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INFLUENCE OF ORGANIC AND CONVENTIONAL METHODS OF GROWING ON QUALITATIVE PROPERTIES OF SOYBEAN

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Abstract

Two-year survey was conducted according to the principles of organic and conventional dryland cropping technologies. Experiment was placed in Backa Topola, on calcareous chernozem with wheat as preceding crop. In ecological production basic soil fertilization was performed with 15 $t \cdot ha^{-1}$ cowshed manure, and in conventional production as pre-sowing treatment was applied 100 kg $N \cdot ha^{-1}$. In both years were similar weather conditions. Examination factors were production ways and application of microbial fertilizer. Microbial fertilizer was in liquid state and it contained various types of microorganisms. Microbiological fertilizer used in both varieties of production of sample plots in five variations: 1-control (with out specific microbiological fertilizer), 2-treat fields seven days before planting, 3-during phenological stage 1-3 leaves, 4-first flovering, 5- lots of flovering. Data were processed by two-factorial split-plot experiment variance analysis method, and differences between treatments were analyzed by LSD-test. Correlation analysis was conducted. The aim of this work was to determine protein content and oil of organic and conventional cropping technologies and correlational dependency between surveyed characteristics. Average content of protein is 39.93% in 2012 was above that figure. Analyis effected plant breeding didn't recognised regularity of examined traits. Effect of application of microbiological fertilizer on protein and oil was very significant. Average oil content was higher in the organic and by 2.32% in comparison to the conventional production. Ecological soybean production, as production system with respect of environmental principles and standards, as well as specific local agroecological conditions, has its priority.

Keywords: *conventional and organic production, protein and oil content, microbial fertilizers, soybean*

Introduction

Areas that are seeded with soya variety, partially because achieved yields and also economic conditions but it has become an important factor crop production (Dozet, 2009). Soya grain is used in the form of various to process for human consumption. Therefore it's essential for part of soya production without applying mineral fertilizers and pesticides. Soya has important economic importance, mainly due to chemical structure of grain which has the following components around 40 % proteins and 20% oil. It's used in food industry as well as in different branch industries. Soya represents "popular products" on the global market. Retailing soya is of great importance practically in processing soya as flour, soya oil etc. Therefore it is especially achieved significant cooperation between primary agricultural production of soybeans and industry. (Cvijanovic D. and Cvijanovic G., 1989). Primary microbiological fertilizers are very important factor in the manufacture of soybeans which significant impact on its growth, envelopment and productivity (Cvijanovic et al., 2013). Soybean because of high content of proteins has very high nitrogen requirements, but as leguminous plants biggest part of nitrogen provides by nitrification. Instability of soya beans

very often represents a problem in industry animal feed, because of level of proteins and oils in biggest measure depend of genotype and environmental (Westgate et al., 2000). In agriculture production one of rate targets and guidelines is integrated and organic production, this means finding alternative ways of fertilization in order to avoid the consequences of land degradation (Cvijanovic et al., 2010). The prices of organic products still are higher than average from 15% to 30% in compared with products obtained commercially producing (Dozet et al., 2013).

Target of this work was to determine the protein and oil content in organic and commercial way of cultivation and with it determine the optimal variant of application effective microorganisms in both technology cultivation which will enable getting high, stable yield good chemical composition of soybeans with rational use of nitrogen and fertilizers. I addition, paper aimed at determining correlation dependency between important surveyed feature.

