



## Neglected legume crops of Serbia - Faba bean (*Vicia faba*)

Vojislav Mihailović<sup>1</sup>, Aleksandar Mikić<sup>1\*</sup>, Mirjana Vasić<sup>1</sup>, Branko Ćupina<sup>2</sup>,  
Branko Đurić<sup>3</sup>, Gérard Duc<sup>4</sup>, Frederick L. Stoddard<sup>5</sup>, Pavol Hauptvogel<sup>6</sup>

<sup>1</sup>Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia

<sup>2</sup>Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia

<sup>3</sup>Faculty of Agriculture, University of Banja Luka,

Banja Luka, Republic of Srpska, Bosnia and Herzegovina

<sup>4</sup>Institut National de la Recherche Agronomique, Unité Mixte de Recherche en Génétique et Ecophysiologie des Légumineuses à Graines, Building B1, 17 Rue de Sully, 21065 Dijon, France

<sup>5</sup>University of Helsinki, Department of Agricultural Sciences,

Latokartanonkaari 5, FIN-00014 Helsinki, Finland

<sup>6</sup>Plant Production Research Center Piešťany, Bratislavská cesta 122, 921 68 Piešťany, Slovakia

**Summary:** Faba bean is cultivated locally in Serbia with no available official data. The collection at Institute of Field and Vegetable Crops in Novi Sad contains 141 accessions of food and feed faba bean. Forage yields in faba bean may surpass 40 t ha<sup>-1</sup> of green forage and 8 t ha<sup>-1</sup> of forage dry matter, while grain yields are often higher than 5 t ha<sup>-1</sup>. Faba bean may produce more than 1,500 kg ha<sup>-1</sup> of forage crude protein and about 2,000 kg ha<sup>-1</sup> of grain crude protein, as well as more than 250 kg ha<sup>-1</sup> of above-ground biomass nitrogen. The first Serbian feed faba bean breeding programme, carried out at Institute of Field and Vegetable Crops in Novi Sad, resulted in registration of two cultivars in 2007, Gema and Šarac, with more than 4,500 kg ha<sup>-1</sup> of grain and more than 45 t ha<sup>-1</sup> of green forage.

**Key words:** breeding, faba bean, forage, grain, quality, *Vicia faba*, yield

### Origins and distribution

Faba bean (*Vicia faba* L.) originates from Central Asian centre of diversity (Zeven & Zhukovsky 1975) and from here it has spread in all directions, mostly towards China and Near East. It is one of the first domesticated plants with archaeological findings in Syria about 10,000 years old (Tanno & Willcox 2006). In comparison to other legume crops, faba bean reached Europe later, but soon became the main pulse in the Mediterranean areas in the second millennium BC (Ljuština & Mikić, 2008).

The same form of the word denoting faba bean in all modern Slavic languages, having been derived from the Proto-Slavic \**bobŭ*,

Project 20083: *Advance in forage crops production for healthy feed production* (2008-2010) of the Ministry of science and technological development of the Republic of Serbia / Projekat 20083: *Unapređenje tehnologije gajenja krmnih biljaka u funkciji proizvodnje zdravstveno bezbedne stočne hrane* (2008-2010) Ministarstva za nauku i tehnološki razvoj Republike Srbije

Project 18817: *Recherche de variabilité génétique nouvelle de pois et fève, pour développer ces protéagineux dans des agricultures durables* (2008-2009), between France, Bulgaria, Russia, Serbia and Bosnia and Herzegovina, within the ECO-NET Programme of the Ministry of foreign and european affairs of France / Projekat 18817: *Istraživanje nove genetičke varijabilnosti graška i boba u svrhu njihovog korišćenja u održivoj poljoprivredi* (2008-2009), između Francuske, Bugarske, Rusije, Srbije i Bosne i Hercegovine, u okviru ECO-NET programa Ministarstva spoljnih i evropskih poslova Republike Francuske

