KNOWLEDGE – International Journal
Vol. 26.5
September, 2018

IMPACT OF CLIMATE CONDITIONS AND DIFFERENT LEVELS OF ORGANIC FERTILIZER ON SOYBEAN PRODUCTION (*Glycine max*. L)

Marija Cvijanović
Kompanija Dunav osiguranje, Beograd Srbija, marijacvijanovic@yahoo.com
Vojin Đukić
Institute of Field and Vegetable Crops, Novi Sad, Serbia vojin.djukic@nsseme.com
Vojin Cvijanović
University of Belgrade, Faculty of Agriculture, Belgrade-Zemun, Serbia
cvija91@yahoo.com
Zlatica Miladinov
Institute of Field and Vegetable Crops, Novi Sad, Serbia zlatica.miladinov@nsseme.com
Gordana Dozet
University of Megatrend, Faculty of Biofarming,, Srbija gdozet@biofarming.edu.rs

Abstract: In the last few years, the impact of climate change on agriculture is obvious. Today climate change implies the consequences of human economic activities in industry, agriculture, energy production and transportation along with natural disorders in the atmosphere. Agriculture must solve a double challenge: reducing greenhouse gas emissions, but also has to adapt to the expected consequences of climate change. Unforeseen climate change events in the future are progressing progressively, and it is difficult to adapt to agricultural production that has been facing negative consequences for some time. Adaptations, traditional methods of cultivation and proper access to natural resources (land, air, water, biodiversity) is crucial for the survival of agriculture and yield stability. Systems of organic farming actually heals the land that is degraded by conventional measures in agricultural production. It is known that nitrogen is an important element in achieving stable, economic and cost-effective yields. Continuous use of nitrogen fertilizers usually leads to the formation of pollutants that have a negative impact on the elements of the environment most important in the production of food. These problems lead to the invention and application of new technologies that are aimed at stimulating natural biological cycles. One of the measures is to increase the cultivation of leguminous plants in the rotation of crops in order to increase the fertility of the soil and reduce the use of energy. In world proportions, soybeans as legumes represent the most important plant species for the production of proteins and oils, as 75% of their nitrogen needs are provided in symbiosis with bacteria *Bradyrhizobium japonica*, which reduces the pollution of soil and water by excess nitrate ions. On the other hand, different groups of microorganisms are introduced as biofertilizers, of which the groups of microorganisms known as effective microorganisms are the most widely used. They can be entered predely in the soil, on the seed immediately prior to planting and foliar over the leaf. Many studies have focused on examining the impact of combined application of microbiological and organic fertilizers in growing leguminous plants, given the mutual benefit.

The aim of the research is the influence of the year, ie precipitation and temperature, in the sustainable system of soybean cultivation with different combinations of organic and mirkoobiological fertilizers. Two years of research (2014-2015) for the sustainable development of soybean Valjevljka variety were carried out at the experimental site of the Institute of Field and Vegetable Crops in Novi Sad. For basic fertilizers, a granulated poultry manure formulation was used in an amount of: control (without fertilization), 750 and 1300 kg.ha^{-1}. The subplots contain the foliar treatment of plants in the vegetative fenofusion of intensive plant growth (Vn) with a microbiological preparation containing a mixture of effective microorganisms. In the course of the research were determined by the following characteristics plant height (cm), weight per plant (g) and the weight of 1000 grains (g) as a generative parameters that influence on a yield of plants. According to the amount of precipitation and the measured temperatures in 2015, the year was extremely unfavorable. In the period of vegetation, the water deposit deficit was 116 mm, and the average temperatures were on average 2.6°C more than in 2014. Such unfavorable conditions were when the soybeans passed through the stages of vegetative growth, the formation of pods, filling of grains and ripening. All this influenced that the parameters tested in 2015 were lower at the level of statistical significance $p<0.01$. The applied treatments in 2015 statistically significantly influenced the increase in the values of the tested parameters. Finally, it can be concluded that soybean production requires irrigation in the course of climate change.

