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CONFERENCE PROCEEDINGS

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INTERACTION VARIETY AND MICROBIOLOGICAL FERTILIZER ON YIELD BEAN IN ORGANIC CULTIVATION

Gordana Dozet²⁶¹ Sufyan Abuatwarat²⁶² Nenad Djuric²⁶³

Abstract: Bean is an annual legume, which resembles an important plant species in production and an alimentation basis for many nations. In Serbia, bean is produced in organic production on vast surfaces. However, even if bean consumption is increasing, surfaces are linearly decreasing in the period from 2005 to 2014 (r=-0.97). Yields vary between 0.8 and 1.3 tha⁻¹. In Serbia, modern verieties from the state's official list of varieties are used for organic production. Bean makes 4.3 % of the total vegetable consumption structure in Serbia. Global bean consumption is 2.4 kg. In Europe, the consumption is very modest and amounts to 0.7 kg, which is 4.5 kg less than in Serbia. Bean consumption in Serbia is recording an increase. The research goal was to determine the interaction between the genetic factor and the application of microbiological fertilizers on bean yield in an organic breeding method, which would contribute to the consumption of food that is safe in terms of health and to environment preservation.

The experiment was set on an experimental plot of the Faculty of Biofarming in Bačka Topola. Plants were grown on calcareous chernozem. Determination of the content of mineral nitrogen is done before planting and after harvest. Bean was bred by the principles of organic production. The weather conditions during the experiment's realisation were tracked, therefore their influence on the interaction between the genotype and the microbiological fertilizers on yield was also measured. In an experimental biennial field plot arranged by split-plot method in four repetitions, two genotypes were used, bean varieties: Zlatko and Maksa. Large plots were varieties and subplots — control and variants of effective microorganism (EM) and Trichoderma atroviride use. The size of an elementary plot was 10 m². A variance analysis was made and the average yield values of the bean from applied treatments were tested by LSD test (least significant differences).

In both years of study, the variety Maksa had a statistically significantly higher yield in comparison with the variety Zlatko. The use of microbiological fertilizer didn't show any regularity in bean yield formation. The interraction between genotype and microbiological fertilizer is statistically significant. In both years the lowest yield was measured in the variant of treating the soil with EM before sowing. The interaction between microbiological fertilizer and variety was, in average for both years, statistically significant and regular. Both varieties have recorded the highest yield with the use of EM in the combination: soil treatment before sowing, in the pheno-phase of 3 to 4 leaves and beginning of flowering. Obtained results refer to a proposal of bean breeding in an organic breeding system. However, the researches should be continued on various localities which would be a factor of influence on interaction and bean yield.

Key words: bean, interaction, microbiological fertilizer, organic breeding, variety, yield

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1. INTRODUCTION

Beans are one of the basic vegetable crops that are used in human nutrition. In terms of nutrition, they are one of the richest sources of plant protein, carbohydrates, dietary fibers and minerals (Fe, Ca, Sn, Mo), biologicaly most valuable in human nutrition [1]. Beans are plants with a long cultivation tradition. It used to be cultivated as a intercrop in corn, but today it is cultivated on smaller surfaces, house gardens for personal use and on greater surfaces for industrial production.

Organic agriculture suits the general concept of sustainable development, because it tends towards ecologicaly clean, profitable, eticaly acceptable and socialy just agricultural production. Agricultural modernization led to a degradation of the link between ecology and agricultural production, because ecological principles are often ignored and neglected [2].

Organic agriculture is a sustainable, natural alternative for intensification of production methods. It uses traditional methods of soil cultivation and maintenance and control of weeds, pests and diseases. The impact of globalization and increasing world trade in agriculture, there remain large, persistent and, in some cases, worsening spatial differences in the ability of societies to both feed themselves and protect the productive capacity of their natural resources. This paper explores these differences and develops country×farming a typology for exploring the linkages between human needs, agriculture environment, and for assessing options for addressing future food security, land use and ecosystem service challenges facing different societies around the world [3].

