

GENETIC RESOURCES OF GRAIN LEGUMES IN SERBIA

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Introduction

Grain legumes (fam. *Fabaceae*), comprising pulses and feed legumes, represent an important source of protein and energy for humans and domestic animals in Serbia like in other world countries.

Edible legumes with significant growing area in Serbia are dry and snap bean (*Phaseolus vulgaris* L.) and vining pea (*Pisum sativum* L.). The average annual consumption of dry bean is 10 kg per capita. One half of the demand for dry bean is provided by import. Pea and snap bean are important in processing industry and for export.

The production of dry bean is carried out usually on smaller fields, with stable harvested area and low and variable average yields. A statistically monitored part of the dry bean area in Serbia, related to pure crop, is between 20,000 ha and 30,000 ha. Snap bean for industrial purposes used to be cultivated as a pure crop on between 7,000 ha and 10,000 ha, while today in Serbia it is grown on about 1,000 ha. Vining pea is grown on between 12,000 ha and 15,000 ha. However, a good deal of dry bean production is carried out in intercropping with maize, while snap bean is grown in gardens. These areas, with no official records, should be added to those related to pure crop. Both ways of production in Serbia surpass 50,000 ha in dry bean and reach 5,000 ha in snap bean.

Only Serbian cultivars of dry bean are grown, developed either in the Institute of Field and Vegetable Crops in Novi Sad or in the Institute for Vegetable Crops in Smederevska Palanka, as well as domesticated cultivars maintained by farmers themselves. On the other hand, the modern internationally widespread cultivars are used in both vining pea and snap bean production for industrial purposes. In gardens, there are widely used local landraces of snap bean and old cultivars of vining pea.

Recently, soybean in Serbia has been grown on between 100,000 ha and 150,000 ha. All cultivars are of exclusively Serbian origin, developed either in the Institute of Field and Vegetable Crops or in the Maize Research Institute Zemun Polje in Zemun, both of which maintain extensive soybean collections.

Among feed legumes, it is field pea that is the most important, with a harvested area of about 30,000 ha. Another widespread feed legume is common vetch (*Vicia sativa* L.), together with Hungarian (*Vicia pannonica* Crantz) and hairy vetches (*Vicia villosa* Roth), all of which together take about 7,000 ha (Mihailović *et al.*, 2005). So far, it is the Institute of Field and Vegetable Crops that deals with the development of the cultivars of these species. Recently established research programmes in the same institute have produced the first Serbian cultivars of fodder faba bean (*Vicia faba* L.), white lupin (*Lupinus albus* L.), bitter vetch (*Vicia ervilia* (L.) Willd.) and grass pea (*Lathyrus sativus* L.), with a strategic aim of (re)introduction of these species into the Serbian agriculture. The cultivars of all these species are grown either for dry grain, or for forage, biomass or green manure, or for both purposes.

The intersection of major trade routes and the existence of many ethnic groups with their different dietary habits in the Serbia have caused great divergence of grain legumes genotypes, both of populations and of cultivars. This is a special feature of *Phaseolus* beans among edible grain legumes. At the same time, the Serbian wild flora is extremely rich in

annual legume species, where diverse *Vicia* and *Lathyrus* species are dominant, being the main reason for a growing interest in their *ex situ* conservation and sustainable utilisation.

Current situation in Serbian grain legume collections

The establishment of the National Gene Bank of Serbia has its roots in at least a two-decade old project of the National Gene Bank of the former Socialist Federative Republic of Yugoslavia. Located in Zemun, near Belgrade, the National Gene Bank today is at the final stage of establishment.

Meanwhile, there are several collections that continued to perform its task of the conservation, the management and the improvement of national genetic resources, alongside with their primary role of serving as a basis for diverse breeding programmes:

1. Institute of Field and Vegetable Crops in Novi Sad;
2. Maize Research Institute Zemun Polje in Zemun;
3. Institute for Vegetable Crops in Smederevska Palanka;
4. Institute for Agricultural and Technological Research in Zaječar.

