

Plant Genetic Resources as a part of the biodiversity

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Summary

The preservation of plant biodiversity of Bulgarian flora is the main priority in scientific activities of IPGR – Sadovo. It is a part of the National Programme on Plant Genetic resources (PGR). Plant accessions in the base collections are evaluated according to the standards of FAO and European programme for PGR. The scientific programme for conservation of germplasm under controlled conditions in the gene bank is prepared according to the FAO requirements. The national collection of PGR in Sadovo includes crops and crop wild relatives- new varieties, selection lines, old varieties, local populations, mutants and wild species. The collection is divided into 7 main groups: cereals, grain legumes, industrial crops, vegetable crops, forage crops and medical and ornamental plants. The scientific work is carried out in 6 directions: enrichment with new geneplasm; evaluation of PGR; maintenance of PGR; conservation of PGR; documentation of PGR; use of PGR.

Key words: biodiversity, PGR, germplasm, gene bank

Introduction

Conservation of plant genetic resources (RGR) is a priority worldwide. According to the Convention on Biological Diversity (CBD), the sustainable use and conservation of crop diversity is a national task, duty and responsibility of each country. In line with the Convention is the International Treaty on Plant Genetic Resources for Food and Agriculture, which entered into force in 2004. The Institute of Plant Genetic Resources, Sadovo (IPGR) entered into this contract as a coordinator for Bulgaria.

The preservation of plant biodiversity of Bulgarian flora is the main priority in the scientific activities of IPGR – Sadovo that is a part of the National programme in Plant Genetic resources (PGR) through realization of the "Conservation, Management and Use of PGR in Bulgaria" Project. The main goal of the project is conservation of the national plant biodiversity.

Materials and methods

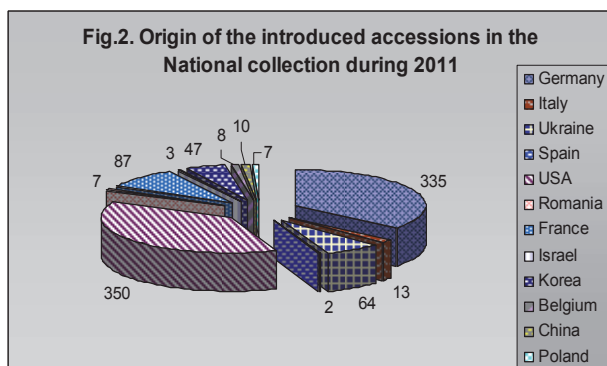
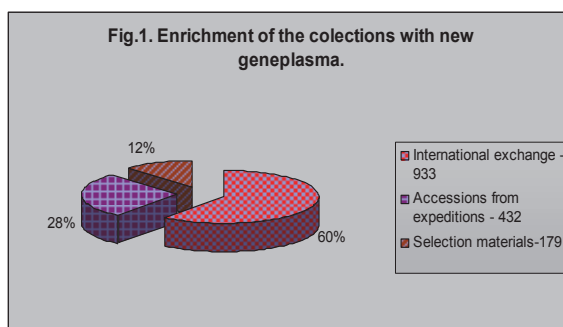
The plant accessions in base collections are evaluated according to actual methods, classification and standards of FAO and the European programme for PGR. The scientific programme for conservation of germplasm under controlled conditions in the genebank is prepared according to the FAO requirements.

Different methods for potato vine, mint, hops and medical plants storage-sterilization of starting explants, establishment of appropriate composition of the food environment are developed and applied for prolonged storage *in vitro*. To reduce the growth rate maintained at a high level of vitality, different approaches for each type of plant and its adjacent varieties are experimented with - low positive temperatures, growth inhibitors, osmotic stress, reduction of nutritive composition of culture media and their combined impact.

Results

The national collection of PGR in Sadovo includes crops and crop wild relatives- new varieties, selection lines, old varieties, local populations, mutants and wild species. The collection is divided into 7 main groups: cereals, grain legumes, industrial crops, vegetable crops, forage crops and medical and ornamental plants. The scientific work is carried out in 6 directions: enrichment with new germplasm; evaluation of PGR; maintenance of PGR; conservation of PGR; documentation of PGR; use of PGR.

Enrichment. Each year the collections are enriched with 950 to 1544 accessions (Fig. 1).



The biggest part of these includes the accessions either obtained through international exchange or collected during expeditions (Fig. 2.).

New accessions are registered with cat. Number and passport information.

Evaluation. By using the methods and

descriptors of Bioversity International and UPOV, evaluation of the accessions in

the main collections is done. During 2011, 2453 accessions were evaluated. The evaluation diagram for the *ex situ* collections is given in Figure 3.