Also, for safer and more stable production, it is necessary to apply mirkoobiological preparations in the supplementary nutrition of plants over the leaf.

Keywords: soybean, sustainable production, climate change, organic fertilizer, effective microorganisms

UTICAJ KLIMATSKIH USLOVA I RAZLIČITIH KOLIČINA ORGANSKOG ĐUBRIVA NA PROIZVODNJU SOJE (*Glycine max*. L)

Marija Cvijanović
Kompanija Dunav osiguranje, Makedonska 4, 11000 Beograd Srbija, marijacvijanovic@yahoo.com
Vojin Đukić
Institut za ratarstvo i povrtarstvo, Novi Sad, Srbija, vojin.djukic@nsseme.com
Vojin Cvijanović
Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, Srbija, cvija91@yahoo.com
Zlatica Miladinov
Institut za ratarstvo i povrtarstvo, Novi Sad, Srbija zlatica.miladinov@nsseme.com
Gordana Dozet
Univerzitet Megatrend, Fakultet za biofarming, Srbija gdozet@biofarming.edu.rs

Rezime: U poslednjih nekoliko godina, uticaj klimatskim promenama na poljoprivredu je očigledan. Danas klimatske promene podrazumevaju posledice nastale kao rezultat ljudskih ekonomskih aktivnosti u industriji, poljoprivredi, proizvodnji energije i transport uz prirodne poremećaje u atmosferi. Poljoprivreda mora rešavati dvostruki izazov: smanjenje emisije štetnih gasova, a ujedno se mora prilagođavati očekivanim posledicama klimatskih promena. Nepredvidivi događaji klimatskih promena u budućnosti se odvijaju progresivno, te je teško prilagoditi poljoprivrednu proizvodnju koja se već neko vreme suočava sa negativnim posledicama. Prilagođavanja, tradicionalna način gajenja i pravilan pristup prirodnim resursima (zemljište, vazduh, voda, biodiverzitet) je presudno za opstanak poljoprivrede i stabilnost prinosa. Sistemi ekološke proizvodnje zapravo leči zemljište koje je degradirano konvencionalnim merama u poljoprivrednoj proizvodnji. Poznato je da azot predstavlja važan element za postizanje stabilnih, ekonomskih i isplativih prinosa. Stalna upotreba azotnih đubriva su najčešće dovodi do stvaranja polutanata koje imaju negativan uticaj na elemente životne sredine najznačajnije u proizvodnji hrane. Navedeni problemi dovode do iznalaženja i primene novih tehnologija koje su usmerene ka stimulaciji prirodnih bioloških ciklusa. Jedna od mera je povećanje gajenja leguminoza u rotaciji useva u cilju povećanja plodnosti zemljišta i smanjenju korišćenja energije. U svetskim razmerama soja kao leguminoza predstavlja najvažniju biljnu vrstu za proizvodnju proteina i ulja, jer 75% svojih potreba za azotom obezbedi u simbiozi sa bakterijama *Bradyrhizobium japonica*, čime se smanjuje zagađenje zemljišta i voda viškom nitratnog jona. S druge strane uvode se različite grupe mikroorganizama kao biofertilizatori od kojih najveću primenu imaju grupe mikroorganizama poznate kao efektivni mikroorganizmi. Mogu da se unose predsetveno u zemljište, na seme neposredno pred setvu i folijarno preko lista. Mnoga istraživanja su usmerena na ispitivanje uticaja kombinovane primene mikrobioloških i organskih đubriva kod gajenja leguminoznih biljaka, obzirom na obostranu korist.

