# POSSIBILITIES FOR UTILIZATION OF SPRING VETCH FOR GRAIN

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*ABSTRACT: Common vetch (Vicia sativa L.) grain contains a high level of crude proteins, but have limited utilisation because of high portion of γ-glutamyl-β-cyanoalanine and vicine. Various breeding progammes on reducing the toxins resulted in cultivars such as Australian Morava. A small-plot trial (2000-2002) was aimed at the breeding value of spring vetch accessions for grain yields. Thanks to a uniform stand, the Serbian cultivars Beograd and Novi Beograd had the highest grain yield (1225 and 1248 kg ha$^{-1}$). The highest level of crude proteins was in the French Topaze (3.29 g kg$^{-1}$ DM) and Novi Beograd (3.21 g kg$^{-1}$ DM).*

**Key words:** crude proteins, grain yield, spring vetch, *Vicia sativa*.

## INTRODUCTION

As a close botanical relative to more or less important grain legume crops belonging to *Pisum* L., *Lens* Miller and *Lathyrus* L., the genus *Vicia* L. contains several important forage and food species such as common vetch, *Vicia sativa* L., Hungarian vetch, *Vicia pannonica* Crantz, hairy vetch, *Vicia villosa* Roth and field or faba bean, *Vicia faba* L. (Vučković, 1999, Maxted, 1995). Vetches are one of the most distributed temperate legumes and are grown mostly in the countries of the ex-Soviet Union, as well as in the Middle and Eastern Europe (Mejakić & Nedović, 1996). Officially, the vetch-sown area in Serbia and Montenegro varies between 3000 and 7000 ha (Federal Department for Statistics, 2002), but it is estimated that this area is about 30 000 ha, together with forage pea (Mihailović *et al.*, 2003).

Common vetch is one of the most significant components in improvement of grassland forage quality (Mišković, 1986). In Serbia and Montenegro, vetch is used in the form of either hay, haylage and silage and is sown either alone or mixed with cereals. The best quality of dry matter is provided by cutting during full bloom and first pod forming stages, with the average protein content ranging from 1.86 to 2.26 g kg$^{-1}$ DM (Đukić, 2002; Stojanova *et al.*, 2002). Winter vetch cultivars yield from 35 to 40 t ha$^{-1}$ of fresh weight, between 7 and 8 t ha$^{-1}$ of hay and from 1.9 do 2.3 t ha$^{-1}$ of grain (Đukić,

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1993). Spring vetch cultivars produce between 30 and 35 t ha$^{-1}$ of fresh weight, from 6 to 7 t ha$^{-1}$ of hay and between 2,0 and 2,5 t ha$^{-1}$.

Common vetch grain contains between 2.80 and 3.20 g kg$^{-1}$ DM of crude proteins, representing thus a worthy component in sheep and cattle nutrition. However, a high portion of certain poisonous matters makes it unsuitable for monogastric animals and humans (Enneking, 2001). The most important of these compounds, harmful to poultry and humans, are γ-glutamyl-β-cyanoalanine, that has a bad influence on metabolism of sulphuric amino acids, and vicine and convicine, responsible for a disease called favism. During last few decades, the first programmes on common vetch breeding for reduced toxins level have been commenced. As a rule, the first steps were to screen all common vetch accessions in one collection for toxin level in grain and grain yield potential; those with low toxin level shall be used as gene donors for further work and various methods of selection (Tate, 1996). In that way, the initial level of γ-glutamyl-β-cyanoalanine was reduced from 1,2-1,6 % to 0,8 i 0,6 % in Australian cultivars such as Morava, Love.1 i Love.2, enabling thus their use in pig and poultry diets (Chowdhury *et al.*, 2001; Tate *et al.*, 2004). Moreover, cultivars like Morava are highly resistant to prevailing diseases and have high yields of hay and grain, what makes them suitable for multiple utilisation (Saunders & Matić, 2001).

