Biotechnology in Animal Husbandry 30 (3), p 517-528 , 2014
Publisher: Institute for Animal Husbandry, Belgrade-Zemun
ISSN 1450-9156
UDC 633.853.52
DOI: 10.2298/BAH1403517K

INFLUENCE OF INTER-ROW SPACING AND CULTIVAR ON THE PRODUCTIVITY OF SOYBEAN

Lj. Kolarić [1], Lj. Živanović[1], V. Popović[2], J. Ikanović[1], M. Srebrić[3]

[1]University of Belgrade, Faculty of Agriculture, Nemanjina 6, Belgrade, Serbia
[2]Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia
[3]Maize research Institute, Zemun Polje, Slobodana Bajića 1, Belgrade, Serbia
*Corresponding authors: E-mail: kolaric@agrif.bg.ac.rs; vera.popovic@nsseme.com;
Original scientific paper

Abstract: Influence of inter-row spacing on a productivity of soybean yield was studied on the experimental field on low carbonate chernozem soil. The greatest grain weight per plant (13.22 g) was achieved at the smallest row spacing. It decreased at higher row spacing, except for cultivar Balkan, where value of these parameters was the highest (13.09 g). The highest grain yield (4,868 kg ha^{-1}) was determined at the 20 cm inter-row width. It decreased equally at bigger row spacing for 7.0-12.9%. The highest grain yield was achieved with Balkan cultivar (4,773 kg ha^{-1}), and the lowest with Dragana cultivar (4,284 kg ha^{-1}).

Keywords: soybean, inter-row spacing, cultivars, yield components

Introduction

Soybean (*Glycine Max.* [L.] Merr.) is importance of comes first and foremost from the chemical composition of its grain, which is about 40% protein and 20% oil (*Popovic et al. 2012, Popovic et al.,2013).* Soybean meal, as a by-product in processing, is indispensable protein component for animal feed. In addition to traditional sources of animal proteins, soybean is used in developed world for controlled nutrition of certain population groups *(Miladinovic et al., 2008).* Grain seed are in the usage for humans and domestic animals diet (*Nikolic et al.,* 2013). Protein content accounts for about 40% of dry soybeans while carbohydrates and oils account for about 35% and 20%, respectively. Because soybeans have high protein content, they are a major ingredient in livestock feed. A smaller percentage is processed for human consumption and made into products including soy milk, soy flour, soy protein, tofu and many retail food products. Soybeans are also used in many non-food (industrial) products. Recently, soybean oil has caused considerable attention due to its increased use for biodiesel production. High quality soybeans are grown, harvested and purchased by the seed industry to be used as seed for the next year's crop *Anđelovic et al.,* (2011).

Sown area under soybean in the world is constantly increasing. About 90% of the area is concentrated in the U.S., Brazil, Argentina, China and India. In Serbia, the area under soybean was over 160.000 ha in recent years *(Miladinovic et al., 2008, Popovic et al., 2013).*

High and stable yields of soybean can be achieved only when they are based on cultivation of varieties of high yielding capacity and the implementation of intensive cropping. A wide range of local high-yielding cultivars that were selected in our climatic conditions, i.e. adapted to our climate, is available to soybean producers in our country *(Popovic, 2010).*

The proper arrangement of plants in appropriate plant density is one of the requirements to achieve high and stable yields during intensive production of soybean. It is well known that the ideal vegetation space is a square shape. However, in practice it is difficult to achieve a square shape if soybean is sown at inter row-spacing of 50 cm and intra row-spacing of 3-5 cm. Changing the shape of growing space and row spacing leads to change in microclimate growing conditions (light, relative humidity, aeration), where soybean is very sensitive, especially in the flowering stage. Therefore, a form of vegetative area or sowing modes was study object in almost all areas of growing soybeans. When sowing with greater spacing is performed, large portion of the sunlight falls between the rows and remains unused, especially in the initial part of soybean growing season *(Glamočlija,2004, Kolarić, 2010).*

The aim of this study was to examine the effect of inter row spacing at the same density on productivity of soybean yield. This would give quite a contribution to a better understanding of the impact of row spacing, and in this regard, specific recommendations related to modern production technology of soybean.