Cilj istraživanja je uticaj godine, odnosno padavina i temperatura, u održivom sistemu gajenja soje sa različitim kombinacijama organskog i mirkobiološkog đubriva. Dvogodišnja istraživanja (2014-2015) održive proivodnje soje sorte Valjevljka su sprovedena na oglednom dobru Instituta za ratarstvo i povrtarstvo u Novom Sadu. Za osnovno đubrivo korišćen je granulirani živinski stajnjak formulacije, u količini od: kontrola (bez đubrenja), 750 i 1300 $kg.ha^{-1}$. Podparcele sadrže folijarni tretman biljaka u vegetativnoj fenofazi intezivnog porasta biljaka (Vn) sa mikrobiološkim preparatom koji sadrži smešu efektivnih mikroorganizama. U toku istraživanja određivane su sledeće osobine visina biljaka (cm), masa zrna po biljci (g) i masa 1000 zrna (g) kao generativni pokazatelji koji utiču na visinu prinosa biljaka. Prema količini padavina i izmerenim temepraturama 2015. godina je bila izrazito nepovoljna godina. U periodu vegetacije izmerene je deficit vodenog taloga, koji je iznosio 116 mm, a prosečne temperature bile su u proseku više za 2,6°C nego u 2014. godini. Ovako nepovoljni uslovi su bili kada je soja prolazila kroz faze vegetativnog porasta, formiranje mahuna, nalivanja zrna i zrenja. Sve ovo je uticalo da su ispitivani parametri u 2015. godini bili niži na nivou statističke značajnosti $p<0,01$. Primenjeni tretmani u 2015. godini su statističko značajno uticali na povećanje vrednosti ispitivanih parametara. Na kraju se može zaključiti da je

za proizvodnju soje u toku klimatskih promena potrebno navodnjavanje. Takođe, za sigurniju i stabilniju proizvodnju neophodno je primeniti mirkobiološke preparate u dopunskoj ishrani biljaka preko lista.
Kjučne reči: soja, održiva proizvodnja, klimatske promene, organsko đubrivo, efektivni mikroorganizmi

1. INTRODUCTION

A growing number of studies that have focused on the application of alternative measures in crop production in order to avoid adverse effects resulting hyper production. The products obtained by sustainable production are of high quality, safe for human health, and the production itself contributes to the protection of the environment. Soybean as the most common legumes because of their specificity with symbiotic bacteria suitable preceding crop as many cultures as well as in the preservation of the productive potential of land and state of health (Cvijanović et al.[11]). Soyabean intensely reacts to climate change. In generative soybean development phases, it is necessary to provide sufficient moisture in the soil, in order to obtain high yields (Đukić et al.[12]). Soyaben can well tolerate drought to the stage of flowering, and in the event that the drought continues to later stages of plant development, yields of soybeans are reduced considerably, as plants reject flowers and dry out (Cvijanović[13]). The use of well-declared and varietal seeds and proper implementation of all agro-technical measures are the achievement of high and stable yields (Đukić et al.[14]).

One of the measures is the application of microbiological fertilizers (Cvijanović et al.[15]). Microorganisms that have a defensive and stimulating effect on the growth and development of the plant additionally affect the biological activity of the soil. The application of microbiological fertilizers represents the introduction of living organisms into the soil with the aim of improving, supplying plants essential nutrients (nitrogen, phosphorus, potassium, iron, sulfur and plant growth stimulators). It accelerates the transformation of organic matter and azotofixation, reduces the carbon dioxide concentration in the soil, reduces the possibility of root affinity, releases elements from hardly accessible forms into easily accessible (Dozet et al.[16]).

2. MATERIALS AND METHODS

The study was conducted at the Institute of Field and Vegetable Crops in Novi Sad, Serbia. On the soil of the Chernozem type, a three-factor tour was set up in four repetitions by a working design. The paper used the soybean Valjevka variety, 0 groups of ripening, the length of the vegetation period up to 120 days. Factor A is the year of research (2014-2015). Factor B is a basic fertilization with a granular livestock manure, the formulation N 4.5%, P_2O_5 2.7%, K_2O 2.2%, MgO 0.9%, CaO 10.4%, in the amount of: control (without fertilization), 750 i 1300 kg.ha^{-1}. Subparagraphs contain foliar treatment of plants with a mixture of useful microorganisms in two development phenophases in an amount of 6 l/ha. The EM Active product, which contains a mixture of various types of aerobic and anaerobic effective microorganisms, was used.