It is researchers, most often breeders, who act like curators of these collections.

Along with the institutes, there are collections maintained by the Faculty of Agriculture of the University of Belgrade, the Faculty of Agriculture of the University of Novi Sad and the Faculty of Agriculture of the University of Priština, currently located in Lešak.

Each collection is described according to the descriptors recommended by ECPGR and is accompanied by its passport database and the results of characterization and evaluation.

The Institute of Field and Vegetable Crops has been involved in grain legume breeding for 70 years with a high-quality basis for all its directions in the form of diverse activities related to grain legume genetic resources. Its grain legume resources are maintained within its Soybean and Agroecology, Vegetable Crops and Forage Crops Departments.

The most numerous of the Novi Sad collections is the Annual Forage Legumes Collection (AFLCNS) in the Forage Crops Department. Despite its official name, this collection comprise species used in animal feeding not only in the form of forage, but in the form of dry grain as well. Today, it contains more than 2,200 accessions of about 70 species, with more than 600 accessions of pea and more than 1,200 accessions of diverse vetch species, dominated by common and large-flowered vetch (*Vicia grandiflora* Scop.). The accessions are characterised for the most important traits and evaluated for forage and grain yields, forage and grain chemical composition and resistance and tolerance to biotic and abiotic stress.

The Vegetable Crops Department maintains the edible legume collections. The *Phaseolus* collection has several hundreds accessions, mainly of dry bean and with a certain number of runner bean (*Phaseolus coccineus* L.), that belong to diverse market classes and agronomic types. A significant number of the accessions are local landraces, since common bean has been the most important pulse crop in the country for more than a century. The collections of vegetable faba bean and lentil (*Lens culinaris* Medik.) are being built up mostly of the local landraces (Vasić *et al.*, 2007). The collection of vining pea consists of about 300 accessions of diverse genographic origin and agronomic types, with dominant cultivars suitable for preservation, garden production, peeling, with high protein content and those of sugar pea.

The content of the collections in the Novi Sad Forage Crops and Vegetable Crops Departments and in the Institute for Vegetable Crops are shown in the Table 1.

Table 1. The content of the collections in the Novi Sad Forage Crops and Vegetable Crops Departments and in the Institute for Vegetable Crops (Mihailović *et al.*, 2006; Vasić *et al.*, 2006; Marković *et al.*, 2007)

	Name of species	English and local name(s)	Novi Sad	Smed. Palanka	
1.	<i>Cicer arietinum</i>	Chickpea; leblebija, naut	66	1	
2.	<i>Lathyrus sativus</i>	Grass pea; sastrica	35	-	
2.	<i>Lathyrus spp.</i>	vetchlings; grahori	52	-	
4.	<i>Lens culinaris</i>	Lentil; sočivo, leća	51	-	
5.	<i>Lupinus spp.</i>	Lupins; lupine	164	-	
6.	<i>Pisum sativum</i>	Common pea; obični grašak	975	104	
7.	<i>Pisum fulvum</i>	Red-yellow pea; mrkožuti grašak	13	-	
8.	<i>Phaseolus vulgaris</i> .	Dry bean; pasulj, grah	380	341	
9.	<i>Phaseolus coccineus</i>	Runner bean	10	5	
10.	<i>Vicia faba</i>	Faba bean, field bean; bob	141	5	
11.	Vicia	<i>sativa</i>	Common vetch; obična grahorica	496	-
12.		<i>grandiflora</i>	large-flowered vetch; krupnocvetna grahorica	462	-
13.		<i>hirsuta</i>	tiny vetch; kosmata grahorica	46	-
14.		<i>narbonensis</i>	Narbonne vetch; narbonska grahorica	45	-
15.		<i>pannonica</i>	Hungarian vetch; panonska grahorica	44	-
16.		<i>villosa</i>	hairy vetch; maljava grahorica	27	-
17.	<i>Vigna unguiculata</i>	Cowpea; crnookica	10	1	