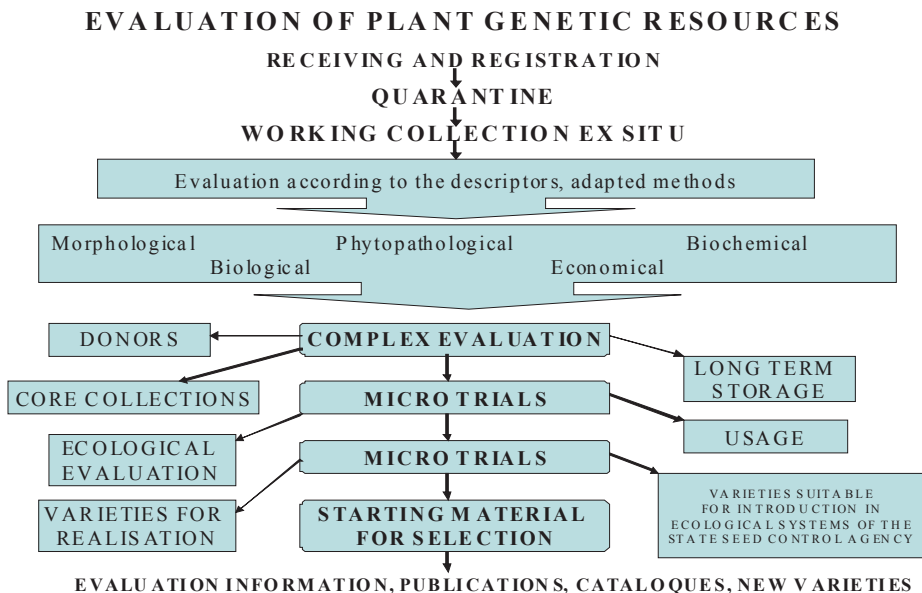


Fig. 3. Evaluation of plant genetic resources
Evaluacija biljnih genetičkih resursa

The evaluation of in situ collections is shown in Figure 4.

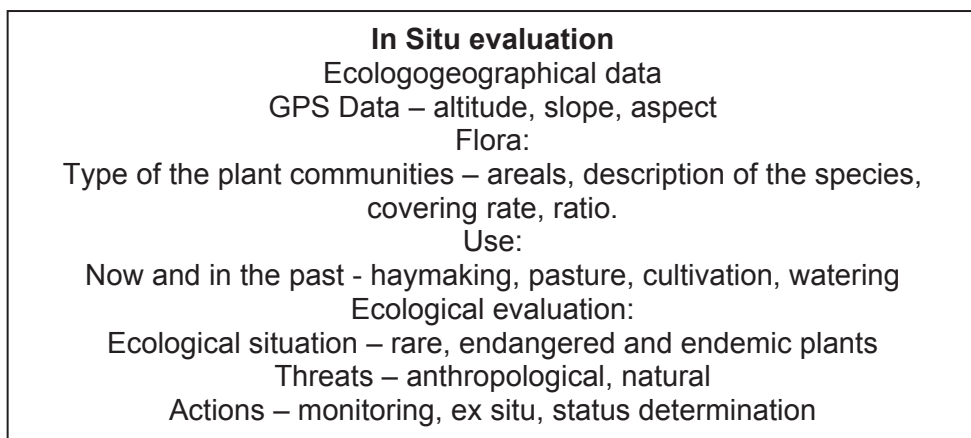


Fig. 4. In situ evaluation
In situ evaluacija

Maintenance of PGR. This is done by applying the most suitable methods:

Reproduction – each year about 2000 accessions are reproduced for their preservation.

Propagation – recognised grain legumes, forage and vegetable crops varieties are maintained.

In ex situ field collections, 983 accessions are maintained from vegetatively propagated crops - potatoes, forage grasses, sunflower, ornamental and medical species. *In situ* conservation – a database is created including the investigated areas with wild species in Strandja mountain, South Dobrudja, Black Sea (North), East and West Rhodopi mountains. *On farm* conservation – information is collected about areas where old varieties and forms are grown.

In vitro. For *in vitro* storage of vine plants, low positive temperatures (2 C°) allow growth suppression over a period of 18 months, but the vitality is lowered to 72%. The differences between cultivars and rootstocks are not essential (Ruseva, 2011).

For storage of varieties of hops and mint, the use of osmotic stress is recommended (high carbohydrate content in the culture media) and reduced content of culture media. Both approaches are suitable for maintaining samples of hops and peppermint for a period of one year and the reported viability of explants after the storage period is within 61% - 73% (Rousseva, 2000, 2011).