The aim of the study was to investigate the influence of the year, ie precipitation and temperature on the morphological and generative properties of plants that define the yield yield: plant height (cm), grain mass per herb (g) and weight of 1000 grain (g) soybeans under conditions of natural irrigation production system with three different levels of basic fertilization in combination with microbiological fertilization.

Vremenski uslovi: The weather conditions in the two-year research period were markedly different (Table 1). The rainfall for the vegetation period in 2014 (595.60 mm) is slightly higher than the perennial average 1964-2015 (375

[11] Cvijanović, M., Đukić, V., Marinković, J., Cvijanović, G., Dozet, G., Dragičević, V. *The importance of using organic inputs and electromagnetic waves in soybean production*, Proceedings of 7th International scientific/profesional conference: Agricultural in nature and environment protection, (2014)

[12] Đukić, V., Balešević-Tubić, S., Đorđević, V., Tatić, M., Dozet, G., Jaćimović, G., Petrović, K. *Yield and seed quality of soybean depending on the conditions of the year*, Rat Pov/Field Veg Crop Res, (2011)

[13] Cvijanović, M. *The effect of low-frequency electromagnetic field and biological components on the yield and quality of seeds in sustainable soybean production*, doctoral dissertation, (2017)

[14] Đukić, V., Miladinov, Z., Dozet, G., Cvijanović, M., Marinković, J., Cvijanović, G., Tatić M. *Impact of ground treatment time on soybean 1000 soil weight*, Proceedings of the PKB Agroekonomik Institute, (2018)

[15] Cvijanović G., Dozet G., Milošević N., Lalević B. *Importance of microorganisms in organic production*, International Tourism Fair, Mediterranean Days of Trebinje 2010, Healthy Life Conference, Thematic Journal, (2010)

[16] Dozet, G., Cvijanovic, G., Vasic, M., Djuric, N., Jaksic, S., Djukic, V. *Effect of microbial fertilizer application on yield of bean (Phaseolus vulgaris L.) in organic production system*. Proceedings of XXIII Inter. Conf. »Ecological Truth«, (2015)

mm). The highest rainfall was in May (202.10 mm), which was favorable for vegetative soybean development phases. By the end of the vegetation period, soya was well supplied with water at the level of perennial averages. In 2015, an average rainfall of 389 mm was recorded, which was just 14 mm higher compared to the annual rainfall of 375 mm. The quantities and schedule of precipitation in 2015 were not satisfactory in the months of June and July when the flour was formed and poured, and can be considered as a dry year. The average value of the temperature in 2014 was approximately the values of the long-term period and with a good rainfall schedule it is considered a very suitable year for the production of soybeans. However, in 2015, the average temperature values in each month were more than the perennial average and, with an incorrect rainfall schedule, is considered a markedly unfavorable year in the last few decades, especially in the stage of flowering and filling of grains.

Table 1. Average values of precipitation (mm) and the temperature (ºC)

Month	Precipitation (mm)			Temperature (ºC)		
	2014	2015	1964-2015	2014	2015	1964-2015
April	51,20	15,00	46,90	13,20	11,80	11,70
May	202,10	192,00	67,10	16,30	17,80	17,00
June	38,20	28,00	86,60	20,50	20,50	20,00
July	141,10	2,00	67,40	21,90	24,50	21,70
August	78,70	99,00	59,30	20,90	24,40	21,20
September	84,30	53,00	47,80	17,20	19,90	16,90
Average	595,60	389,00	375,00	18,30	19,80	18,10

The negative impact of climatic conditions, above all uneven precipitation, affects the growth and development of soybeans, as well as the intensity of symbiotic relationship with lumpy bacteria Komesarović i sar.[17]. According to Đukić i sar.[18] on the yield of soybean grain, morphological and generative properties of soybean, the importance of temperature and precipitation during vegetation is of great importance.

3. RESEARCH RESULTS

The priority of agricultural production is the formation of a high and stable yield, which depends primarily on the genotype of plants, agroecological factors and applied agro-technology. Certain morphological characteristics of plants can have a significant impact on the formation of yields, and in doing so, they themselves depend on the various environmental influences Cvijanović[3].