Project SK-SRB-01307: *Conservation of the genetic resources of annual forage and grain legumes in Slovakia and Serbia* (2008-2009), within the bilateral scientific cooperation between Slovakia and Serbia / Projekat SK-SRB-01307: *Očuvanje genetičkih resursa jednogodišnjih krmnih i zrnih mahunarki u Slovačkoj i Srbiji* (2008-2009), u okviru bilateralne naučne saradnje između Slovačke i Srbije

\*autor za kontakt / corresponding author  
(mikić@ifvcns.ns.ac.rs)

with the same meaning (Mikić et al. 2007c), proves that this crop was well-known to the ancestors of Serbs and other Slavic peoples before their great migration from their original homeland in eastern Europe fifteen centuries ago (Mikić-Vragolić et al. 2007).

However, over the past few centuries faba bean was replaced in Serbia and many other Balkan countries by *Phaseolus* beans, which became the most important pulse in national cuisines (Vasić et al. 2009b) leaving faba bean to be used in diets sporadically, such as in Orthodox monasteries in both Serbia and Republic of Srpska (Đurić, pers. comm). Today, faba bean is cultivated in Serbia rather locally with no official statistical data available (Mihailović et al. 2005).

### Genetic resources

On a world scale, there are at least 37 listed faba bean collections with more than 38,000 accession entries. The greatest difficulty in maintaining a faba bean collection remains a partial allogamous status of this crop, while there is a need for more research on pollinators and preservation of genetic diversity within populations (Duc et al. 2008).

There are two collections of faba bean in Serbia, namely at Institute of Vegetable Crops in Smederevska Palanka, with 5 accessions of food faba bean, and at Institute of Field and Vegetable Crops in Novi Sad, with 141 accessions of both food and feed faba bean (Vasić

et al. 2009c). Along with faba bean, the Novi Sad collection contains another 21 *Vicia* species, including Narbonne vetch (*V. narbonensis* L.) which is its closest relative (Mikić et al. 2008), and detailed passport data and characterization of the most important traits (Mihailović et al. 2007c).

Re-introduction of traditional legume crops, such as faba bean, represents one of the least expensive and the most quality answers to a demand for high-value agricultural products for human and animal consumption in Serbia today, where local landraces may play a significant role (Vasić et al. 2006, Vasić et al. 2008b). A wide action aimed at collecting local landraces of faba bean in Serbia started in 2008, mostly through contacts and visits to farmers and green markets (Hauptvogel et al. 2008, Vasić et al. 2009a). About 30 locally-grown and *on farm* maintained landraces of faba bean were collected during 2008, mainly in wider regions of Novi Sad and Kruševac (Hauptvogel et al. 2009).

### Cultivation potential

As many other annual legumes, faba bean is a multi-purpose crop and may be used for both human consumption and animal feeding, in the form of green forage, forage dry matter, forage meal, pods with undeveloped grains, immature grain, mature grain and straw, as well as green manure (Mikić et al. 2006).

Tab. 1. Average values of the forage yield components and forage yields of faba bean accessions during 2004 and 2005 at Rimski Šančevi (Mihailović et al. 2006b)

Tab. 1. Prosečne vrednosti komponenti prinosa kreme i prinosa kreme akcesija boba 2004. i 2005. na Rimskim Šančevima

Accession name / Naziv akcesije	Plant height / Visina biljke (cm)	Number of stems / Broj stabala (plant <sup>-1</sup> )	Number of internodes / Broj internodija (plant <sup>-1</sup> )	Yield of green forage / Prinos zelene kreme (g plant <sup>-1</sup> )	Yield of green forage / Prinos zelene kreme (t ha <sup>-1</sup> )	Yield of forage dry matter / Prinos suve materije kreme (g plant <sup>-1</sup> )	Yield of forage dry matter / Prinos suve materije kreme (t ha <sup>-1</sup> )
No. 7	56	1.4	18.0	45.73	31.9	8.11	5.4
B-206	66	1.5	17.0	41.29	30.5	7.94	6.4
Liber	87	2.0	22.0	72.99	46.7	15.39	9.3
Brok	74	2.1	17.7	64.73	43.3	15.69	12.7
Nadwislanski	69	1.3	21.0	60.58	40.0	12.80	8.7
LSD <sub>0,05</sub>	7	0.4	2.9	18.57	10.2	3.80	3.9
LSD <sub>0,01</sub>	10	0.6	3.8	25.87	14.6	5.78	5.4