Materials and Methods

Research of the effect of inter-row spacing and cultivar on the productivity of soybean was conducted at the experimental field of Maize Research Institute in Zemun Polje on low carbonate chernozem soil in 2003 and 2004. Field micro-experiments were carried out as a two-factorial, using split-plot method in four replications.

This research covered two factors: 1. Inter-row spacing (A): 20 cm distance between rows, 45 cm distance between rows, 70 cm distance between rows and 2. Cultivar (B): Bosa (0 maturity group), Maize Research Institute, Zemun Polje, Balkan (I maturity group), Institute of Field and Vegetable Crops, Novi Sad; Dragana (II maturity group), Selsem.

Crop density within cultivars was the same for all variants, which was 500,000 plants per hectare for cultivar Bosa, 450,000 plants per hectare for cultivar

Balkan, and 400,000 plants per hectare for cultivar Dragana. Different densities were taken for each cultivar because of previous research that found that they exert maximum genetic potential in these conditions. The size of experimental plots was 5.4 m (6.0 x 0.9 m) for a combination of sowing at 45 cm between rows, 6.0 m (6.0 x 1.0 m) for a combination of sowing at 20 cm between rows and 8.4 m (6.0 x 1.4 m) for sowing at 70 cm spacing between rows.

Standard agricultural practices for soybean production were applied in the experiments, with the exception of the studied factors. In both research years, preceding crop to soybean was corn. Deep plowing was performed to a depth of 25 cm in fall, immediately after maize harvest and on this occasion 100 kg ha^{-1} of UREA (46% N) was applied. Seedbed soil preparation was performed in spring. Sowing was performed on April 23 in the first year of study and May 5 in the second year of study. Just before sowing, seeds were inoculated by microbiological chemical preparation, NS-Nitragin. Hand weeding and hoeing was performed two times during the growing season. Harvesting was performed by hand on September 10 and September 17, in the first and second year of the study. After harvest, samples from each plot and all replications consisting of ten plants were taken for laboratory analysis of following important characteristics of fertility: the number of pods per plant, grain weight per plant and 1,000-grain weight. Grain yield was reduced to 13% moisture content, determined for each plot and converted to yield kg per hectare.

The obtained experimental data were analyzed by analytical and descriptive statistics using the statistical package STATISTICA for Windows 1*0*. Significance of differences between the calculated mean values of the studied characteristics (year and genotype) was tested by the two-way analysis of variance. All significant values obtained in the LSD test were calculated for significance levels of 0.05% and 0.01.

Meteorological conditions. An analysis of thermal conditions concluded that the temperature in 2003 was higher 1.9°C compared to 2004 and 1.6°C compared to long-term average (Tab. 1).

In 2004, the temperature was close to multi-year average. It should be noted that an average monthly temperature in May and June 2003 was higher compared to 2004 and multi-year average for about 4°C and 4.5°C. Very high average monthly temperature in August 2003, which was a 3°C higher than in 2004 and multi-year average. That significantly influenced on the yield, since the soybean crop was in the stage of grain filling. In September 2003, high temperature in the first ten-day period accelerated seed ripening and soybean harvest (Tab. 1).

Table 1. Average air temperature (°C) and sum of rainfall (mm), 2003-2004, Zemun Polje

Month	Temperature		Rainfall		Temperature	Rainfall
	2003	2004	2003	2004	Average	
4.	11.5	12.9	14.6	27.2	11.5	49.1
5.	20.9	16.6	36.4	53.6	17.1	62.4
6.	24.6	20.4	19.0	125	19.9	79.9
7.	22.6	22.9	105.4	66.4	21.8	61.5
8.	24.7	21.7	26.4	39.4	21.6	51.5
9.	19.2	16.2	41.2	35.8	17.2	44.7
Total/Average	20.6	18.5	243.0	347.4	18.2	349.1