3.1. Plant height (cm) has a significant impact on the yield height. The height of soybean plants is on average 0.2-2.0 m and more depending on climatic factors, fertilization and supplemental nutrition. The average height of plants for the study period was 89.69 cm (Table 2). In 2014, the average value of the examined morphological trait was 11.45% higher, which is statistically significant, compared to 2015. The highest plant height was measured in the amount of fertilizer from 1300 kg.ha^{-1} in both years, however, there was no statistically significant difference. The use of effective microorganisms has positively influenced plant height values relative to treatment without foliar application at a level of statistical significance of 1%. Interaction of investigated focal factors was not statistically significant. According to research Mandić et al.[19] the interaction of the genotype in agrometerological conditions was determined.

[17] Komesarović, B., Redžepović, S., Blažinkov, M., Sudarić, A., Uher, D., Sikora, S. *The symbiotic efficiency of selected autochthonous strains of Bradyrhizobium japonicum*, Dairy, (2007)
[18] Đukić, V., Miladinov, Z., Dozet, G., Cvijanović, M., Tatić, M., Miladinović, J., Balešević-Tubić, S. *Pulsed electromagnetic field – a cultivation practice used to increase soybean seed germination and yield*, Zemdirbyste-Agriculture, (2017)
[19] Mandić, V., Simić, A., Krnjaja, V., Bijelić, Z., Tomić, Z., Stanojković, A., Ruzić, M.D. *Effect of foliar fertilization on soybean grain yield*. Biotechnology in Animal Husbandry, (2015)

Table 2. Average plant height (cm) depending on the factors examined

Year (A)	Fertilization (kg ha^{-1}) (B)	Microbiological preparation (C)		AB	A
		C_1	C_2		
2014	0	90,73	98,15	94,44	94,54
	750	90,58	95,60	93,09	
	1300	96,15	96,05	96,10	
	AC	92,48	96,60		
2015	0	81,03	85,60	83,31	84,83
	750	83,33	87,20	82,26	
	1300	84,10	87,73	85,91	
	AC	82,82	86,84		
BC	0	85,88	91,88	88,88	
	750	86,95	91,40	89,18	
	1300	90,13	91,89	91,01	
	C	87,65	91,72		
Average 2014 - 2015				89,69	

	A**	B	C**	AB	BC	AC	ABC
F test	289,66	3,76	33,00	2,04	3,05	0,03	1,93
LSD 5%	1,82	1,83	1,49	2,59	2,58	2,11	3,65
LSD 1%	1,74	2,57	2,04	3,64	3,53	2,88	5,00

3.2. The weight of the grain per plant (g) is an important component of the yield per plant that has a significant impact on the yield level per unit area. The average grain weight per plant in this experiment was 9.00 g (Table 3). Given the favorable climatic conditions in 2014, the average grain weight per plant was 12.14 g, which is statistically significant in comparison with the dry year (5.86 g). All the measured values in the fertilization of 750 and 1300 kg.ha^{-1} were more than control. The identified differences were statistically significant at $p<0.01$. The average value of grain mass per plant in foliar treatment was 35.91% higher than the non-treatment variant, which was statistically significant ($p<0.01$). The results obtained are in correlation with the results of the application of effective microorganisms in the examination of grain weight per plant in different soybean varieties Dozet et al.[20]. Similar results on favorable climatic conditions in combination with various organic and mirkoobiological fertilizers, which led to an increase in the value of grain mass per plant, has determined Cvijanović[3]. Interaction of factor of year / fertilization (AB) has a significant effect on the height of plants. The same trend was achieved in the interaction of years / seed treatment (AC), fertilization / seed treatment (BC) and year / fertilization / seed treatment (ABC).

