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Inventory of the conserved plant gene fund with a view to utilization of its biological potential in favor of the healthy nutrition

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Abstract

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The food security of the population depends to a large extent on the diversity of species providing clean and healthy food, as well as the ability to respond adequately to the climate changes. Valuable plant accessions with local origin are stored in the National Genebank, which are an inexhaustible source of useful traits for crop breeding and practice. *Ex situ* conservation also serves as a reserve of some of varieties which are threatened with extinction in nature due to the process of urbanization and intensive agricultural production. The purpose of the study is to determine the status of the stored collections of grain legumes, cucurbits and medical crops based on information in the electronic register of plant genetic resources. The locations of origin in the country have been marked and areas with concentration of local plant genetic resources have been identified. Routes for conducting expeditions to enrich the collections with a new plant germplasm for its sustainable conservation and use have been planed. As a result a total number of 85 local accessions were acquired in collections. The inventory was carried out in connection with activities of the National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" (WP 1.3 Providing of a plant resource base for priority food systems of the country).

Keywords: plant genetic resources, local origin, *ex situ* collections, genebank, passport descriptors

Introduction

The food security of the population highly depends on the diversity and adaptability of the species providing clean and healthy foods. Global climate changes affects the environmental factors, which put crops in unfavorable conditions for cultivation and development and this leads to ecosystem destruction (FAO, 2008; Stoilova et al., 2014; Borrell et al., 2019; FAO, 2021).

Plant genetic resources (PGR) are a valuable gene fund for every country, including old and primitive varieties and populations, wild relatives and protected species. Local accessions of grain legumes, vegetables and medicinal crops are a significant resource as a source material for crop breeding and for the utilization of their biological potential for healthy nutrition. These genotypes, formed as a result of the natural or artificial selection in population from farmers and adapted to a special regions in the country, get used very well to the unfavorable agri-environmental conditions. Indigenous varieties and populations are characterized by resistance to pathogens, as well as sources of traditional qualities and valuable economical traits (Krasteva et al., 2008; Danailov, 2012).

Compared to the modern varieties, local populations are less productive, less responsive to high level of agricultural technology, but on the other side they have a high degree of resistance to various factors of abiotic and biotic stress. This defines them as suitable resources for organic farming and environmentally sustainable production (FAO, 2002).

Ex situ conservation guarantees the preservation of PGR for present and future generations and acts as a reserve for some of the diversity that is threatened by extinction in nature due to urbanization and intensive agricultural production (FAO, 2014). By expanding collections documentation of plant genetic resources acquired a huge importance for information management of all conservation activities in genebank (Weise et al., 2020).

Bulgaria is characterized by one of the richest country with plant diversity in the Balkans. Valuable accessions from different cultures with local origin are stored in the National Genebank of IPGR Sadovo as an inexhaustible source of useful traits of crop breeding and agricultural practice (Krasteva et al., 2009).

The purpose of the study is the inventory of the conserved collections of local grain legumes, cucurbits and medical crops based on passport information in the electronic register of plant genetic resources.

Material and Methods

The National Seed Genebank in Sadovo was established in 1984 and the research activities are carried out according to the standards of FAO (2014).

The Center for Information and Documentation of IPGR Sadovo was established in 1982. It is responsible for registration of seed accessions, deposited in the fund of genebank, providing information for the state of *ex situ* collections, managing all databases of PGRs – Excel, Access, maintaining information in the electronic register, improving the information about collecting, evaluation and conservation activities, updating the National Inventory passport data on EURISCO Server.

The National Collection is enriched annually with an average of about 500 accessions new germplasm, mainly from the country and with valuable materials from abroad. All accessions are documented in the electronic database of plant genetic resources by passport descriptor in accordance with the International Standard of FAO/Bioversity (2017).

The local PGR accessions represent 25% of the conserved gene fund. They are registered under 36 passport indicators, including taxonomic description, biological status – local variety, population, wild or semi-cultural form; ecological type of the place – home garden, farm, natural habitat; habitat characteristics, including altitude, geographical coordinates; donor of the accession; organizer of the collecting mission, project; type of the collected material and other additional information about the accession. The issued from the Computer Center catalogue number contains the year of including the accession in *ex situ* collection, "E" – expedition material and the serial number of the accession. The electronic database allows sorting by year of registration, catalogue number and taxonomic description.

Information access to the PGR is guaranteed through the participation of accessions from the National Collection in international databases (Velcheva et al., 2017).

