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PLANT GENETIC RESOURCES INFORMATION SYSTEM OF SLOVAKIA AS THE PRIMARY SOURCE OF THE INFORMATION

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Thanks to the support of two projects from European Regional Development Fund of European Union the National Agricultural and Food Centre, Research Institute of Plant Production in Piešťany (Slovak Republic) provides the development and deployment of an information system GRISS designed for complex information management research of plant genetic resources for food and agriculture and to support of management processes accessions of plant genetic resources stored in Genebank according to international principles and in accordance with the National Programme of Conservation of Plant Genetic Resources for Food and Agriculture in Slovak Republic. Genebank is responsible for the providing of the Genetic Resources Information System of Slovakia (GRISS). An information system is used through the Web interface used by the curators of collections of plant genetic resources and users from breeder's institutions, universities, public institutions, and others. Currently, the Information System provides passport information on more than 27.000 accessions and more than 23.000 accessions stored in active and basic collection in the Genebank. At present, the Slovakian collection in the European Search Catalogue for Plant Genetic Resources (EURISCO) represents 17.142 accessions from which 640 accessions are included in the European Genebank Integrated System (AEGIS). On request of plant breeders, researchers, but also private persons, the genebank is distributing research material amounting to over 2.000 samples in response to more than 50 individual requests per year. The information system GRISS is freely accessible at http://griss.vurv.sk.

Keywords: plant genetic resources, accessions, information system, GRISS, web application, passport data, evaluation data

Introduction

The *ex situ* conservation of plant genetic resources started by the mid-twentieth century as a reaction to the rapid loss of agricultural biodiversity, mainly due to the replacement of landraces by improved varieties (Gepts, 2006; Van de Wouw et al., 2009; Khoury et al., 2014). Genebanks were created in the mid-twentieth century to preserve cultivated biodiversity. The Genebank in the Research Institute of Plant Production in Piešťany (RIPP) is a coordination of

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activities under the National Programme of Conservation of Plant Genetic Resources for Food and Agriculture in the Slovak Republic. The National program is a long-term program of the Ministry of Agriculture and Rural Development of Slovak Republic. Genebank is responsible not only for the methodological leadership and coordination of the international cooperation but also for documentation of plant genetic resources (PGR) in the form of national information system GRISS (Genetic Resources Information System of Slovakia). An integral part of activities with plant genetic resources in the Genebank of Slovak republic consists of records keeping and documentation of all *ex situ* seed accessions of generatively propagated plant species stored in the active and basic collection as well as fruit species, vegetatively propagated species and *in vitro* maintained cultures. Other activities belonging to informatization include the following activities such as reception of accessions, germination control, seed monitoring, regeneration of accessions as well as distribution of accessions to users. There is no need to emphasize that such a volume of informally demanding activities could not be effectively managed without a sufficient information system. GRISS acts as a data source for global information systems, such as the Global Biodiversity Information Facility (GBIF) (Endersen, Knupffer, 2012) or the European Search Catalogue for Plant Genetic Resources (EURISCO) (Faberová, 2010; Weise et al., 2017).

The aim of this paper is to present the highly complex work of the Slovak genebank maintenance is supported by the management component of the new Information System GRISS.

Material and methodology

Conceptual and technological framework

GRISS is a new plant germplasm information system (IS) that will replace the earlier offline version of the genetic resources documentation system – EVIGEN used since the opening of Gene Bank in 1996 (Žáková, 2004; Žáková, 2005). IS GRISS is fully compatible with the passport descriptors standards of FAO/Bioversity Multicrop Passport Descriptors – MCPD v.2.1 (Alercia et al., 2015). IS GRISS is conceptually, methodically and methodologically compatible with the largest online search systems in Europe and USA, represented by GBIS and GRIN (Oppermann et al., 2015; Faberová, Papoušková, 2013; Papoušková, 2016).

Base system unit

The basic unit kept separately in a genebank is called an accession, which is represented by physical objects such as seed samples, plants from an accession grown together in a field plot or material preserved *in vitro*. All these iterations of an accession share their origin and common information.

Taxonomy

Information about scientific names of genebank accessions is fundamental. The taxonomic hierarchy, e.g. genus, species, and infraspecific taxa, is reflected in the system. The taxonomic system of IS GRISS is based on the concept (Marhold and Hindák, 1998).

Information management

IS GRISS is determined to comprehensive management of accessions of plant genetic resources stored in the National Agricultural and Food Centre, Research Institute of Plant Production in Piešťany in the Genebank in accordance with international principles and in accordance with the National Programme (Benediková et. al., 2014). GRISS presents the platform for information about *ex situ* plant collections maintained in Slovak republic. IS GRISS allows users to search and obtain information about a number of crop species such as cereals, legumes, fodder crops, medicinal and aromatic plants, wild species, landraces, and breeding lines. IS GRISS allows search by crop, taxonomy, country of origin, acquisition, accession status, and other passport descriptors. The collected germplasm is freely available for use in scientific research programs. IS GRISS provides access to information's not only the managers of genebanks but also provides information to other curators of collections, scientists, plant breeders, farmers, students and the general public responses.