Apart from the most important species listed in the Table 1, majority of which in Serbia is utilised for human consumption or in animal feeding, there are also maintained the accessions of the following species: groundnuts (*Arachis spp.*), pigeon pea (*Cajanus cajan*), calopo (*Calopogonium mucunoides*), hyacinth bean (*Lablab purpureus*), perennial horse gram (*Macrotyloma axillare*), Bengal bean (*Mucuna pruriens*), serradellas (*Ornithopus spp.*), *Phaseolus lunatus*, capitata pensilflower (*Stylosanthes capitata*), fenugreek (*Trigonella phoenicum-graecum*), various other vetches (*Vicia spp.*), adzuki bean (*Vigna angularis*) and mung bean (*Vigna radiata*). Nearly all these species were introduced in Serbia and are represented by a small number of accessions. A part of them can be successfully grown in the conditions of Serbia, while the others are used for scientific and educational purposes only.

The soybean collections have been deliberately excluded from the review so far due to its specific nature. There are references that soybean was cultivated in present Serbia a long time ago (Radić, 1878; Lukićević, 1902; Lapčević, 1929) under the name of *uljani pasulj*, 'oil dry bean'. Its area of cultivation was small and it was used for both human consumption and in animal feeding. Although it was brought in relation with dry bean, there was used not only its dry or immature grain, but its complete plant. Unfortunately, those old cultivars have not been preserved and does not exist any more.

In the Institute of Field and Vegetable Crops, the soybean collection comprises over 830 accessions belonging to the maturity groups from 000 to III and originating from 15 countries (Table 2.). There prevail the advanced cultivars, breeding lines and germplasm with special traits. The collection was established in 1975 and has been constantly enriched in number of accessions provided with passport and other relevant data. Of constant concern for

its maintenance and utilisation are both characterisation and evaluation of its accessions, with each of them maintained by sowing every second year and with at least 3,000 seeds available.

Table 2. The soybean collection in the Institute of Field and Vegetable Crops in Novi Sad

Country of origin	No. of accessions	Maturity group					
		000	00	0	I	II	III
China	89	-	-	22	27	36	4
Croatia	10	1	-	7	2	-	-
France	11	-	-	6	4	1	-
Germany	16	1	3	8	4	-	-
Hungary	20	-	-	15	5	-	-
Italy	1	-	-	-	1	-	-
Poland	1	-	1	-	-	-	-
Romania	23	-	5	7	6	5	-
Russia	12	-	-	10	2	-	-
Serbia	190	2	17	70	65	34	2
BiH, Srpska Rep.	1	-	-	-	1	-	-
Sweden	2	-	-	2	-	-	-
Ukraine	21	-	-	17	1	3	-
USA	390	1	12	84	102	158	33
Unknown	50	-	1	12	9	23	2
Total	834	5	39	260	229	260	41

The current status of the soybean collection in the Maize Research Institute Zemun Polje is shown in Table 3. A part of this collection is collected during the establishment of the National Gene Bank from 1989 to 1992.

Table 3. The soybean collection in the Maize Research Institute Zemun Polje

	From wide world	From the former Yugoslavia
No. of accessions	409	205
No. of genotypes	287	162
Size of accessions	14 - 8000 seeds	0.01 - 1kg
Emergence	2 - 100 %	4 - 100 %
Year of regeneration	1984 - 2007	1988 - 2007
Number of regeneration	0 - 6	0 - 5

For a new round of collecting from, old literature sources could be examined for indications where native landraces should be looked for. At the beginning of the 20th century, the most important pulses in Serbia were the common bean, lentil and pea. Of the three crops, only the first one was grown on a sizable acreage. Lapcevic (1923) specified that lentils were grown in eastern Serbia (Homolje, Stara Planina, Suva Planina), southwestern Serbia (around the Studenica Monastery) and western Serbia (around Pozega). He also mentioned that good common beans could be found around the Manasija Monastery along the Velika Morava River. Vladisavljevic (1928) commented on lentil landraces differing in grain color, which were grown in western Serbia and Backa region. As an owner of a seed-trading company, Vladisavljevic praised the foreign cultivars he was selling, but nevertheless he mentioned “rani niski”(early short), a native population of faba bean.