Results and Discussion

Grain legumes are a major contributor to global food production worldwide and are a major source of protein. According to GENESYS – the international electronic platform for PGR for food and agriculture (https://www.genesys-pgr.org/), they occupy about 15% of the accessions stored in genebanks. In Europe, according to ECPGR Grain Legumes Central Crop Databases (http://www.ecpgr.cgiar.org), grain legumes are represented by the following crops: *Cicer, Glycine, Lathyrus, Lens, Lupinus, Phaseolus, Pisum, Vicia faba, Vigna*.

The status of Bulgarian *ex situ* collection of local grain legumes, collected from expeditions, is presented in Table 1.

Table 1. Local grain legumes collections in the National Genebank*

№	Genus	Species	Origin	Number of accessions
1	*Cicer*	*arietinum*	BGR/Local	41
2	*Cicer*	*sp.*	BGR/Local	3
3	*Lathyrus*	*cicera*	BGR/Local	1
4	*Lathyrus*	*inermis*	BGR/Local	1
5	*Lathyrus*	*pancicii*	BGR/Local	1
6	*Lathyrus*	*sativus*	BGR/Local	7
7	*Lathyrus*	*sp.*	BGR/Local	8
8	*Lens*	*culinaris*	BGR/Local	5
9	*Lens*	*esculentum*	BGR/Local	12
10	*Lens*	*sp.*	BGR/Local	2
11	*Lupinus*	*elegans*	BGR/Local	10
12	*Phaseolus*	*coccineus*	BGR/Local	78
13	*Phaseolus*	*vulgaris*	BGR/Local	1767
14	*Phaseolus*	*sp.*	BGR/Local	2
15	*Pisum*	*elatius*	BGR/Local	2
16	*Pisum*	*sativum*	BGR/Local	18
17	*Pisum*	*sp.*	BGR/Local	2
18	*Vicia*	*faba*	BGR/Local	87
19	*Vigna*	*sesquipedalis*	BGR/Local	3
20	*Vigna*	*sinensis*	BGR/Local	10
21	*Vigna*	*unguiculata*	BGR/Local	57
22	*Vigna*	*sp.*	BGR/Local	3
Total number				2 308

* The data source is the electronic register of PGR in IPGR-Sadovo

The Cucurbits have been grown from thousands of years in our lands. They are of great economic importance in our country and worldwide. The fruits and seeds are used for consumption, medical purposes, as forage, as well as for decoration.

The status of collection of local accessions, collected from expeditions, from the genus *Cucurbita* is presented in Table 2.

Table 2. Status of *Cucurbita* accessions in the National Genebank*

№	Genus	Species	Origin	Number of accessions
1	*Cucurbita*	*maxima*	BGR/Local	57
2	*Cucurbita*	*moshata*	BGR/Local	37
3	*Cucurbita*	*ornamental*	BGR/Local	9
4	*Cucurbita*	*pepo*	BGR/Local	274
5	*Cucurbita*	*sp.*	BGR/Local	2
Total number				**379**

*The data source is the electronic register of PGR in IPGR-Sadovo

The collection of medical and ornamental crops of IPGR Sadovo includes 470 annual and perennial plant species divided in 60 families – local accessions, wild forms and crop wild relatives. The species *Foeniculum vulgare*, *Ocimum basilicum*, *Salvia*, *Sideritis scardica*, *Verbena hybrid*, *Lavandula*, *Tagetes erecta* and *Zinia elegans* are characterized with high diversity.

The results show that the National Genebank has a rich gene fund from local varieties, populations, wild species, including crop wild relatives, characterized by diverse geographical origins. The accessions are examined on morphological and biological traits by unified international characterization and evaluation descriptors for each crop. The comprehensive assessment identifies new sources of resistance to economically important diseases, examines the adaptive responses of accessions to stress factors, provides information on the nutritional qualities of different species and facilitates the wider use of PGR to create sustainable agriculture systems.

The inventory of the conserved gene fund identifies areas in the country with a concentration of local PGR where collecting missions are urgently needed to prevent the loss of valuable for crop breeding and agricultural practice diversity.

Expeditions were planned on the routes as follows: 1st expedition: region of Plovdiv (near Parvomai), district of Pazardzhik, Velingrad, Smolyan and Kardzhali; 2nd expedition: the region of Blagoevgrad; 3rd expedition: the region of Haskovo (Lyubimets, Svilengrad) and the Strandja area; 4th expedition: Northeast Bulgaria – the region of Dobrich (Figure 1).