Materials and methods

Field research to examine the impact of soybean growing technology and application of microbiological fertilizers on quality of soybeans and other important features was carried out on the basis of set of plot in localities Backa Topola (Serbia), on carbonate chernozem, after wheat as a previous crop during 2012 and 2013. Plot represented principle of organic and conventional growing, like as first research factor and application of microbiological fertilizers is the second research factor. Plot is set in four repeated with length lines from 5 m. Each repetition is shared on 10 large plots (5 plots for conventional and 5 plots on organic growing). For sowing were use seed soybean varieties Galina which one is early maturing varieties and belongs to the zero group of ripening and created in Institute of Field and Vegetable growing in Novi Sad. Previous crops for soybean in the previous three years were barley, corn, wheat. Previous crops not fertilized by mineral fertilizers, not used chemical protection for plants in the previous three years. On the surface of plot which is planned for organic production performed the basic fertilization by bovine manure in quantity of 15 tha^{-1}.On part of plot for conventional production for basic fertilization used 100 kg Nha^{-1}. By the manure and nitrogen also used microbiological fertilizer in liquid condition which contains mixture of different varieties microorganisms (bacteria of milk acid, photosynthetic bacteria, yeasts, actinomycetes, fungi). Sowing was performed by machines; six rowing machines in depth of 4 cm. Size of main plot is 15 m^2. Set of plants is 500.000 plants ha^{-1} . Protection crop from weeds was done by cultivating, hand digging and twitch weeds.

Microbiological fertilizer used in both ways of production per lot in five variants; 1-control (with out of used microbiological fertilizers), 2-tretment land seven days before of sowing, 3-in phonological stage 1.-3 leafs, 4-begining of flovering, 5-full of flovering. Reproduction stage, beginning and full of flovering is given in definition Fehr and Caviness (1977). Land treatment was carry out with quantity of 30 lha^{-1} microbiological fertilizer which was diluted with water in quantity of 500 lha^{-1}. It is put in land by rotary hole in depth of 10 cm. In variants with foliar applicant’s preparations was used quantity of 5 lha^{-1} microbiological fertilizer dissolved in 400 l of water.

It is applied with help of back sprayer. Harvest is done by hand, (plants taken from two central row instead of frontal plants and carefully are connected in bundles). Thrashing is done by Wintersteiger combines which is just used for soybean plots in Department of Field and Vegetable growing in Novi Sad. Threshed grain is measured, determined contains of moisture which is reduced to 13% and by this calculated yield per unit area. Contents of protein and oils in grain of soybean is stated by helping DA-700 FLEXI-MODE NIR/VIS spectrophotometer (Balesevic-Tubic et al., 2007) in Department of Field and Vegetable growing in Novi Sad. The air temperature and precipitation values are given from

Agricultural extension service, Backa Topola. Data are determinate by analysis variance according to the method two factor split –plot gate, differences between treatments tested by LSD-test. The correlation coefficients between tested properties of soybean were calculated. For statistical analysis of the results was used to program GENSTAT 9.1 (Trial Version) and Statistical 12.0.

Results and Discussion

Chemical properties of chernozem represent special value of this kind of soil (Tab. 1). $CaCO_3$ is present in this soil from its surface, but in AC and C horizon it is present in great amounts. Because of that, in humus accumulative horizon chernozem has neutral, and at greater depth weak alkaline reaction.

Table 1. Chemical properties of chernozem (Backa Topola, Serbia)

Horizons	Depth	pH		$CaCO_3$	Humus	N	mg/100g soil	
	(cm)	KCl	H_2O	(%)	(%)	(%)	P_2O_5	K_2O
A arable	0-35	7.01	8.05	1.95	2.63	0.173	11.2	20.5
A subarable	35-55	7.20	8.25	3.79	2.03	0.134	7.9	17.2
AC	55-95	7.79	8.63	19.19	1.60	0.105	2.9	10.5
C	95-200	8.05	8.75	32.12	0.36	0.024	2.4	6.6

