 Accepted: 16.10.2026 Published: 30.10.2026

https://doi.org/10.54414/XOFO8878

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Abstract

The conservation and effective management of plant genetic resources for food and agriculture (PGRFA) depend not only on the maintenance of biological material but also on the availability of reliable and standardized information associated with individual accessions. Genebanks maintain passport data that support the identification, management, exchange, and utilization of conserved genetic resources. However, differences in database structures, terminology, and data formats can limit the interoperability and international exchange of such information. In Azerbaijan, passport information for plant genetic resources is maintained in the Central Database (CDB) of the Azerbaijan National Genebank. This study describes the preparation and harmonization of National Genebank passport data for integration into the Genesys PGR platform. The process included review and refinement of existing passport records, standardization of field content and formats, mapping of national database fields to the corresponding Multi-Crop Passport Descriptors (MCPD), verification of taxonomic and geographic information, and selection of accessions suitable for public sharing. The integration process established a standardized dataset suitable for international data exchange and improved the accessibility of information on Azerbaijan's conserved plant genetic resources. The experience demonstrates that successful integration into an international PGR information platform requires systematic data preparation, descriptor harmonization, quality verification, and appropriate management of public-access information. The resulting integration provides a basis for improved discoverability of national genetic resources and supports their use in research, breeding, and international collaboration.

Keywords: plant genetic resources, Genebank, Genesys, passport data, MCPD, data harmonization, data standardization, data integration.

1. Introduction

Plant genetic resources for food and agriculture (PGRFA) provide the genetic basis for crop improvement, adaptation, and sustainable agricultural production. Genebanks play a central role in conserving this diversity and maintaining the passport information required to identify, manage and exchange individual accessions [1]. The quality and completeness of such information are important for the effective management and use of ex situ collections [2].

The increasing use of digital information systems has created new opportunities for making Genebank collections more discoverable and facilitating access to information by researchers, breeders, and other users [3]. Genesys PGR is an international information platform that provides access to passport information on plant genetic resources maintained by Genebanks and other institutions. Effective information management is an essential component of long-term genetic resource conservation, as documentation provides the link between conserved biological material and its potential use [4]. International catalogues such as EURISCO demonstrate the value of

standardized passport information for making Genebank material searchable across institutional and national boundaries [5], [6].

Effective international exchange of passport information requires compatible data structures and standardized terminology. The Multi-Crop Passport Descriptors (MCPD) provide a common framework for documenting passport information and facilitate interoperability between national and international plant genetic resource information systems [7].

In Azerbaijan, passport information for the national plant genetic resources collection is maintained in the Central Database (CDB) of the Azerbaijan National Genebank. The dataset was reviewed for data consistency and metadata quality, and the MCPD-compatible passport records were prepared for submission to Genesys, with accessions selected according to their public accessibility status. The development of the national Genebank has supported the conservation and management of plant genetic resources in Azerbaijan [8], [9]. Previous work has also demonstrated the use of international descriptor systems for documenting characterization data from the national collection [10], [11].

The objective of this study was to describe the harmonization and preparation of Azerbaijan National Genebank passport data for integration into the Genesys PGR platform and to assess the resulting contribution to the international accessibility of national plant genetic resources information.

2. Materials and Methods

The study was based on passport data maintained in the Central Database (CDB) of the Azerbaijan National Genebank. The dataset contains information associated with accessions conserved in the national ex situ collection, including accession identification, taxonomy, geographic origin, collection and conservation-related information. Following database review and inventory assessment, passport records for 15286 registered accessions were used as the basis for data preparation. A subset of 10296 accessions was maintained under medium- and long-term storage conditions.

The passport records were maintained in a structure compatible with the Multi-Crop Passport Descriptors (MCPD). The preparation process therefore focused on reviewing the existing fields, standardizing field content and formats where necessary, mapping national database fields to the corresponding MCPD descriptors, and verifying the consistency of taxonomic and geographic information [7]. The data preparation process included:

- review of the existing passport data structure;
- refinement and standardization of data fields and formats;
- mapping of national database fields to MCPD descriptors;
- verification of taxonomic and geographic information
- identification and correction of inconsistencies where applicable; and
- preparation of the standardized dataset for Genesys integration.

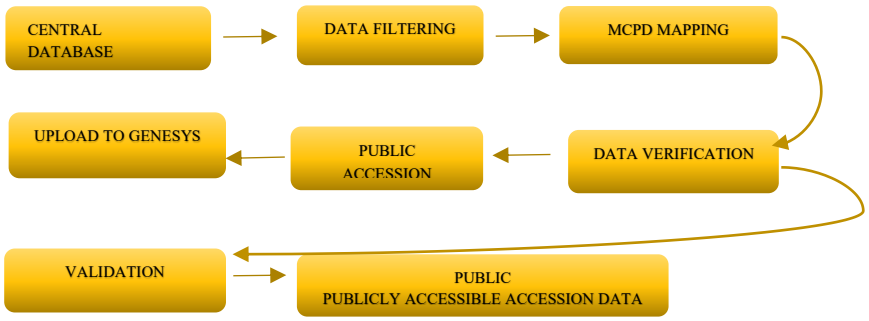


Figure 1. Workflow for the harmonization and integration of passport data into Genesys.