Preliminary evaluation of forage yields in faba bean spring cultivars of diverse geographic origin has shown that this species may produce average yields of more than 40 t ha<sup>-1</sup> of green forage and 8 t ha<sup>-1</sup> of forage dry matter (Tab. 1). These results may be equal or even better than those of forage pea and common vetch (Mikić et al. 2009a).

Evaluation of grain yield in local landraces of feed faba bean has confirmed that they may have a considerable potential, especially in comparison to advanced cultivars such the Czech Inovec, which is included in the Serbian national list (Table 2), as well as the potential for grain production of faba bean as a crop in the conditions of Serbia.

Tab. 2. Average values of the agronomic characteristics of six feed faba bean accessions during 2003-2005 at Rimski Šančevi (Mihailović et al. 2006c)

Tab. 2. Prosečne vrednosti agronomskih osobina šest akcesija stočnog boba 2003-2005. na Rimskim Šančevima

Accession name / Naziv akcesije	Plant height / Visina biljke (cm)	Number of fertile nodes / Broj rodnih kolenaca (plant <sup>-1</sup> )	Number of pods / Broj mabuna (plant <sup>-1</sup> )	Number of grains / Broj zrna (plant <sup>-1</sup> )	Thousand grains mass / Masa hiljadu zrna (g)	Grain yield / Prinos zrna (g)	Grain yield / Prinos zrna (kg ha <sup>-1</sup> )	Harvest index / Žetveni indeks
PP 1	100	7.0	9.3	24.7	506	12.08	5247	0.45
PP 2	94	4.3	5.8	15.4	469	7.14	4607	0.43
PP 4	103	6.9	10.8	31.3	398	11.98	5190	0.47
PP 3	100	8.8	10.9	24.3	517	12.39	6150	0.46
PP 5	99	6.1	10.8	32.3	428	13.19	5727	0.48
Inovec	97	6.2	8.7	22.1	484	10.59	5290	0.52
LSD <sub>0,05</sub>	7	2.1	3.2	10.2	4.33	4.33	721	0.05
LSD <sub>0,01</sub>	10	2.8	4.2	13.6	5.76	5.76	958	0.07

Tab. 3. Average values of forage, grain and straw crude protein yields (kg ha<sup>-1</sup>) of faba bean cultivars in the trials at Rimski Šančevi for 2005 and 2006 (Mihailović et. 2007b, Mikić et al. 2007a)

Tab. 3. Prosečne vrednosti prinosa sirovih proteina krme, zrna i slame (kg ha<sup>-1</sup>) sorti boba u ogledu na Rimskim Šančevima 2005. i 2006.

Cultivar / Sorta	Forage crude protein yield / Prinos sirovih proteina krme	Cultivar / Sorta	Grain crude protein yield / Prinos sirovih proteina zrna	Straw crude protein yield / Prinos sirovih proteina slame
PP 1	1586	Inovec	1719	483
PP 2	1722	Tanagra	1193	348
No. 7	1099	Mammoth	2073	424
PP 4	1137	Petite Windsor	1775	374
Debek	807	Uran	1903	514
VIC 206	1322	PP 3	1548	590
Omar	1158	Aušra	1620	579
Liber	1918	Nora	1611	503
Brok	2625	B-412	2045	714
Nadwislanski	1790	B-413	2230	662
LSD <sub>0,05</sub>	401	LSD <sub>0,05</sub>	234	66
LSD <sub>0,01</sub>	573	LSD <sub>0,01</sub>	312	89

With an average content of crude protein of between 205 g kg<sup>-1</sup> and 210 g kg<sup>-1</sup> in forage dry matter, 325 g kg<sup>-1</sup> in grain dry matter and

about 100 g kg<sup>-1</sup> in straw dry matter, and depending on forage, grain or straw yields, faba bean may easily produce more than 1,500 kg

ha<sup>-1</sup> of forage crude protein, about 2,000 kg ha<sup>-1</sup> of grain crude protein and more than 500 kg ha<sup>-1</sup> of straw crude protein (Tab. 3).