*Source: https://www.mrrb.bg/en/regional-development/regions-in-bulgaria/

Fig. 1. Planned routes for conducting of expeditions for local PGR

Villages, sufficiently distant and with different ecological and geographical characteristics, were marked according to the methodology of conducting expeditions for collecting of PGR (Guarino et al., 2011). The selection of home gardens and small farms to be visited from researchers is made with the kind assistance of a representative agent from the relevant mayoralty or municipality.

During 2019-2021 as a result of the conducted expeditions a total number of 85 accessions were collected, including: sweet corn (1), bean (37), cowpea (1), chickpeas (1), broad bean (1), pepper (13), tomatoes (14), eggplant (1), pumpkin (11), garlic (1), 4 medicinal species (Figure 2). Accessions are acquired in *ex situ* collections as seeds, donated by farmers as a specific population belonging to a particular area and grown for traditional use in household. The greatest variety of old varieties and local forms has been found in cereals and legumes.

Sustainable conservation of PGR includes documentation activities as well as preservation of traditional knowledge and good practices of farmers who cultivate the local varieties (Vasileva et al., 2021; Velcheva & Stoilova, 2021). Therefore, a questionnaire was compiled including information on: the climatic characteristics of the area; cultivation technology, maturity, disease resistance, fruit quality, yield; where the accession was obtained from; how long it has been cultivated on the farm; area occupied by the accession; reasons for its cultivation – traditional, cultural/religious, market demand, taste; direction of production – for domestic consumption, local market, ecotourism, for the country/abroad, direct market/through an intermediary; traditional recipes for using, etc. The information is collected in an in-

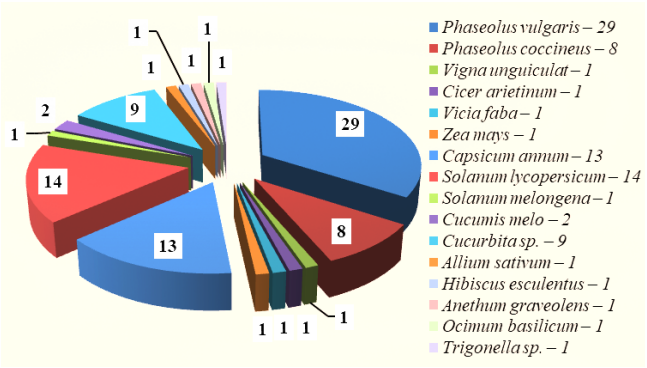

Fig. 2. Enrichment of the *ex situ* collections by National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" (WP 1.3 Providing of a plant resource base for priority food systems of the country)

formal discussion with the visited farmers. The restoration of old varieties in the agricultural practice, as well as preservation of traditional recipes as a part from Bulgarian culture, and their sustainable use has attitude to mitigating the effects of climate changes (Velcheva et al., 2021; Webb & Sonnino, 2021).

From the collected information it is established that in the home gardens of the visited villages in Southern Bulgaria: the village of Petkovo, the village of Arda, the village of Ognyanovo, the village of Sinitovo, the village of Selcha, the village of Mihalkovo, the village of Pavelsko and the village of Indje Voyvoda a large variety of vegetables, cereals, medicinal plants, flowers and spices are still grown. The structure of the farms from which seeds of local varieties are collected are different depending on the specifics of the region, but are generally small, aimed at meeting the needs of the particular household. Mainly hereditary seeds are used, which are maintained for many years in the family. The preservation over time of these old varieties is very closely related to their traditional use, the habits of local communities, family traditions, festivals and more. This unique heritage allows each village and region to give its specific qualities and taste to the native products. Along with the cultivation of a wide range of native species, farmers apply ecological practices in their cultivation and care for the collection of quality seeds for the maintenance of these specific varieties.

Accessions of local origin from Southwestern Bulgaria (Blagoevgrad region) have shown good adaptability and good yield potential in dry conditions. In a drought resistance test, they even exceed standard yields from conventional production. The dry matter content is indicative of suitability for use in the processing industry. According to this indicator, the accessions collected from the South Central region of the country (the regions of Pazardzhik and Asenovgrad) are aligned with the standard. The content of sugars in the fruit is a sign that determines the suitability of the product for the market, as it affects the taste. On this basis, the populations from the two central regions of the country are in the group of the standard, and those from Northeastern Bulgaria (Targovishte region) exceed the values in conventional production.

Conclusions

The current status of grain legumes, Cucurbits and medical crops conserved in the National Genebank of IPGR Sadovo, part from the European PGR *ex situ* collection, has been clarified and an inventory has been carried out.