According to its requirements, soybean can be classified in plants which require higher temperatures and at high temperatures are well-developed, but also, soybean is resistant to short periods of low temperatures and frost. In flovering phase soybean is sensitive to low soil moisture, and o low relative humidity, especially if drought occurs at the same time with high temperatures (Sekulic and Kurjacki, 2008). In both year average month temperatures during vegetation were at the multy-year average (Fig. 1) and they were appropriate to soybean requirements during the grow and development phases. Precipitation significantly deviated from multy-year average for vegetation period from April to September. In 2012 precipitation sum was lower for 24.4 % (82.1 $l.m^{-2}$), and in 2013 it was higher for 43.5 % (146.4 $l.m^{-2}$) compared to multy-year average. However, precipitation distribution was better in 2012 because there were more precipitation in July compared to 2013 and multy-year average. Then soybean was in flovering phase and pod formation, when soybean needs the most the soil moisture. Too much water in stages from germination to flovering, as it was the case in 2013, plants form big aboverground mass and relatively shallow root system, which reduced plant’s resistence to drought. For soybean it is often more important distribution of precipitation than its sum during vegetation (Dozet, 2006, 2009, Djukic, 2009). Average relative humidity significantly deviated from multy-year average and in 2012 it was just 55 %, while in 2013 it was 63 %. Relative humidity wasn’t favorable for soybean in its reproductive phases.

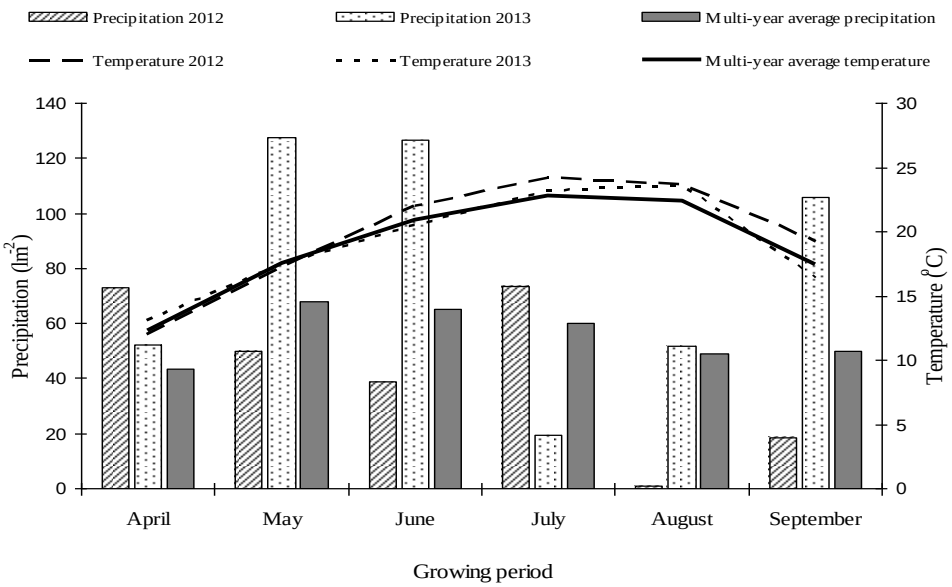

Figure 1. Weather conditions during the production year and multi-year average

Table 2. Proteins and oil in the soybean depending on cultivation technology and application of microbiological fertilizer (%)

Year		Variants	Protein content Method of production (A)		x̄ (B)	Oil content Method of production (A)		x̄ (B)
			Conventional	Organic		Conventional	Organic	
2012	Microbial fertilizer (B)	1	40.40	40.24	40.32	20.97	21.09	21.03
		2	40.92	37.04	38.98	20.25	23.77	22.01
		3	40.47	40.35	40.41	21.13	20.57	20.85
		4	39.97	41.37	40.67	21.55	20.33	20.94
		5	39.82	41.42	40.62	21.93	19.55	20.74
		x̄ (A)	**40.32**	**40.08**	**40.20**	**21.17**	**21.05**	**21.11**
2013	Microbial fertilizer (B)	1	39.89	40.55	40.22	21.57	21.97	21.77
		2	41.29	41.01	41.15	19.56	20.40	19.98
		3	40.08	39.92	40.00	19.78	22.92	21.35
		4	38.78	38.74	38.76	22.15	21.79	21.97
		5	38.02	38.32	38.17	22.03	23.45	22.74
		x̄ (A)	**39.61**	**39.71**	**39.66**	**21.02**	**22.10**	**21.56**
		x̄ 2012-2013	**39.97**	**39.90**	**39.93**	**21.09**	**21.58**	**21.33**