Table 3. Weight of grain per plant (g) depending on the factors examined

Year (A)	Fertilization (kg ha^{-1}) (B)	Microbiological preparation (C)		AB	A
		C_1	C_2		
2014	0	9,90	15,10	12,50	12,14
	750	10,58	13,43	12,01	
	1300	11,04	12,82	11,93	
	AC	10,50	13,78		
2015	0	3,87	7,50	5,68	5,86
	750	4,60	7,10	5,85	
	1300	5,80	6,28	6,04	
	AC	4,75	6,96		
BC	0	6,88	11,30	9,09	
	750	7,59	10,26	8,93	
	1300	8,42	9,55	8,98	

[20] Dozet, G., Cvijanović, G., Đukić, V., Cvijanović, D., Kostadinović, Lj. *Effect of microbial fertilizer on soybean yield in organic and conventional production*. Turkish Journal of Agriculture and Natural Sciences (2014)

		C	7,63	10,37			
		Average 2014 - 2015				9,00	
	A**	B**	C**	AB**	BC**	AC**	ABC**
F test	23.414,82	2,59	2.720,91	21,32	325,62	104,32	12,16
LSD 5%	0,13	0,16	0,11	0,22	0,19	0,16	0,27
LSD 1%	0,13	1,22	0,15	0,31	0,26	0,21	0,37

3.3 The weight of 1000 grains (g) is an indicator of the seed volume that directly affects the yield, because it represents one of the three basic components of the yield. It depends largely on the genetic factor of the variety, fertilization and foliar treatment, but also from external factors. The differences in the weight of 1000 grains in the years of study were statistically significant at the level of 1% (Table 4). In 2014, the average weight of 1000 grains was 189.99 g, which was 32.19% more than in 2015 (143.72 g). A significant impact of the year on the mass of a thousand soybeans in three years of research has been Đukić et al[21]. These authors note an increase in the mass of a thousand grains in years with higher precipitation, while in the most drooling years they were the lowest. The fertilization did not statistically influence the 1000 grain weight, but the highest average value of 1000 grain mass was in the fertilization of 1300 kg.ha^{-1} (166.95 g) in both examined years. Foliar treatment has positively and statistically significantly influenced the soybean test being tested. In 2014, the increase was by 2.03%, and in 2015 by 2.69%. Similar results were reported Aboutalebian and Malmir[22] with a combination of 30 kg.ha^{-1} starter nitrogen together with foliar treatment with bradyrhizobium and mycorrhiza, an increase in the weight of 1000 soybean grains was 11.19% compared to control. Interaction relations did not show statistical significance.

Table 4. Mass of 1000 grains per plant (g) depending on the factors examined

Year (A)	Fertilization (kg ha^{-1}) (B)	Mikrobiološki preparat (C)		AB	A
		C_1	C_2		
2014	0	187,75	191,65	189,70	189,99
	750	188,60	192,30	190,45	
	1300	187,90	191,75	189,93	
	AC	188,08	191,90		
2015	0	143,05	146,20	144,63	143,72
	750	139,25	145,65	142,45	
	1300	143,05	145,10	144,08	
	AC	141,78	145,60		
BC	0	165,40	168,93	167,16	
	750	163,93	168,98	166,45	
	1300	165,48	168,43	166,95	
	C	164,93	168,78		
Average 2014 - 2015				166,85	

	A**	B	C**	AB	BC	AC	ABC
F test	5.155,71	0,05	10,52	0,20	0,28	0,00	0,33
LSD 5%	2,06	5,24	2,49	7,41	4,31	3,52	6,09
LSD 1%	1,98	7,34	3,41	10,38	5,90	4,82	8,35

4. CONCLUSION

On the basis of the obtained results it can be concluded that the parameters tested were significantly higher in the conditions of optimal water sediment and with a good distribution. Also, foliar application of useful groups of

[21] Đukić, V., Đorđević, V., Popović, V., Balešević-Tubić, S., Petrović, K., Jakšić, S., Dozet, G. *The effect of nitrogen and nitrate on soybean yield and protein content*, Ratar. Povrt./Field Veg. Crop Res, (2010)

[22] Aboutalebian, M. A. and Malmir, M., *Soybean yield and yield components affected by the mycorrhiza and bradyrhizobium at different rates of starter nitrogen fertilizer*, Semina: Ciências Agrárias (Londrina), (2017).

microorganisms during vegetation, all investigated parameters were increased at the level of statistical significance $p<0.01$. The use of useful microorganisms can alleviate adverse agro-meteorological effects such as drought.