Search catalog

All information collected by the information system is provided by the user via the online search system. The information system GRISS is freely accessible at the web portal http://griss.vurv.sk (Mendel et al., 2013; Mendel et al., 2016).

Ordering Germplasm

To support the key task of genebanks, to provide seed samples to breeders, researchers and the public domain, comprehensive information needs to be managed. User need to be logged in to order germplasm

Results and discussion

IS GRISS is designed as a web application that provides a sophisticated web interface for simple data input via a web browser. Information system GRISS allows curators of collections of plant genetic resources automated support for all activities related to the creation and management of passport data and characterization/evaluation data. It enables effective management of the collections. Information system mainly used to curators of collections to prepare, management and archiving of protocols, preparation and editing passport and evaluation data for accessions. IS GRISS at every moment provides an overview of stored or processed accessions in all collections, allow accessions lists to effectively filter according to many criteria, manage the process of accessions regeneration, control and evaluate users requests to provide individual items. It provides mechanisms for access to stored data and their individual analysis and export data to <.xls> file.

IS GRISS in terms of user target groups and related functions is divided into two functional and interdependent parts:

a) Front Office – public part of IS, a web application designed primarily to public users from the professional community, facilitates communication and dissemination of knowledge accumulated from the research of plant genetic resources in Slovakia. In particular, it is the communication of basic information on the accessions of

plant genetic resources stored in the Genebank. Registered users (applicants) also have the opportunity online to order accessions of plant genetic resources through the ''shopping cart''.

b) Back Office – non-public part of IS accessible only for authorized users – curators of collections of plant genetic resources through a user name and password. This section is primarily dedicated to curators of genetic resources, laboratory technicians, system admins and genebank management to comprehensive management of all *ex situ* accessions of plant genetic resources stored in an active and base collection in the Genebank of Slovak republic.

Information system GRISS is used by all institutes cooperating within the National Programme of Conservation of Plant Genetic Resources for Food and Agriculture in the Slovak Republic. Internally is composed of 3 parts: passport data, characterization/evaluation data and storage data.

Passport data

Passport data present basic information on crops – a unique identifier = national accession number, genus, species, name of genetic resources, as well as information about holding institute code, country of origin, status of accessions, source of the material, date of collection, type of storage, whether the genotype has safety duplication in another genebank, MLS, etc. Passport descriptors also contain information about wild material received from collection missions such as the collector's institute name, collection number, collection name, geographic data and description of the collection site. All passport data are compliant with the Multicrop Passport Descriptors standard – MCPD v.2.1 (Alercia et al., 2015). The passport part of the National inventory of Slovakia is replicated to the global system for plant genetic resources in Europe – EURISCO (Weise et al., 2017). At present, the Slovakian collection in EURISCO catalog represents 17.142 accessions from which 640 accessions are included in the AEGIS system (Engels et al., 2011). The national accession number is assigned to the genetic resource as the unique identifier. The accession number, in a key field is the first step to include an accession into the documentation system. Curators of collection assign the national accession number to the accessions according to set rules. The national accession number consists of holding institution code, crop code and the serial number of the accession with the crop collection (Mendel, 2019).

Characterization and evaluation of data

C & E data constitute the basis for a standardized characterization system that provides an internationally agreed format and universally understood 'language' for plant genetic resources data (Gotor et al., 2008). Recently, more attention has been paid to increasing the effective utilization of genetic resources through their characterization and evaluation. The evaluation is based on 2–3 years of field experiments where accessions are evaluated by IPGRI/ Bioversity International through crop standard descriptors list these allowing for simple and rapid discrimination between all phenotypes (Oppermann et al., 2015). In contrast to the passport descriptor set with universal usability, characterization and evaluation descriptors

are specific for Genera, characterization and evaluation data are coded on a scale 1–9 according to descriptor lists. Field trials are usually complemented by laboratory tests according to specific crop needs. Descriptive data that is of major importance to users is available to vary degrees from 12.000 genetic resources, i.e. 67% of all accessions due to field and laboratory tests. In general, descriptors contain morphological, biological, biochemical, cytological and yield data. Each year approximately 2000 PGR's are involved. The data obtained from the experiments are processed and included in the information system.