The results of evaluating the possibility of using faba bean as green manure reveal that it has a potential to produce more than 250 kg ha<sup>-1</sup> of nitrogen in its above-ground biomass, if cut at the stage of full flowering (Tab. 4).

The development of winter cultivars of diverse grain legumes, primarily protein pea and faba bean (*Vicia faba* L.) could significantly increase the cultivation area of these crops, especially in the temperate regions such as Serbia (Mikić et al. 2007b). Evaluation of the tolerance to low temperatures in several winter faba bean genotypes of diverse geographic origin has shown that some of them had more than 80 % of the plants surviving winter (Vasić et al. 2008b), and the aver-

age grain yields higher in comparison to those of spring cultivars (Tab. 5).

Tab. 4. Average above-ground biomass nitrogen yield (kg ha<sup>-1</sup>) in faba bean genotypes at Rimski Šančevi in 2005 and 2006 (Mihailović et al. 2007a)

Tab. 4. Prosečne vrednosti prinosa azota nadzemne biomase (kg ha<sup>-1</sup>) genotipova bobna na Rimskim Šančevima 2005. i 2006.

Genotype / Genotip	Above-ground nitrogen yield / Prinos azota nadzemne biomase
Omar	185
Liber	307
Nadwislanski	286
B-412	254
B-413	276
Average / Prosek	260

Tab. 5. Average values of the agronomic characteristics of three winter and one spring cultivar of faba bean in 2004 and 2005 at Rimski Šančevi (Mihailović et al. 2006a)

Tab. 5. Prosečne vrednosti agronomskih osobina tri ozime i jedne jare sorte bobna 2004. i 2005. na Rimskim Šančevima

Accession name / Naziv akcesije	Plant height / Visina biljke (cm)	Number of stems / Broj stabala (plant <sup>-1</sup> )	Number of pods / Broj mahuna (plant <sup>-1</sup> )	Number of grains / Broj zrna (plant <sup>-1</sup> )	Thousand grains mass / Masa biljadu zrna (g)	Grain yield / Prinos zrna (kg ha <sup>-1</sup> )
G ttingen Winter Bean Population	78	2.5	14.9	39.8	512	5527
Diva	89	1.6	11.3	35.4	384	6151
Irena	67	3.4	17.2	46.0	581	5823
Uran (spring / jara)	92	1.2	6.8	21.5	532	5857
LSD <sub>0,05</sub>	9	0.7	4.2	11.4	33	432
LSD <sub>0,01</sub>	14	1.0	7.0	14.1	49	614

### Breeding and commercialisation

The results obtained in other European countries support the specific breeding for each geoclimatic area based on distinct genetic bases and selection environments (Annicchiarico & Iannucci 2008). Following this viewpoint, the first Serbian feed faba bean breeding programme has begun at Institute of Field and Vegetable Crops in Novi Sad by developing hybrid populations of foreign advanced cultivars and Serbian local landraces and selecting lines with desirable agronomic characteristics related to yields of

grain, forage and biomass. Such two spring lines, B-412 and B-413, had better average results in the official state trials during 2006 and 2007 in comparison to the cultivars from the national list, namely the Czech cultivar Uran, and they were registered under the names of Gema and Šarac (Mihailović et al. 2008). Both Gema and Šarac feature average yields of more than 4,500 kg ha<sup>-1</sup> of grain and more than 45 t ha<sup>-1</sup> of green forage.