Before integration into Genesys, accession records were reviewed according to their public-sharing status. The “Is public” filter was set to “Yes” to identify accessions eligible for public dissemination. This filtering step ensured that only records designated as publicly accessible were submitted for integration into the international platform. The harmonized passport dataset was structured for exchange with Genesys using appropriate structured data formats. The integration workflow consisted of the stages shown in Figure 1.



Figure 2. Workflow for the preparation and integration of passport data into Genesys.

The selected passport records were uploaded to Genesys using the Genesys Uploader Tool. Following upload, the submitted records were validated to confirm successful integration and data consistency. After successful validation, the accession records became publicly accessible through Genesys.

3. Results

The review of the national passport dataset identified differences in field structure, terminology, and formatting that required harmonization before international data exchange. National database fields were mapped to the corresponding MCPD descriptors, and the resulting records were prepared in a standardized structure for Genesys integration.

The preparation process established a consistent data structure linking the national passport database with the MCPD framework. Taxonomic and geographic information were also reviewed during data preparation to improve the consistency and reliability of the submitted records.

The public-accessibility filtering procedure was applied before data submission to Genesys. The "Is public = Yes" criterion was used to identify accession records eligible for international dissemination. A total of 15,286 accessions were uploaded, representing 117 families, 460 genera, 892 species, and 367 subspecies. Of these, 10,296 accessions were maintained in medium- and long-term cold storage facilities (Figure 3).

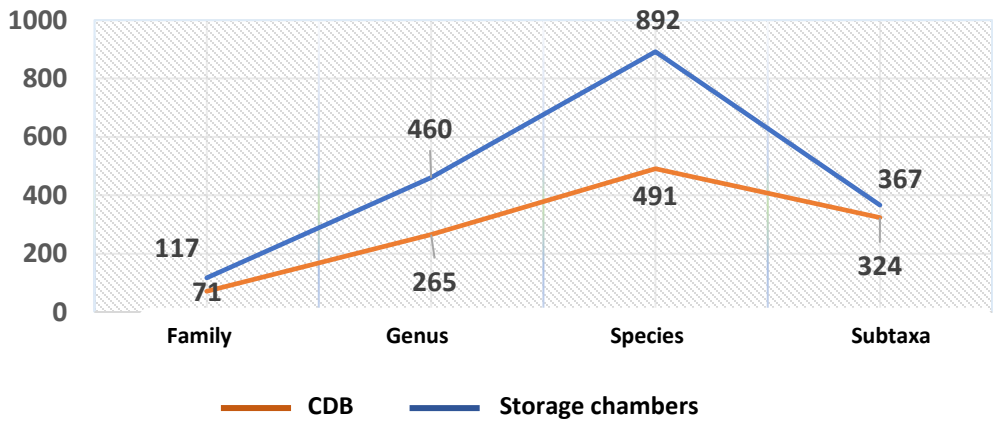


Figure 3. Distribution of accessions in the CDB and in medium- and long-term cold storage according to taxonomic groups.

The integration made eligible passport information from the Azerbaijan National Genebank available through an international PGR information environment. The standardized records can be discovered using the information made available through Genesys and can support further research, breeding, and comparison of plant genetic resources.

The CDB contains 15286 registered accessions belonging to a broad range of plant genetic resources. For the purpose of contextualizing the integration dataset, the collection comprised cereals, legumes, medicinal plants, forage plants, industrial crops, vegetable crops, and fruit crops (Figure 4).

The registered accessions comprised 6123 cereals (40.1%), 2112 legumes (13.8%), 849 medicinal plants (5.6%), 815 forage plants (5.3%), 1670 industrial crops (10.9%), 937 vegetable crops (6.1%), and 2780 fruit crops (18.2%).