Our study was aimed at determining the possibility for successful growing of spring common vetch for grain in the prevailing environmental conditions of Serbia, especially in its northern Province of Vojvodina.

## MATERIALS AND METHODS

A small-plot trial, conducted between 2000 and 2002 at the Institute of Field and Vegetable Crops' Experiment Field, included eight spring vetch accessions from the Annual Forage Legumes Genetic Collection (AFLGC) of the Forage Crops Department: (cultivars) Beograd and Novi Beograd from Serbia and Montenegro, (cultivars) Skopje and Slavej from FYR of Macedonia, (landrace) VIC 006 from Bulgaria, (cultivars) Armantes and Labari from Spain and (cultivar) Topaze from France. In all three years, the accessions were sown in early March, at a crop density of 120 viable seed per m$^2$. We monitored the following grain yield components and traits: plant height (cm), first pod height (cm) number of internodes, number of pods per plant, number of grains per plant, thousand grain mass (g), plant mass (g), yield of grain per plant (g), as well as grain yield per square unit (kg ha$^{-1}$) and level of crude proteins (g kg$^{-1}$ DM). The plant samples for trait analysis were taken shortly before the harvest, while grain yield per square unit and thousand grain mass were determined immediately after the hatvest. The results were processed by the analysis of variance with the LSD test applied.

## RESULTS AND DISCUSSION

The greatest average plant height was found in the Serbian cultivar Beograd (100 cm, Tab. 1), while the smallest plant height was found in the Spanish Armantes (74 cm). Comparing the average values of plant height at harvest to the average plant height at the time of cutting (Mihailović *et al.*, 2004), it is obvious that cultivars such as Beograd and Novi Beograd gain one fifth of its height from the beginning of first pod forming to the full maturity.

*Tab. 1. Average values of grain yield components, plant mass and grain yield per plant in spring vetch during 2000-2002*

| Trait / Accession | Plant height (cm) | First pod height (cm) | Inter-node number | Pod number per plant | Grain number per plant | 1000-grain mass (g) | Plant mass (g) | Grain yield per plant (g) |
|---|---|---|---|---|---|---|---|---|
| Beograd | 100 | 45 | 19.7 | 27.6 | 65.1 | 62 | 16.63 | 4.59 |
| Novi Beograd | 96 | 40 | 19.8 | 29.9 | 78.1 | 61 | 16.92 | 4.31 |
| VIC 006 | 81 | 35 | 18.3 | 27.4 | 88.3 | 78 | 14.70 | 5.38 |
| Skopje | 76 | 34 | 19.0 | 20.0 | 65.3 | 76 | 10.48 | 3.74 |
| Slavej | 76 | 36 | 19.0 | 18.2 | 57.6 | 75 | 11.43 | 2.82 |
| Armantes | 74 | 35 | 17.3 | 20.0 | 56.5 | 96 | 13.95 | 3.83 |
| Topaze | 89 | 39 | 18.5 | 24.3 | 82.3 | 81 | 15.90 | 4.71 |
| Labari | 80 | 27 | 20.1 | 29.6 | 80.6 | 90 | 17.14 | 6.18 |
| LSD 0.05 | 13.6 | 6.2 | 2.7 | 4.0 | 8.5 | 9 | 4.4 | 1.59 |
| 0.01 | 19.4 | 8.9 | 3.8 | 5.4 | 12.0 | 11 | 6.7 | 2.77 |

All examined spring vetch accessions formed pods in the upper half of plant. The Novi Sad cultivar Beograd had the greatest first pod height Beograd (45 cm), what was significantly higher than in the Skopje cultivars Slavej (36 cm) and Skopje (34 cm), the Bulgarian landrace VIC 006 (35 cm) and Spanish cultivars Armantes (35 cm) and Labari (27 cm).

The greatest internode number was found in Labari (20.1). Due to a greater concentration of nodes per length unit, this cultivar proved slightly more resistant to lodging than the other accessions. The smallest internode number was found in Armantes (17.3).