A more detailed study on its main anti-nutritional factors (tannins) will be among the following steps of the faba bean breeding in Serbia. There is a strong positive correlation

between white colour of flowers and reduction of tannin content that is controlled by at least two recessive genes (Duc 1997). The cultivars without tannins, also known as "zero-tannin" or "tannin-free", have found a wide application both for human consumption and in animal feeding (Mikić et al. 2009b). The success in combining the absence of tannins and winter hardiness in faba bean (Link et al. 2008) opens the possibility of developing winter tannin-free cultivars for the conditions in Serbia.

As in case of a faba bean collection, the knowledge of gene flow is essential for designing strategies of the multiplication of the seed of a faba bean cultivar, i.e. its production for the market and its maintenance. In general, it has been shown that gene flow between two or more different faba bean genotypes depends on location, isolation zone and genotype itself, with a possible solution of planting a barrier surrounding the plot for seed production (Suso et al. 2006).

### Conclusion

Faba bean has a great potential to be re-introduced in the Serbian agriculture as a multi-purpose crop with high, quality and stable yields and suitable to fit into different cropping systems, including organic farming. The wealth of the local landraces of both food and feed faba bean is important for the preservation of the Serbian agricultural flora, but also provides a solid basis for the establishment and rapid development of the native Serbian faba bean breeding programmes. The research on faba bean in Serbia shall make a significant contribution to the benefit of both farmers and the international legume community.

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## Zanemarene gajene mahunarke Srbije - bob (*Vicia faba*)

Vojislav Mihailović<sup>1</sup>, Aleksandar Mikić<sup>1</sup>, Mirjana Vasić<sup>1</sup>, Branko Čupina<sup>2</sup>,  
Branko Đurić<sup>3</sup>, G arđ Duc<sup>4</sup>, Frederick L. Stoddard<sup>5</sup>, Pavol Hauptvogel<sup>6</sup>

<sup>1</sup>Institut za ratarstvo i povrtarstvo, Maksima Gorkog 30, 21000 Novi Sad, Srbija

<sup>2</sup>Poljoprivredni fakultet Univerziteta u Novom Sadu,  
Trg Dositeja Obradovića 8, 21000 Novi Sad, Srbija

<sup>3</sup>Poljoprivredni fakultet Univerziteta u Banja Luci, Republika Srpska, Bosna i Hercegovina

<sup>4</sup>Institut National de la Recherche Agronomique, Unité Mixte de Recherche en Génétique et Ecophysiologie des Légumineuses à Graines, Latokartanonkaari 5, FIN-00014, Dijon, France

<sup>5</sup>University of Helsinki, Department of Agricultural Sciences,  
Building B1, 17 Rue de Šully, 21065 (Dijon), Helsinki, Finland

<sup>6</sup>Plant Production Research Center Piešťany, Bratislavská cesta 122, 921 68 (Piešťany), Slovakia

**Izvod:** Bob se u Srbiji gaji lokalno i bez zvaničnih podataka. Zbirka Instituta za ratarstvo i povrtarstvo u Novom Sadu sadrži 141 akcesiju povrtarskog i stočnog boba. Prinosi krme boba mogu da premaše 40 t ha<sup>-1</sup> zelene krme i 8 t ha<sup>-1</sup> suve materije krme, dok su prinosi zrna često veći od 5 t ha<sup>-1</sup>. Bob može da proizvede više od 1.500 kg ha<sup>-1</sup> sirovih proteina krme i oko 2.000 kg ha<sup>-1</sup> sirovih proteina zrna, kao i više od 250 kg ha<sup>-1</sup> azota nadzemne biomase. U okviru prvog srpskog programa oplemenjivanja boba, koji se odvija u Institutu za ratarstvo i povrtarstvo u Novom Sadu, tokom 2007. stvorene su i priznate dve sorte, Gema i Šarac, sa prinosima od više od 4.500 kg ha<sup>-1</sup> zrna i više od 45 t ha<sup>-1</sup> zelene krme.

**Ključne reči:** bob, krma, kvalitet, oplemenjivanje, *Vicia faba*, zrno

Primljeno / Received: 07.12.2009.

Prihvaćeno / Accepted: 16.12.2009.