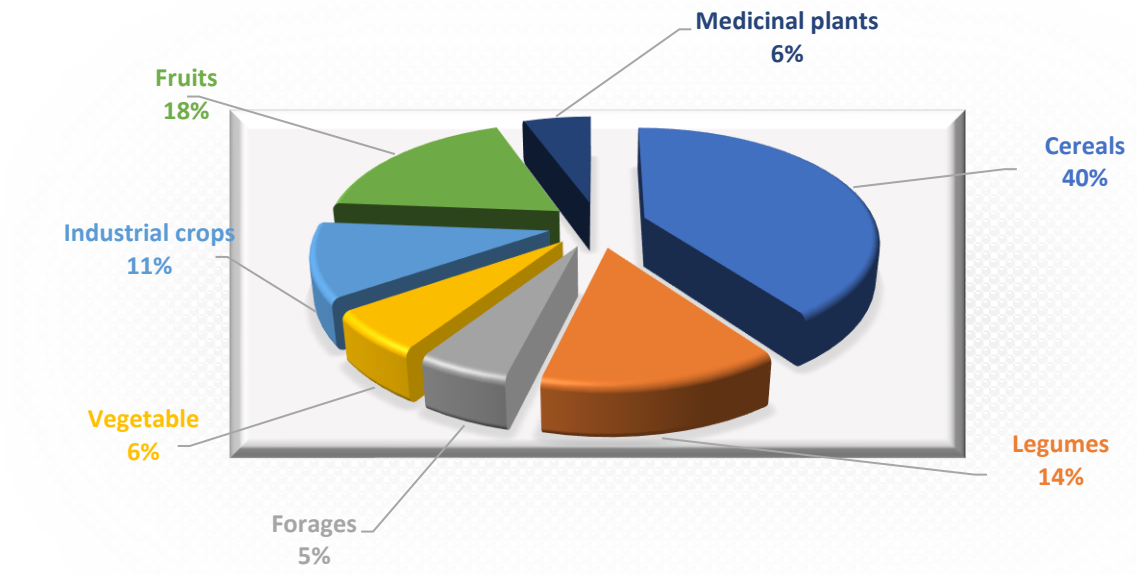


Figure 4. Distribution of registered accessions among major crop groups.

4. Discussion

The preparation of Azerbaijan National Genebank passport data for integration into Genesys demonstrates that international accessibility of Genebank information depends on the quality and structure of the underlying national data. Integration is therefore not limited to the technical transfer of records; it requires prior data refinement, standardization, verification, and appropriate selection of publicly accessible information. This is consistent with the broader role of information management in the long-term conservation and use of plant genetic resources [4].

The use of MCPD provided a common framework for mapping national passport fields to an internationally recognized descriptor structure. Standardized passport information facilitates the exchange and interpretation of accession data across information systems and contributes to the broader interoperability of PGR documentation [2], [7].

The verification of taxonomic and geographic information was an important component of the preparation process. Accurate passport information is essential for the interpretation and discovery of Genebank accessions, while inconsistencies in passport data can reduce their value for users and affect the reliability of information exchanged between databases [2].

The use of a public-accessibility filter also demonstrates the importance of distinguishing between information maintained within a national database and information that can be disseminated through an international platform. The “Is public = Yes” criterion provided a practical mechanism for selecting records eligible for public sharing.

Integration into Genesys makes Azerbaijan's plant genetic resource information discoverable beyond the national database environment. The experience is consistent with the role of international PGR information systems such as EURISCO in facilitating the discovery and use of conserved genetic resources through standardized passport information [5], [6]. The availability of national passport information through such systems can also complement ongoing efforts to document and conserve Azerbaijan's genetic resources [8], [9], [12].

The composition of the integrated collection, including cereals, legumes, medicinal, forage, industrial, vegetable, and fruit crops, illustrates the breadth of the national ex situ resource base. Such diversity provides a documented foundation for further characterization and utilization activities. Previous characterization studies from the

Azerbaijan National Genebank have similarly demonstrated the value of structured descriptor-based information for documenting conserved plant material [10].

The integration process also highlights the importance of maintaining passport-data quality after the initial submission. Changes to accession records, taxonomic information, and other passport fields require continued review and updating so that information available through international platforms remains consistent with the national collection. Regular maintenance is particularly important for the long-term reliability and usefulness of Genebank information systems [4], [13].

Future work should therefore focus on regular updating of passport records, improving data completeness, maintaining MCPD compatibility, integrating additional datasets, and strengthening links between passport, characterization and evaluation information. Such developments would further improve the value of the national information infrastructure for research, breeding and international collaboration.

4. Conclusion

The harmonization and integration of Azerbaijan National Genebank passport data into Genesys established a standardized pathway for international data exchange and improved the accessibility of information on conserved plant genetic resources. The application of MCPD, together with data refinement, field mapping, metadata verification, and public-accessibility filtering, provided a practical basis for preparing national passport information for integration into an international PGR information platform. The experience demonstrates that effective digital integration requires coordinated attention to data structure, terminology, quality, and public-access conditions. Continued maintenance and updating of the national dataset will support the reliability and long-term usefulness of the information made available through Genesys and will facilitate the wider discovery and potential use of Azerbaijan's conserved plant genetic resources.

Author Contributions

The sole author is responsible for conceptualizing, collecting, and analyzing data, and writing and editing the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

Funding

This research received no external funding.

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