Because of the greatest number of fertile nodes per plant, Novi Beograd and Labari had the greatest number of pods per plant (29.9 and 29.6). Significantly smaller pod number per plant was found in Topaze (24.3), Skopje and Armantes (both 20.0) and Slavej (18.2).

On the other hand, because of more prominent branching, the Bulgarian landrace VIC 006 had the greatest grain number per plant (88.3), what was significantly higher than in Skopje (65.3), Beograd (65.1), Slavej (57.6) and Armantes (56.5).

There were significant differences in thousand grain mass between the accessions examined. The cultivar Armantes had the largest thousand grain mass (96 g), while the cultivars Beograd and Novi Beograd had the smallest thousand grain masses (62 g and 61 g).

The largest plant mass was found in the Spanish Labari (17.14 g) and the Serbian Novi Beograd (16.92 g) and Beograd (16.63 g), while the smallest plant mass was found in the Macedonian Slavej (11.43 g) and Skopje (10.48 g).

The cultivar Labari had the highest grain yield per plant (6.18 g), what was significantly higher than in cultivar Slavej (2.82 g).

Thanks to a rather uniform stand and small competition within it, as well as to a good realtionship between grain yield components, the Novi Sad cultivars Beograd and Novi Beograd had the highest grain yield per square unit: 1225 i 1248 kg ha$^{-1}$ (Tab. 2). The lowest grain yield per square unit was found in Slavej (839 kg ha$^{-1}$).

*Tab. 2. Spring vetch grain yield per square unit (kg ha$^{-1}$) during 2000-2002*

| Accession | Grain yield per square unit | | | |
|---|---|---|---|---|
| | 2000 | 2001 | 2002 | average |
| Beograd | 1119 | 1332 | 1223 | 1225 |
| Novi Beograd | 1122 | 1414 | 1207 | 1248 |
| VIC 006 | 481 | 1348 | 1193 | 1007 |
| Skopje | 464 | 990 | 1202 | 885 |
| Slavej | 407 | 884 | 1225 | 839 |
| Armantes | 701 | 966 | 892 | 853 |
| Topaze | 818 | 1238 | 1055 | 1037 |
| Labari | 775 | 1352 | 1000 | 1042 |
| LSD 0,05<br>0,01 | 619<br>798 | | | |

Regarding the average level of crude proteins in dry matter (Tab. 3), the highest one was in the French Topaze (3.29 g kg$^{-1}$ DM) and the Serbian Novi Beograd (3.21 g kg$^{-1}$ DM), while the lowest one was determined in the Spanish Armantes (3.01 g kg$^{-1}$ DM).

*Tab. 3. Average level of crude proteins (g kg-1 DM) in spring vetch during 2000-2002*

| Accession | Average level of crude proteins | | | |
|---|---|---|---|---|
| | 2000 | 2001 | 2002 | average |
| Beograd | 3.22 | 3.06 | 3.14 | 3.14 |
| Novi Beograd | 3.26 | 3.07 | 3.29 | 3.21 |
| VIC 006 | 3.25 | 3.09 | 3.12 | 3.15 |
| Skopje | 3.34 | 2.98 | 3.06 | 3.13 |
| Slavej | 3.01 | 2.96 | 3.16 | 3.04 |
| Armantes | 3.18 | 2.92 | 2.93 | 3.01 |
| Topaze | 3.29 | 3.30 | 3.30 | 3.29 |
| Labari | 3.28 | 2.81 | 3.03 | 3.04 |
| LSD 0,05<br>0,01 | 0.14<br>0.20 | | | |

It can be concluded that spring common vetch can be successfully grown and utilised for grain in the prevailing environmental conditions of Serbia, especially in its northern Province of Vojvodina. Apart from a traditional orientation towards the production of forage and hay, the future common vetch breeding programmes in Serbia and Montenegro remain aimed at the creation of new cultivars with an optimal relationship between grain yield components and a significantly lower level of toxins, resulting in higher, more stable and quality yields of grain. Eight examined spring vetch cultivars, together with many more from the AFLGC of the Forage Crops Department, represent a good basis for achieving it, mostly thanks to a wide morphological and genetic variation existing in *Vicia sativa* L. as a species. At the same time, every kind of biotechnological assistance, provided by novel knowledges on vetch genetics, genomics, QTL and syntheny, shall receive the warmest welcome.