The localities of origin are marked and areas with a high concentration of local PGR in the country are identified.

Routes for conducting of expeditions to enrich the *ex situ* collections with new germplasm with a view to utilizing the biological potential for healthy nutrition are planned.

As a result of the conducted expeditions a total number of 85 accessions were collected, including cereals, legumes, vegetables and medicinal species.

A questionnaire about plant materials and crop cultivation in origin area for interviewing farmers during the collection missions has been created and the information would be used in other research projects.

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References

Borrell, J. S., Dodsworth, S., Forest, F., Pérez-Escobar, O. A., Lee, M. A., Mattana, E., Stevenson, P. C., Howes, M.-J. R., Pritchard, H. W., Ballesteros, D., Kusumoto, B., Ondo, I., Moat, J., Milliken, W., Ryan, P., Ulian, T. & Pironon, S. (2019). The climatic challenge: Which plants will people use in the next century? *Environmental and Experimental Botany.* ISSN: 0098-8472, 103872.

Danailov, Zh. (2012). Tomato breeding and seed production (*Solanum lycopersicum* L.). History, methods, achievements, trends. "*Prof. Marin Drinov" Academic Publishing House,* Sofia, 265, (Bg).

FAO (2002). Organic Agriculture and Genetic Resources for Food and Agriculture. Rome. Italy.

FAO (2008). Climate Change and Biodiversity for Food and Agriculture. Rome. Italy.

FAO (2014). Genebank Standards for Plant Genetic Resources for Food and Agriculture. Rome. Italy.

FAO/Bioversity (2017). Multi-Crop Passport Descriptors. Rome. Italy.

FAO (2021). Interpretation of the international undertaking on plant. Genetic Resources. Available online: http://www.fao.org/3/z4968en/z4968en.pdf.

Guarino, L., Ramanatha Rao, V. & Goldberg, E. (editors) (2011). Collecting Plant Genetic Diversity: Technical Guidelines – 2011 Update. Bioversity International. Rome. Italy. ISBN 978-92-9043-922-6. http://cropgenebank.sgrp.cgiar.org/index.php?option=com_content&view=article&id=390&Itemid=557

Krasteva, L., Stoilova, T., Varbanova, K. & Neykov, St. (2008). Collecting of local plant genetic resources. *SUB-Plovdiv*, *VII*, 357-361, (Bg).

Krasteva, L., Stoilova, T., Varbanova, K. & Neykov, St. (2009). Bulgarian Landrace Inventory – Significance and Use. Bioversity Technical bulletin. 15. European Landraces: *on-farm* Conservation, Management and Use, 53-68.

Stoilova, T., Berova, M., Kuzmova, K. & Stamatov, S. (2014). Study on diversity of *Phaseolus* spp. landraces with reference to global climate change. *African Journal of Agricultural Research, Academic Journals, 9,* 2925-2935.

Vasileva, E., Stoilova, Ts., Uzundzhalieva, K., Velcheva, N., Petrova, S. & Chavdarov, P. (2021). Current state of agricultural ecosystems and plant resources, as a basis for the balance of food in Bulgaria. *Bulgarian Journal of Crop Science, 58(5),* 65-77.

Velcheva, N., Knüpffer, H. & Weise, St. (2017). Bulgarian National Inventory in International Plant Genetic Resources Databases. 135 years Agricultural Science in Sadovo and 40 Years Institute of Plant Genetic Resources, 137-144.

Velcheva, N. & Stoilova, Ts. (2021). Status of conserved local plant biodiversity in Bulgaria – new challenges and research priorities. *Ecologia Balkanica, Special Edition 4,* 153-161, Online ISSN: 1313-9940, Print ISSN: 1314-0213.

Velcheva, N., Stoilova, Ts. & Chavdarov, P. (2021). Enrichment of the local plant genefund for providing a resource base for priority agro-food systems. 75 years of AU-Plovdiv Jubilee Scientific International Conference. *Agricultural Science, 13 (Special Issue 29),* 85-93, ISSN 1313-6577.

Webb, P. & Sonnino, R. (2021). Everyone at the table, Co-creating knowledge for food systems transformation. Directorate-General for Research and Innovation, European Commission, ISBN 978-92-76-40362-3, DOI 10.2760/21968.

Weise, S., Lohwasser, U. & Oppermann, M. (2020). Document or Lose It – On the Importance of Information Management for Genetic Resources Conservation in Genebanks. *Plants, 9,* 1050.

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