As the soil vitality was presented not only with a presence, but balanced interactions of organisms that inhabit it, there is a need for access, quantity growth and ensime activity of Gordana Dozet is associate professor of Faculty of Biofarming, Backa Topola, University »John Naisbitt«Belgrade. Field of scientific work: Biotechnology in crop production



PROFESSIONAL ORIENTATION

Scientific field: Biotechnology in crop production

Scientific field of interest: Productions of field plants (field and vegetable crops), Integrated, Biotechnology, Sustainable agriculture and Organic/Ecological agriculture etc.

Specialist scientific field: Productions of legumes

SCIENTIFIC AND RESEARCH PROJECTS

1.NGO »Hera» and NGO »Resource Center for Rural Development«, Backa Topola:

"Mechanisms to combat violence in the family"- Project Coordinator (2005-2006), Balkan Fund for Local Initiatives;

"Both women vote" – Project participant (2005-2006)

2.TR31031: "Promotion of sustainability and competitiveness in organic plant and livestock production by means of novel technologies and inputs" (2011-2014)

3.III46006: "Sustainable agriculture and rural development in order to achieve the strategic objectives of the Republic of Serbia within the Danube region" (2011-)

RESULTS OF SCIENTIFIC WORK

She has published over 200 scientific papers, Published two monographs of national significance, Published a textbook General Organic Vegetable Crops.

She is member in professional and scientific associations: Serbia Organica, Development Academy of Agriculture Serbia, Seed association of Serbia, ESA, ISF, Association of Agricultural Economists Balkans

soil flora and fauna correction. It would include an abolition of chemical pesticide and fertilizer

use, that nonselectively decrease quantity or eliminate organism populations that are present and necessary in that soil, maintaining homeorhesis in it's common activities [4].

In Serbia, beans are produced in organic production on many surfaces. However, although the production of beans is being increased, the surfaces, in the period from 2005 to 2014. are linearly decreasing (r=-0.97). Yields vary from 0.8 to 1.3 tha⁻¹. Contemporary varieties from the state variety list are being used for organic production of beans. In the structure of total vegetable consumption in Serbia, beans take place with 4.3%. World beans consumption amounts 2.4 kg. In Europe, the consumption is very modest and it amounts 0.7 kg, which is 4.5 kg less than in Serbia. The consumption in Serbia is being increased.

Soil protection from degradation in agricultural production is one more measure in a frame of aims and directives of integral and organic production. Hence, there is an increasing number of researches that are oriented on finding the use of alternative measures in plant production, so that unwanted consequences can be avoided. One of the measures is the use of microbiological fertilizers [5]. Microorganisms that have both defensive and stimulative influence on plant growth and development, thus on their yield as well are contributers of biological soil activity intensificationthat and development. One of those microorganisms are also fungi from genus Trichoderma spp. Numerous experiments have determined that most of Sufyan Abuatwarat EDUCATION:

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strains from this genus have a positive effect on plant growth and development, protection and on higher yield [6],[7]. *Trichoderma* does not show an unfavorable influence on microbiological processes in soil, on plants and surounding enviornment, but it takes place in humigation and degradation of heavily degradable matter, such as hemicellulose and lignin [8], [9]. In order for the bean genus to have an organic status, it is necessary to carry out an organic production certification in accordance with the Organic Production Law (*Službeni glasnik RS*, No. 30/10) and it is obligatiory in the Republic of Serbia.

The aim of this research was to determine genetic factor interaction and the use of microbiological fertilizers on bean yield in organic breeding technology, which would contribute to organic food consumation and environmental conservation.

2. MATERIAL AND METHOD

The experiment was set on an experimental plot in Bačka Topola, Serbia. Plants were grown on calcareous chernozem. Bean was bred by the principles of organic production. Basic soil cultivation without mineral fertilizer use was done. Sowing was done in both experimental years in the first decade of May. A declared bean seed, obtained from the Institute of Field and Vegetable Crops from Novi Sad, Serbia was used for sowing. Two bean varieties were used in the experiment, Maksa and Zlatko.

EM preparation is a liquid concentrate, in which were bred more than 80 strains of main antibiotic organisms, which are in nature found in the soil. The preparation does not contain genetically modified organisms, but a stable community of aerobic and anaerobic microorganisms.