Amount and distribution of rainfall per year varied so that water regime in a year with less rainfall (2003) significantly affected the production of soybean (Tab. 1). In 2004, rainfall during growing season was at multi-year average and higher by about 105 mm, compared to 2003. In the first year, when weather was unfavorable for growing soybean, there was less rainfall in April, May and especially in June (only 19 mm). In relation to a long-term average, rainfall deficit, combined with high temperatures especially in May and June, has caused a drastic reduction in grain yield of soybean. Higher amount of rainfall was recorded in July (105.4 mm). Far better distribution and quantity of rainfall were recorded in 2004, a year with more favorable weather. Higher amount of precipitation, as well as its favorable distribution especially in the critical stages of water, combined with favorable temperatures, had favorable impact on the growth and development of soybean. It has certainly influenced better yield and quality of soybean genotypes. Our study is consistent with *Popovic et al. (2013)* research, where authors stated that there was a significant effect of temperature and rainfall on soybean yield.

Soil conditions. Parental material, calcareous forest (soil organic matter) is very well connected with the mineral part, so it is a well-formed organic-mineral complex.

According to the pH factor, it is evident that this is a soil of neutral to slightly alkaline reaction. $CaCO_3$ content at a depth of 20 cm was 1.6%, while at a depth of 40 cm was 2.2% and indicates that the soil was slightly calcareous. The humus content is variable and gradually decreases with depth. Its percentage at a depth of 20 cm is 2.87%, and at depths of 20 to 40 cm was 2.72%, which indicates high coverage with soil humus and substantial share of nitrogen therein. In addition, soil supply with phosphorus and potassium is higher. Chernozem, with its favorable chemical and physical properties, is an ideal pursued by every user of the land because it provides high yields of major agricultural land.

Results and Discussion

Influence of row spacing and cultivar on grain weight per plant

Grain weight per plant, in two-year study, was 12.26 g for factors included in this study, averagely. The highest grain weight per plant in the two-year average was achieved on a square sowing (20 cm between rows) and was 13.22 g, which is higher by 8.2% compared to the standard sowing (45 cm between rows) and 13.5% in relation to the largest sowing (70 cm between rows). On average for row spacing, the highest grain weight per plant in two-year study was achieved by cultivar Balkan (13.09 g), which is higher by 7.4% compared to cultivar Dragana, and 14.3% compared cultivar Bosa (Table 2).

Individually, in all three cultivars, the highest grain weight per plant was achieved at the smallest spacing (20 cm between rows). Similarly to the number of pods per plant, grain weight uniformly decreased with increase of row spacing, except for Balkan cultivar. This important parameter of soybean productivity ranged from 8.05 g with cultivar Bosa in wide sowing (70 cm between rows) in 2003 to 18.6 g with Balkan genotype in weather favorable 2004 at smallest sowing (20 cm between rows), (Table 2).

In the first year of study, grain weight per plant was 8.92 g, on average for the factors included in studies. Averagely for genotypes, the highest grain weight per plant was recorded at smallest row spacing (20 cm) and was 9.68 g. With increase of row spacing to 45 and 70 cm, grain weight decreased from 0.96 to 1.31 g per plant. There was no statistically significant difference in grain weight per plant between standard (45 cm) and largest row spacing (70 cm) (Table 2).

Table 2. Grain weight per plant (g) of estimated soybean cultivars in different row spacing

Year	Row spacing (A)	Cultivar (B)			Average	Index (%)
		Bosa	Balkan	Dragana		
	20	8.96	9.98	10.1	9.68	100.0
	45	8.20	8.87	9.08	8.72	90.1
2003	70	8.05	8.30	8.77	8.37	86.5
	Average	8.40	9.05	9.33	8.92	100.0
	Index (%)	100.0	107.7	111.1	-	-
	20	15.28	18.60	16.38	16.75	100.0
	45	14.72	16.77	15.13	15.54	92.8
2004	70	13.47	16.01	13.97	14.48	86.4
	Average	14.49	17.13	15.16	15.59	174.8
	Index	100.0	118.2	104.6	-	-
	20	12.12	14.29	13.24	13.22	100.0
Average	45	11.46	12.82	12.11	12.13	91.8
	70	10.76	12.16	11.37	11.43	86.5
Total average		11.45	13.09	12.24	12.26	-
Index (%)		100.0	114.3	106.9	-	-