Figure 5. shows *in vitro* storage of the vine, potatoes and hops samples in test-tube cultures whose form is preferred over other type of culture vessels in order to prevent fungal and bacterial infections.



Fig.5. *In vitro* stored samples from the vine, potatoes and mint
Uzorci vinove loze, krompira i mente koji se čuvaju in vitro

As for medical plants, the experimental work requires longer time due to the specifics of each type. The same methods are applied separately as well as combined to establish optimal conditions for each of the species studied. The results achieved so far allow maintenance in *in vitro* conditions to a maximum period of six months but the extent of survival is not very high - 30-40% (Varbanova et al., 2002).

Currently, local Bulgarian and introduced varieties of potatoes, wine and dessert wine varieties and rootstocks from the vine, hops - Bulgarian and foreign selection as well as mint varieties are stored *in vitro*. Medical plants with warranted price for their medicinal qualities, typical for the flora of Bulgaria are also stored (Table 1.).

Tab. 1. *In vitro* collections of vegetative propagated plant species
In vitro zbirke biljnih vrsta dobijenih vegetativnim razmnožavanjem

<i>Solanum tuberosum</i> L.	VITIS spp.		<i>Mentha</i> spp.	<i>H. lupulus</i> L.	Medical plant species
	Bulgarian varieties	Introduced varieties			
Bulgarian varieties 67	Wine 23	Wine 22	species 4	Introduced varieties 17	<i>L. aestivum</i> L., <i>S. officinalis</i> L., <i>A. montana</i> L., <i>G. glabra</i> L., <i>L. vera</i> L., <i>A. beladona</i> L.
Introduced varieties 92	Desert 31	Desert 23	species 13		<i>S. rebaudiana</i> L., <i>R. tinctorum</i> C. <i>etythraea</i> L., <i>H. perforatum</i> L., <i>O. majorana</i> L., <i>H. officinalis</i> L.
Old varieties 11	Rootstocks 4				<i>N. cataria</i> L., <i>M. officinalis</i> L., <i>P. elongate</i> L., <i>S. scardica</i> L., <i>R. graveolens</i> L., <i>S. marianum</i> L.
Total 170	Total 103		Total 17	Total 17	Total 18

Completion of *in vitro* assortment continues each year after conducting preliminary studies on *in vitro* culture and micropropagation and testing of the storage conditions for each plant species and variety.

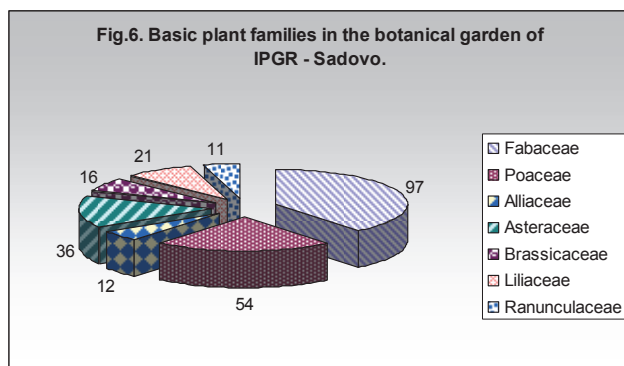
As a result of long-time research, all the methods mentioned are applied on *in vitro* storage of potato samples. The best results are achieved with the use of growth inhibitors, where 12-month storage is reached with preserved viability of explants up to 80% (Dimitrova, 2009).

Conservation of PGR. Bulgaria has a national PGR programme with gene bank whose main priorities are in line with international standards and national interests. The national genebank was developed in 1984 and undertakes a scientific programme for long-term preservation of germplasm with seeds under controlled conditions in accordance with FAO standards (1980/1995). The preservation of the diversity of cultural plant species and their relatives is carried out in 3 different

conditions: a base collection – long term preservation in air-proof packages under -18° C; a working collection – preservation of the seeds up to ten years under 6° C; an exchange collection – a non-currency exchange with partners from the national and international system is established.