Both of them, regardless of different life forms, live in one enviornment in an active food source exchange regime. The metabolic products of one group represent food to the other group. In such a system, it comes to an acumulation of positive characteristics of the united microorganisms. Before sowing the soil was treated with EM preparation. In the third variant, EM preparations were applied before sowing+in pheno-phase 3-4 trifoliate leaves+begining of butonization. TIFFI is a product made of live fungi spores (conidia and chlamydospores) and mycelia, genetically not modified. *Trichoderma atroviride* – 898G is a fungi strain which have a very antagonistic effect on many pathogenic fungi which live in the soil (*Fusarium spp., Rhizoctonia sp., Verticillium spp., Armillaria spp., Phyrochaeta spp.*) and on plants (*Phytophtora spp., Botrytis spp.* i sl.). Doses and application method: the powder has to be mixed with peat or soil before sowing or planting. For vegetables as tomato, cabbage, pepper, onion, potato, beans etc. it is necessary to use 1,5-2 kgha⁻¹ of powder. In the experiment, the seed was sprayed with the powder mixed with a little water. The other half of the TIFFI powder was mixed with water and sprayed ten days before sowing.

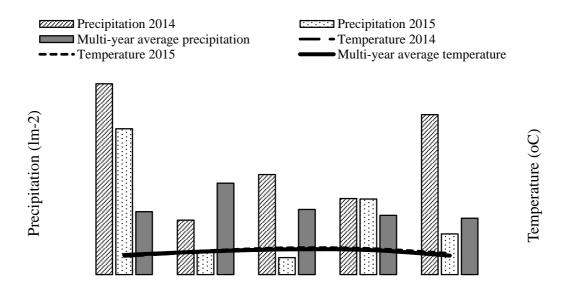


Figure 1: Average temperature and precipitation for the 2014 and 2015, and long term average (1983-2013)

Growing period

The organic bean experiment was set after the first onion crop in 2014, while in 2015, the first crop was wheat.

The weather conditions during the experiment's realisation were tracked, therefore their influence on the interaction between the genotype and the microbiological fertilizers on yield was also measured. In an experimental biennial field plot arranged by split-plot method in four repetitions, two genotypes were used, bean varieties: Zlatko and Maksa. Large plots were varieties and subplots – control and variants of effective microorganism (EM) and Trichoderma atroviride use. Beans were sowed manualy in four hoe made furrows with a row distance of 50 cm, distance of 4 cm between seeds and depth of 4-5 cm. The size of an elementary plot was 10 m^2 .

Wether conditions

In the vegetation period of 2014, precipitation sum was 512.0 lm⁻², which is 73.5% higher in comparison to the perennial average (Fig.1). Temperatures were lower in the begining of the vegetation in comparison to the perennial average, while in September, it was 0.5°C higher in comparison to the perennial average. In general, they did not deviate significantly from the average for the analyzed vegetation period. In 2015, precipitation sum for the vegetation period was 48.0% lower in comparison to perennial period and 9.9% in comparison to 2015. Hence, the temperatures in 2015 were significantly higher in comparison to perennial period and 2014. That indicates the conclusion, that the 2014 was, from the aspect of weather conditions, more favorable for bean production in organic system of breeding.

2. RESULTS AND DISCUSSION

The average yield for both research years was 3896.5 kgha⁻¹, taking in consideration that in 2014, it was 5367 kgha⁻¹, and in 2015, 2426 kgha⁻¹, which is 121.2% higher (Tab.1).