LITERATURE

[1] M. Cvijanović, V. Đukić, J. Marinković, G. Cvijanović, G. Dozet, V. Dragičević, The importance of using organic inputs and electromagnetic waves in soybean production. Proceedings of 7th International scientific/profesional conference: Agricultural in nature and environment protection, pp. 241-246, 2014.

[2] V. Đukić, S. Balešević-Tubić, V. Đorđević, M. Tatić, G. Dozet, G. Jaćimović, K. Petrović, Yield and seed quality of soybean depending on the conditions of the year,. Rat Pov/Field Veg Crop Res. vol. 48, no. 1, pp. 137-142, 2011.

[3] M. Cvijanović, The effect of low-frequency electromagnetic field and biological components on the yield and quality of seeds in sustainable soybean production, Doctoral dissertation, University of Belgarde, Faculty of agriculture, 2017.

[4] V. Đukić, Z. Miladinov, G. Dozet, M. Cvijanović, J. Marinković, G. Cvijanović, M. Tatić, Impact of ground treatment time on soybean 1000 soil weight, Proceedings of the PKB Agroekonomik Institute, Belgrade, vol.24 no.1-2, pp. 93-99, 2018.

[5] G. Cvijanović, G. Dozet, N. Milošević, B. Lalević, Importance of microorganisms in organic production, International Tourism Fair, Healthy Life Conference, Thematic Journal, Trebinje, pp. 86-93, 2010.

[6] G. Dozet, G. Cvijanovic, M. Vasic, N. Djuric, S. Jaksic, V. Djukic, Effect of microbial fertilizer application on yield of bean (*Phaseolus vulgaris* L.) in organic production system. Proceedings of XXIII International Conference »Ecological Truth«, Kopaonik, Serbia, pp. 105-107, 2015.

[7] B. Komesarović, S. Redžepović, M. Blažinkov, A. Sudarić, D. Uher, S. Sikora, The symbiotic efficiency of selected autochthonous strains of *Bradyrhizobium japonicum*, Dairy, vol. 57, pp. 289-302, 2007.

[8] V. Đukić, Z. Miladinov, G. Dozet, M. Cvijanović, M. Tatić, J. Miladinović, S. Balešević-Tubić, Pulsed electromagnetic field – a cultivation practice used to increase soybean seed germination and yield. Zemdirbyste-Agriculture, DOI 10.13080/z-a.2017.104.044, vol. 104, no. 4, pp. 345–352 2017.

[9] V. Mandić, A. Simić, V. Krnjaja, Z. Bijelić, Z. Tomić, A. Stanojković, D. Ruzić, Effect of foliar fertilization on soybean grain yield. Biotechnology in Animal Husbandry, vol. 31, no. 1, pp. 133-143, 2015.

[10] Dozet G., Cvijanović G., Đukić V., Cvijanović D., Kostadinović Lj., Effect of microbial fertilizer on soybean yield in organic and conventional production. Turkish Journal of Agriculture and Natural Sciences, Special Issue 1, pp. 1333-1339., 2014.

[11] V. Đukić, V. Đorđević, V. Popović, S. Balešević-Tubić, K. Petrović, S. Jakšić, G. Dozet, The effect of nitrogen and nitrate on soybean yield and protein content, Ratar. Povrt./Field Veg. Crop Res. vol 47, pp. 187-192, 2010.

[12] M. A. Aboutalebian and M. Malmir, Soybean yield and yield components affected by the mycorrhiza and bradyrhizobium at different rates of starter nitrogen fertilizer, Semina: Ciências Agrárias (Londrina) DOI: 10.5433/1679-0359.2017v38n4Supl1p2409, vol. 38, no. 4, suppl. 1, pp. 2409-2418, 2017.