The National Gene Bank supports more than 56 000 samples from 2 670 plant species. 39 340 samples are kept in the base collection. The specific activity of the laboratory to the gene bank includes the following tasks: seed control analysis and preparation of samples for preservation; monitoring of the status of the seeds; support of exchange collection and establishing of free exchange; defending of cultivar identity according to the methods of ISTA and UPOV. The national gene bank in IPGR - Sadovo is nominated by the European PGR programme as a focal point for Bulgaria, which is a significant achievement for the agricultural science. Thus, the right of other institutes in the country to join the system and participate in the electronic catalogue is protected. The database for the National Collection of PGR as part of the EURISCO - European electronic catalogue, can be found on the web site of the European Programme on Genetic Resources (<http://eurisco.ecpgr.org>) (Stoyanova, 2005; Koeva, 1987, Koeva et al., 1995). Information (uploaded on-line) is annually updated and there are conditions to include partners from other scientific institutes with their collections. As part of the database for Bulgarian collections of PGR (PHYTO `2002 in the ACCESS file format), Dobrudja Agricultural Institute - G. Toshevo and the Institute of Roses, Essential and Medical Cultures- Kazanlak also participate.

Documentation. By creating a European electronic catalogue, EURISCO (<http://eurisco.ecpgr.org>), it has become clear that we have the richest collection of plant gene pool stored in a gene bank in the Southeast Europe and the third largest collection of wheat varieties (common and hard) after those in Gatersleben - Germany and VIR - Russia. The electronic catalogue contains passport data, about 26 descriptors and includes 62 131 specimens, 57 710 of which are in the IPGR - Sadovo, 3 857 are at DAI - G. Toshevo and 564 in IREMC - Kazanlak. The total collection in the National gene bank - Sadovo, which is maintained under



conditions of medium and long term controlled storage, consists of 57 684 seed samples from more than 1 400 plant species, representatives of cultural and wild flora, of local and foreign origin (Stoyanova, 2007; Krasteva, et al., 2009, Angelova, et al., 1998).

There have been 238 crop species of

Bulgarian origin registered in the gene bank: 33 cereals, 34 grain legumes, 41 industrial crops, 29 vegetable crops, 43 forage crops, 19 ornamental and 39 permanent crops.

The Botanical garden is a specialised unit of the Programme of Plant Genetic Resources of IPGR – Sadovo. It was established in 2002 with its main goal being the preservation of local resources through *in vivo* and in garden conservation. Rare, endemic, and endangered plants are kept there belonging to 54 families (Fig.6). Out of their total number, 8 are Balkan endemics - *Achillea clypeolata*, *Allisoides bulgarica*, *Knautia macedonica*, *Chamaecitissus janke*, *Iris reichenbachii*, *Iris suaveolens*, *Aegilops cylindrica*, *Haberlea rhodopensis*, which is also rare; 5 are Bulgarian endemics - *Allium rhodopaeum*, *Sedum album*, *Vicia incisa*, *Aegilops neglecta*, *Soldanella rhodopaea*; 4 are endangered plants - *Leucosyrum aestivum*, *Artemisia pedemontana*, *Anemone sylvestris*, *Pyracantha coccinea*; 11 are rare plants - *Meum athamanticum*, *Artemisia lerchiana*, *Artemisia pontica*, *Leontopodium alpinum*, *Leucanthemum vulgare*, *Andrachne telephioides*, *Aegilops triuncialis*, *Koeleria brevis*, *Secale cereale var. perene*, *Clematis alpina*, *Paeonia tenuifolia*. The medical plant collection that is kept in the botanical garden comprises 51 species. The specimens in the Botanical Garden are divided thematically as follows: essential –oil plants; grasses; forage crops; ornamental plants; rare and endangered plants; crop wild relatives; introduced plant species.

Demonstrative collections in the botanical garden are made of species that include crop wild relatives, old varieties and ecotypes: *Beta maritima*, *Trigonella coerulea*, *Luffa acutangula*; old pea varieties as well as introduced plant species- *Physalis peruviana*, *Cynara scolymus*, *Cynara cardunculus*.

Herbarium collection. Enriched with samples from expeditions, a herbarium collection was created at the IPGR - Sadovo, including rare, endangered and endemic species: *Dracunculus vulgaris* – endangered; *Artemisia chamaemelifolia*; *Centaurea parilica* – rare, Balkan endemic plant; *Ligularia sibirica* – endangered; *Anthemis sancti-johannis* – rare, Bulgarian endemic plant; *Onosma rhodopaea* – endangered, Balkan endemic plant; *Trachelium rumelianum* – rare, Balkan endemic plant; *Astragalus physocalix* – Balkan endemic plant; *Gentiana punctata* – endangered; *Lilium rhodopaeum* – rare, Balkan endemic plant; *Geum rhodopaeum* – rare, Bulgarian endemic plant; *Origanum vulgare*.

Use of PGR. Exchange collection and use of the germplasm. It comprises 2930 accessions, and 1000 of them, stored for more than 5 years, are tested for vitality. Selection of starting material – 26 new varieties were created in the IPGR for 35-year period. Educational work – rare and endemic plants, crop wild relatives, old varieties as well as introduced varieties, medical and spice plants, divided in thematical collections are maintained in connection with different educational projects.