		Protein content Factors				Oil content Factors			
		A	B	AxB	BxA	A	B	AxB	BxA
2012	$LSD_{0.01}$	0.93	0.23	1.63	0.43	0.60	0.17	1.04	0.30
	$LSD_{0.05}$	0.70	0.19	1.23	0.33	0.45	0.13	0.78	0.23
2013	$LSD_{0.01}$	0.98	0.28	1.70	0.49	0.50	0.27	1.14	0.40
	$LSD_{0.05}$	0.74	0.21	1.28	0.37	0.35	0.23	0.88	0.33

An amount of average contents proteins is 39.93%, in conventional production was higher than in organic cropping system (Tab. 2). Influence of treatment by different technology in production of soybean was not showed regularity in measured values. They don’t have common statistical differences. Using microbiological fertilizers shows significant impact in contents of proteins in grains. In 2012 highest contents of proteins was registered on 4.

variants and it was very important in comparing with other variants, instead of 5. Variants. In 2013 on 5. Variants determined the lowest percentage of proteins in soybean grains in compare with control of rest of tested variants and by highest level of statistic relevancy. Measured average oil content which is 21.33%, but in 2012 was lower (21.11%) in compare in 2013.year (21.56%). On average for both years recorded highest percentage in soybean grains which was in organic productions (21.58%). For 2.32% higher than conventional productions (21.09%) (Tab. 2). In first researching year wasn't been significance differences in tested between applied growing technology.

However in 2013 significantly higher contents of oil recorded in organic productions and it is for 5.02% in compare with conventional productions. In research Djukic et al. (2015) using of microbiological fertilizer (effective microorganisms) fortified significant increased microbiological activity, fortified a higher total number of microorganisms and Azobacter in compare with control.

Table 3. Correlative interdependence of some studied properties of soybean

Observed traits	HP	PN	GN	GW	W1000	Z	P	O
HP		0,68*	0,71**	0,60*	-0,29	0,60*	0,45	-0,42
PN	0,68*		0,88**	0,39	-0,48	0,39	0,46	-0,37
GN	0,71**	0,88**		0,33	-0,71**	0,33	0,36	-0,21
GW	0,60*	0,39	0,33		0,38	0,78**	0,87**	-0,85**
W1000	-0,29	-0,48	-0,71**	0,38		0,38	0,31	-0,48
Y	0,60*	0,39	0,33	0,78	0,38		0,87**	-0,85**
P	0,45	0,46	0,36	0,87**	0,31	0,87**		-0,93**
O	-0,42	-0,37	-0,21	-0,85**	-0,48	-0,85**	-0,93**	

$p<0.05$* $p<0.01$**

Number of pods (PN) was in a very positivley correlation in number of grains (GN), and number of grains (GN) with plant height (PH) (Table 3). Yield (Y) was in a strong correlation between mass of grain (GW) and contains protein (P), but it was calculated a strong negative correlation between number of grains (GN) and weight of 1000 grains (W1000), such as and between grain yield (Y), hawever contains protein (P) and oil in grain (O) (-0.85 and -0.93). Similar results got Djukic (2009), Dozet i sar. (2014).

Conclusion

Application of growing technology not significant effect in contains of protein and oil in grain of soybean. These properties are conditioned by the genetically. Using of microbiological fertilizer has been significant impact depending on the time of using. But is not recorded appropriate regularity, and because of it plot required repeat on some or different region. Correlative dependence between important tested properties was been statistically important.

Ecological soybean production, as production system with respect of environmental principles and standards, as well as specific local agroecological conditions, has its priority.

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