Year	Microbiological treatment (A)		Variety (B)		Average	
			Maksa	Zlatko	В	
2014	Control		3881	5715	4798	
	EM (treatment soil)			3400	4625	4013
	Trichoderma (treatment soil)			4115	7450	5783
	EM (soil $+2x$ in vegetacion treatment)			4500	9300	6900
	Trichoderma (treatment seed)			4400	6288	5344
	Average A			4059	6676	5367
2015	Control			2264	2730	2497
	EM (treatment soil)			2024	2330	2177
	Trichoderma (treatment soil)			2247	2878	2563
	EM (soil $+2x$ in vegetacion treatment)			2474	2943	2708
	Trichoderma (treatment seed)			1719	2652	2186
	Average A			2145	2707	2426
	Factor	A	В	AxB	В	BxA
2014	$\mathrm{LSD}_{0.05}$	327	339	521	519	
	$\mathrm{LSD}_{0.01}$	684	495	741	738	
2015	$\mathrm{LSD}_{0.05}$	227	240	420	4	10
	$\mathrm{LSD}_{0.01}$	580	390	640	6	20

Table 1

The obtained results were processed by the analysis of varianse (ANOVA) for two-factorial trials in two years of stady. The average yield values of the bean from applied treatments were tested by LSD test (least significant differences). Analyses were performed in GenStat (Trial version).

Very significant differences between vegetation years of bean yield conditioned by a direct weather condition influence, which was prevailing during the research years. Year, that is, weather condition influence in wheat vegetation period on the yield level are determined in earlier researches [10] - [12]. In both research years Zlatko variety achieved, statistically, a significantly high yield in comparison to Maksa variety. That feature is genetically conditioned. There are similar results within other Leguminosae [11] - [14]. The lowest yield was measured when only the preparation was applied to the soil treatment, in the experiment. The use of Trichoderme atroviride in the soil treatment gave exellent results. In 2014, a yield of 5783 kgha⁻¹ was measured, which is 20.5% higher in comparison to control (4798 kgha⁻¹). In 2015, a yield of 2563 kgha⁻¹ was achieved, and that is 2.6% higher in comparison to the control variant (2497 kgha⁻¹). Similar results of positive Trichoderma sp. application stand out in their researches [15].

It is very important how each variety reacts to the applied treatments. In that manner we dispose with the interaction of variety and applied treatment. Observing both years, Nenad A. Djuric was born on 21 November 1971 in Pancevo. Serbia. He graduated from the Faculty of Agriculture in Belgrade in 1996. Where he also completed his postgraduate studies in 2001, and defended his PhD thesis in 2013.

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In 1996, he started working at the PKB Agroekonomik Institute, in Padinska Skela, Belgrade, in the Department for Wheat Selection. From 2000 to 2005, he was Head of the Department for Wheat Selection and Director of PKB Agroekonomik Institute Division for Crop and Vegetable Production. From 2005 to 2013, he was the Director of PKB Agroekonomik Institute in Padinska Skela.

In 2014, he begins working as Assistant Professor at John Naisbitt University, Faculty of Biofarming in Backa Topola.

He is the author or coauthor of 80 papers published in Serbia and abroad, of which five are on the SCI list, as well as of two monographs.

He is the coauthor of three wheat varieties recognized in Serbia, and five wheat varieties recognized in the European Union. He is also the coauthor of one variety of barley and two varieties of triticale recognized in Serbia. He is the coauthor two maize hybrids recognized in Serbia

He is an active and full member of several academies, scientific and professional organizations in Serbia and abroad.

there was a very significant interaction of varieties and microbiological treatment (AxB). The highest yield was measured within both tested varieties with an EM preparation use variant before sowing with an application to the soil+treatment in pheno-phase 3-4 trifoliate leaves+butonization (begining of flowering). Interaction BxA is highly significant as well (p<0.01).

3. CONCLUSIONS

The bean yield very depends of weather conditions, which were prevailing during the vegetation period. Yield is a genetically conditioned feature. In that manner, there were obtained statistically very significant differences between varieties. Microbiological preparations that were used, had an efficient effect to the yield increasement in both years. The highest yield was

measured within the application of EM preparation variant before sowing+pheno-phase 3-4 trifoliate leaves+begining of flowering. Interaction AxB and BxA are very significant. Both varieties reacted to the applicated treatments. Within all five variants there were significant differneces between the tested genotypes. Obtained results refer to a proposal of bean breeding in an organic breeding system. In order for bean genus to have an organic status, it is necessary to do a certification of organic production in accordance with the Organic Production Law. However, the researches should be continued on various localities which would be a factor of influence on interaction and bean yield.

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