In the list of European cultivars, Vladisavljevic (1928) mentioned Tetovac and Gradistanac, domestic ecotypes of common bean which are nowadays referred to as market class of beans from these parts. Tetovac has the indeterminate climbing growth habit (type IV), with white and kidney-shaped beans. Rosić (1957), who collected 460 accessions of common bean from the Province of Kosovo and Metohija, focused his attention on Tetovac beans. This collection does not exist any more, but Tetovac beans are still the most widely distributed ecotype. They are companion cropped with corn in all parts of Serbia. The type varies in growing season length, growth habit and size of grain. Gradistanac is another important ecotype which originates from the region along the Danube River in eastern Serbia. It has the indeterminate growth habit (type III), with white and semi-flat beans. There are also other bean ecotypes with upright habit and white-coated seeds, which differ in seed size and shape (round, ellipsoid, cylindrical). White beans predominate in eastern and southeastern Serbia. Faba bean landraces can be found in the mountains (Vasić *et al.*, 2006). Landraces with coloured seeds predominate in western and south western Serbia. Indeterminate landraces with colored seed coat can be found along the Drina and Sava rivers. Most of these beans have the determinate and upright growth habit. Beans with white seed coats arrived in Vojvodina from Kosovo and Metohija, beans with colored seed coats from Bosnia and Croatia.

Of other grain legumes species, during few last years, a significant progress have been made in collecting and *ex situ* conservation of locally grown landraces of dry bean, faba bean, lentil and vegetable pea. Along with them, there are collected the wild populations of diverse vetch and vetchling species, with a great potential forage production, as well as of medicine legumes such as fenugreek.

Projects

The work on conservation of genetic resources has been improved by the participation of the Serbian institutions in both national and international bilateral and multilateral programmes such as FAO, ECPGR, South East European Development Network on Plant Genetic Resources (SEEDNet) and Grain Legumes Technology Transfer Platform (GL-TTP).

Within the cooperation with FAO, the decade reports on plant genetic resources in Serbia are regularly submitted. Its significant part is related to grain legumes, as a consequence of the fact that their genetic resources are also significant.

The cooperation with ECPGR was temporarily blocked but there is a sincere hope that this is a way to continue it. The first and the last participation took place during the Second Meeting of a Working Group on Grain Legumes in Norwich in 1998 (Maggioni *et al.*, 1998).

Serbia is an active SEEDNet member from its very beginning. Apart from collecting the accession of all mandate species, there are also legumes, emphasising the need to activate the National Seed Bank.

Nearly all Serbian institutions active in grain legume genetic resources are members of GL-TTP and are actively involved in their utilisation in both basic science and legumes breeding.

National projects.

The Ministry of Agriculture of the Republic of Serbia have been supporting collecting and maintenance of landraces and old cultivars for years. Every year there is a new call for financial support by the government to institutes and universities. This ministry also supports the management of the National Gene Bank, currently preserved in the Maize Research Institute Zemun Polje. From time to time, endangered accessions are regenerated in research institutes.

Within the technological projects, supported by the Ministry of Science and Technological Development of the Republic of Serbia, a work on the grain legume genetic resources is carried out, focused mainly on their characterisation and evaluation within breeding programmes. There is also a lively exchange of germplasm with the institutions from all over the world, new accessions with desirable characteristics enter the collections, core collections are

International projects.

ECO-NET 18817 *Search for new genetic variability in pea (Pisum sativum L.) and faba bean (Vicia faba L.) to support the development of sustainable agricultures.* (2008-2009). A multi-lateral project between France, Bulgaria, Russia, Serbia and Bosnia and Herzegovina, supported by the French Ministry of Foreign and European Affairs.

Conservation of the Genetic Resources of Annual Forage and Grain Legumes in Slovakia and Serbia (2008-2009). A bilateral cooperation between Slovakia and Serbia (2008 and 2009), supported by Slovak and Serbian Ministries of Science.

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