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## REFERENCES CITED

CHOWDHURY, D., TATE, M. E., McDONALD, G. K., HUGHES, R. (2001): Progress towards reducing seed toxin levels in common vetch (*Vicia sativa* L.). Proceedings of the 10th Australian Agronomy Conference, Hobart, Australia, January 2001.

ĐUKIĆ, D. (1993): Prinos i kvalitet NS sorti grahorica i krmnog graška, Zimski seminar agronoma Vojvodine (unpublished).

ĐUKIĆ, D. (2002): Biljke za proizvodnju stočne hrane. Faculty of agriculture, University of Novi Sad.

ENNEKING, D. (2001): Common vetch *Vicia sativa ssp. sativa* cv. Blanchefleur, a mimic of red lentils. http://www.general.uwa.edu.au/u/enneking/VETCH.htm#top

FEDERAL DEPARTMENT FOR STATISTICS (2002): Statistical Annual Report of Yugoslavia, Belgrade, 209.

MAXTED, N. (1995): An ecogeographical study of *Vicia* subgenus *Vicia*. International Plant GeneticResources Institute, Rome.

MEJAKIĆ, V., NEDOVIĆ, B. (1996): Krmno bilje, Glas srpski, Banja Luka.

MIHAILOVIĆ, V., KARAGIĆ, Đ., KATIĆ, S., PATAKI, I. (2003): Proizvodnja i kvalitet NS sorti krmnih biljaka. Zbornik radova (a periodical of scientific research of field and vegetable crops), 38, 65-76.

MIHAILOVIĆ, V., PRENTOVIK, T. VASILJEVIĆ, S., KATIĆ, S., MIKIĆ A. (2004). Forage yield and forage yield components of spring vetch genotypes (*Vicia sativa* L.). Acta Agriculturae Serbica, IX (17), 407-411.

MIŠKOVIĆ, B. (1986): Krmno bilje, Naučna knjiga, Beograd.

SAUNDERS, R., MATIĆ, R. (2001): Morava – a new rust resistant vetch for southern Australia, South Australian Research and Development Institute, Adelaide.

STOJANOVA, M., IVANOVSKI, P. R., PRENTOVIC, TATJANA, TRAJKOVSKI, T. (2002): Chemical composition of the hay of common vetch and field peas. Macedonian Agricultural Review 49 (1/2), 33-37.

TATE, M. E. (1996): Vetches: Feed or Food? Chemistry in Australia, 63, 549-550.

TATE, M. E., CHOWDHURY, D., McDONALD, G., HUGHES, R., FIRINCIOGLU, H. (2004). Conference Handbook of the 5th European Conference on Grain Legumes with the 2nd International Conference on Legume Genomics and Genetics, Dijon, France, 7-11 June 2004.

VUČKOVIĆ, S. (1999): Krmno bilje, *Institute* Serbia, Belgrade – Bonart, Nova Pazova.