Storage data

Information on storage documentation is contained in the third part of the GRISS system. Besides the accession number, there is an acquisition number, the code for the location of the accession in storage, germination ability, moisture content, amount of seeds in the container, storage date of accession is entered. Also documented is how much, when and to whom parts of the accession have been distributed. All other data are available in the passport part via accession number. Each accession stored in the genebank should have an accession number, which is assigned by the curator of the collection. End-users are mainly research institutes, other genebanks, breeders and universities. A smaller proportion of the accessions is distributed to museums for exposure purposes. Accessions are distributed free of charge on the basis of signed SMTA (Standard Material Transfer Agreement). On request of plant breeders, researchers, but also private persons, the genebank is distributing research material amounting to over 2.000 samples in response to more than 50 individual requests per year compared to the German genebank which distributes 30.000 samples per year (Oppermann et al., 2015).

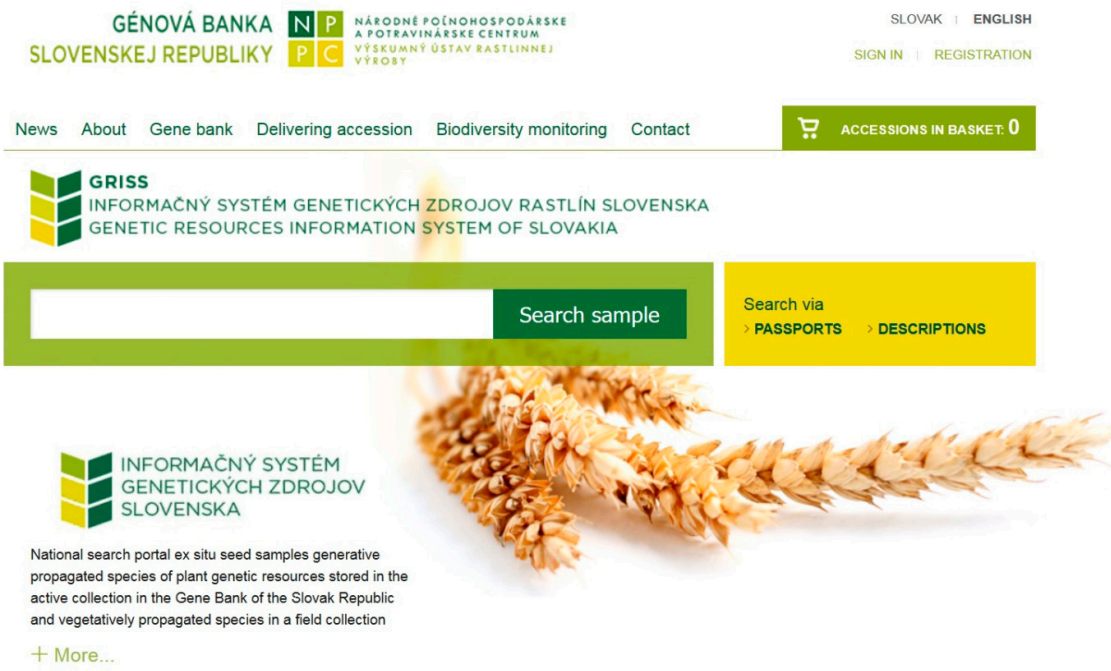

Figure 1 Users interface at http://griss.vurv.sk

The Slovakian *ex situ* plant germplasm collection is illustrated (Table 1). The largest proportion of the accessions belongs to cereals and legumes. More information about accessions can be obtained from the web portal of IS GRISS.

Table 1 Structure of National Collection of Plant Genetic Resources of Slovak Republic in the Genebank

Crop Group	Number of accessions	
	Active Collection	Basic Collection
Aromatic & Medicinal plants	467	43
Beet	152	56
Cereals	11,299	1,817
Flowers	28	62
Grasses	203	89
Vegetables	325	143
Legumes	3,430	1,044
Oilseeds	608	288
Fodder crops	960	83
Industrial crops	476	240
Corn	841	416
Pseudocereals	251	18
Total	19,040	4,298

Conclusions

Thanks to the new IS GRISS for PGR data documentation mainly good interconnection of all three main working areas: passport, characterization/evaluation, and storage parts and profiting from the construction of descriptor lists published by Bioversity. The main effect of the new IS GRISS is overall increase in the quality of documentation of plant genetic resources in the Slovak Republic, where the curators of the new system enable more effective management of PGR collections as well as significantly improve the efficiency of selecting the most suitable resources for the specified use (breeding material or experimental material etc.). The system also facilitates getting information about PGR and also enabled online orders of PGR provided from the gene bank for home and foreign users. At international level has improved compatibility with other documentation systems and international data exchange, mainly for EURISCO. IS GRISS was built as an open system and modular scalable system. The modular system architecture allows its future expansion with additional subsystems such as barcode, image analysis and geographic information systems (GIS). The concept of a comprehensive information system solutions, including interface based on the use of open standards and platforms ensuring low-cost ratio for future growth.

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