Conclusion

Priorities for future activities within the PGR Programme in the IPGR – Sadovo:

- Close interaction with the scientific and educational centres in Bulgaria;

- Collection of the existing old varieties and populations of vegetables, grain legumes, cereals, forage, ornamental and other crops;
- Establishment of new territories and producers for *in situ* and *on farm* conservation;
- Creation of demonstrative collections and trials for educational and practical purposes (with wild species, very old varieties, plants interesting for cultivation, etc.);
- Creation of seed plots with wild forage, medical, oil and other plant species for reintroduction or improvement of areas of high natural value.
- Preparation of a plan for interaction between biodiversity, agriculture and good practices.

Modern agriculture is based on a limited range of varieties and a few species. Generations before us have used countless local forms with large genetic variation, even within one country and region. The conservation and use of old plant material provides researchers, now and in the future, with valuable germplasm resistant to biotic and abiotic factors, many of which are stored only in the gene bank of PGRI - Sadovo.

References

1. *Angelova S., Z. Popova.* 1998. Evaluation of plant genetic resources – base for their utilization. *Plant Science.* XXXV. 10. 805.
2. *Dimitrova, D, M. Marcheva.* 2009. Maintenance and *in vitro* conservation of potatoes. *Acta Horticulturae*, vol. 1. pp.71-77.
3. *Koeva R.* 1987. Plant diversity in Bulgaria - strategy and challenge of today. *Plant Science.* XXXV. 10. 781.
4. *Koeva R., S. Angelova, Y. Guteva, D. Shamov.* 1995. Priorities of plant genetic resources program for biodiversity conservation in the country. *Scientific Session of the AU Plovdiv. IV. book 2.* 257-263.
5. *Krasteva, L., T. Stoilova, K. Varbanova, St. Neykov.* 2009. Bulgarian Landrace Inventory – Significance and Use. *Bioiversity Technical bulletin.* 15. European landraces: on-farm conservation, management and use. 53-68.
6. *Ruseva. R.* 2011. Long-term *in vitro* storage of grapevine varieties (*V. vinifera* L.) by low temperatures. *Journal of mountain agriculture on the Balkans*, Vol. 14, № 6, 1368-1379.
7. *Ruseva, R.* 2000. Increase of osmotic pressure in a culture medium for *in vitro* storage of mint explants. *Intern. conf. "Plant Biotechnology facing the new millennium"*, 16-18 oct. 2000, Kostinbrod, 15 – 17.
8. *Stoyanova S.* 2005. Protecting the identity of the original germplasm through *ex situ* conservation in the National Genebank. *Scientific conference "60 AU-Plovdiv"*. *Scientific works. L (5)* .195-200.
9. *Stoyanova, S.* 2007. National Genebank Strategy in implementation of the National program of Plant Genetic Resources. *PGR- The Basis of Agriculture of today.* Sadovo. 37-42.

10. *Върбанова К., Д. Димитрова, А. Стефанова.* 2002 Възможности за опазване на *Glycyrrhiza glabra* L. (сладък корен) чрез култивиране. Науч. Трудове Аграрен университет, т. XLVII, кн.1, стр.149 – 157.
11. <http://eurisco.ecpgr.org/>

Biljni genetički resursi kao dio biodiverziteta

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Sažetak

Očuvanje biljnog biodiverziteta bugarske flore je glavni prioritet u naučnim aktivnostima IPGR – Sadovo. On je sastavni dio Nacionalnog programa o biljnim genetičkim resursima (BGR). Prinove biljaka u baznim kolekcijama ocjenjuju se prema standardima FAO i Evropskog programa za BGR. Naučni program za čuvanje germplazme u kontrolisanim uslovima banke gena priprema se prema zahtjevima FAO. Nacionalna kolekcija BGR u Sadovu sadrži kulture i divlje srodnike biljaka – nove sorte, selekzione linije, stare sorte, lokalne populacije, mutante i divlje vrste. Kolekcija je podijeljena u 7 osnovnih grupa: žitarice, zrnate mahunarke, industrijsko bilje, povrtne kulture, krmno bilje, ljekovito i ukrasno bilje. Naučni rad je usmjeren u 6 pravaca: poboljšanje novom germplazmom; evaluacija BGR; održavanje BGR; čuvanje BGR; dokumentacija o BPGR; upotreba BGR.

Ključne riječi: biodiverzitet, BGR, germplazma, banka gena

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