# POSSIBILITIES OF ENVIRONMENTALLY FRIENDLY PRODUCTION OF SOYBEANS IN SERBIA AND MONTENEGRO

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*ABSTRACT: Implementation and development of the methods of organic agriculture in soybean production is an option for our country to achieve a satisfactory level of production of high quality and safe food. It would be a way to fully utilize the country's agricultural potentials: climate, non-polluted soil, skilled growers and experienced technicians and researchers. The entire organic soybean production would be intended for food. Soybean is a component in a large number of foodstuffs, making soybean growers and processors responsible for their quality and safety. These requirements can be met by organizing a certified organic production of soybean. A switch from conventional to organic production is technologically relatively simple, especially in the case of small production fields. Strict adherence to the basic principles of the soybean production technology means the adherence to the requirements of organic production. Intensification of organic soybean production would encourage the conventional production since the soybean fits well into the currently used rotations. Further improvements in the quality of processing would significantly intensify the country's exports of soybean-based products.*

**Key words**: soybean, organic production, legislation

## INTRODUCTION

Organic agriculture is part of a wide spectrum of conventional, intensive as well as alternative agricultural methodologies designed for protection of the environment. The USDA National Organic Program (NOP) defines organic agriculture as an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain, or enhance ecological harmony. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people (USDA-NOP, 2002).

On the global level, organic agriculture registers a continual growth of production and demand (Karlen *et al*., 2004), through the strengthening of »the Green Wave« as well as through the realization than not all that is produced must inevitably be healthy. This growth is primarily due to the development of analytical methods, which determine with ever-increasing precision the amounts of harmful residues in human food. It is also due to the newly gained knowledge on the metabolic pathways of chemical substances in human body. Furthermore, the demands for quality and safe food heard in the world and in our country came as a consequence of the occurrence of a number of food-induced diseases and the occurrence of foodstuffs produced from genetically modified organisms.

Organic production intrinsically cannot become the dominant type of production, but it may be expanded to a point where it can provide sufficient amounts of quality and safe food. On the domestic plane, organic production offers a chance of a breakthrough to the EU markets, first because these markets are saturated with and unable to accept additional amounts of conventional food, and second because these markets are in demand for organic food.

## LEGISLATION

Organic production, regardless of plant species in question, has common principles regulated by standard of International Federation of Organic Agriculture Movements (IFOAM). These international standards have enabled the development of organic agriculture in numerous countries around the world, even before these countries legislated their national rules and standard for organic production.

The first model of food production free of synthetic and chemical protectants and mineral fertilizers designed in our country was the result of a joint research effort of Association for Organic Food TERRAS from Subotica, Faculty of Agriculture from Novi Sad and Department for Health Protection from Subotica (Skenderović and Novaković, 2002). This model of organic food production, presently referred to as TERRAS model, has been worked out on the basis of global standards of IFOAM and Rules of EU Council 2092/91 and it is internationally verified. Two more models are in use in our country, MOĆ PRIRODE, HK »Agroekonomik«, Belgrade and NATURA VITA, Association of Cooperatives of Serbia, Belgrade. According to Skenderović and Novaković (2002), food production based on ecological principles is organized at about 15,200 ha, or 0.31% of the total arable land in Serbia and Montenegro. IFOAM data estimate that acreage at 18,800 ha. There is ample room for further expansion of organic agriculture in our country, especially because it would be a way to exploit our comparative advantages in relation to the developed countries, which include the climate, uncontaminated soils, experienced growers and research and technical personnel.

To be able to use these comparative advantages, it is necessary to pass the necessary legislation. The first step was made already, by passing the Law on organic Agriculture (Official Gazette FRY, no. 28/2000). This law regulates methods of organic production, storage, transport, processing, certification and labeling of organic produce, and low enforcement measures. The law specifies basic principles of organic agriculture, production methods, technological procedures to be used in processing, and penal measures for law offenders. The acts accompanying the law were published in Official Gazette FRY, no. 51/2002 of 13 September 2002.

Accepting the rules of organic agriculture brings numerous advantages to farmers - production of highly nutritious food, long term maintenance and improvement of soil fertility and reduction of contamination associated with the conventional agricultural production. Still, the major incentive the is economic one - today in EU, consumers pay more for certified organic produce, in the range from 31% for red wine to 113% for chicken meat (Sudarević, 2002).