LSD	year 2003				year 2004			
	A	B	BxA	AxB	A	B	BxA	AxB
0.05	0.37	0.41	0.72	0.69	0.85	0.95	1.65	1.59
0.01	0.56	0.57	0.98	0.97	1.29	1.30	2.26	2.24

Averagely for row spacing, the highest grain weight per plant was found at the cultivar Dragana (9.33 g). It was higher by 3.4% in comparison to the cultivar Balkan, and 11.1% with respect to cultivar Bosa. There was no statistically significant difference in grain weight per plant between genotypes Balkan and Dragana. The interaction of row spacing x genotype (AxB), at a significance level of 99%, is present in all variants of row spacing between cultivars Bosa and Dragana, while the variant of square sowing (20 cm spacing) between genotypes Bosa and Balkan is statistically significant. Statistically significant interaction BxA is determined in all cultivars between square (20 cm) and the largest sowing (70 cm), while at cultivar Bosa statistically significant difference in the grain weight per plant was found between 20 and 45 cm of row spacing (Table 2).

Table in the second year of study, on average, significantly higher values of grain weight per plant were obtained as a result of better branching plants, higher number of pods per plant due to favorable conditions of humidity and temperature. Similar to the previous year, the highest grain weight per plant, on average for the cultivars included in the study, was obtained at smallest sowing (15.59 g). The difference in grain weight per plant, on average, in the smallest sowing compared to 2003 amounted to 6.67 g or 74.8%. With increase of row spacing, grain weight had almost uniform trend of decreasing from 7.2 to 13.6%.

Statistically significant or very significant difference is present in grain weight per plant between the studied row spacing. On average for the genotypes included in the study, the highest grain weight per plant, similar to the number of pods per plant, was determined at the cultivar Balkan (17.13 g) in 2004. It was statistically significantly higher than in cultivars Bosa and Dragana. AxB interaction has not been established in any of sowing variants between cultivars Bosa and Dragana. The interaction of cultivar x row spacing is statistically significant in all studied cultivars between smallest (20 cm) and largest sowing (70 cm distance between rows), but in cultivar Balkan it is statistically justified between smallest (20 cm) and standard spacing (45 cm between rows) (Table 2).

By summarizing the data on grain weight per plant, it is noted that in both years of study it decreased with increase of row spacing. These data are consistent with results of *Nenadić (2003)* and *Kolarić (2010).*

Influence of row spacing and cultivar on soybean grain yield

Soybean grain yield was 4,545 kg/ha in a two-year study, on the average for the factors included in the research (Table 3). On the average for the cultivars, the highest yield of soybean in this two-year study was achieved with a square sowing (20 cm of row distance) and was 4,868 kg/ha. With increase of row spacing to 45 cm and 70 cm, the yield almost uniformly decreased by 7.0% and 12.9%, (Table 3).

The grain yield in two-year study, on the average for cultivars and row spacing, ranged from 3,997 kg/ha in a cultivar Dragana at wide-spacing (70 cm

between rows) to 5.151 kg/ha in cultivar Balkan at smallest spacing (20 cm between rows) (Table 3).

Table 3. Grain yield (kg/ha) of estimated soybean cultivars in different row spacing

Year	Row spacing (A)	Cultivar (B)			Average	Index (%)
		Bosa	Balkan	Dragana		
	20	3,584	3,792	3,636	3,671	100.0
	45	3,280	3,459	3,359	3,366	91.7
2003	70	3,220	3,237	3,245	3,234	88.1
	Average	3,361	3,496	3,413	3,424	100.0
	Index (%)	100.0	104.0	101.5	-	-
	20	6,112	6,510	5,569	6,064	100.0
	45	5,888	6,037	5,144	5,690	93.8
2004	70	5,388	5,604	4,749	5,247	86.5
	Average	5,796	6,050	5,154	5,595	163.4
	Index (%)	100.0	104.4	88.9	-	-
	20	4,848	5,151	4,603	4,868	100.0
Average	45	4,584	4,748	4,252	4,528	93.0
	70	4,304	4,421	3,997	4,241	87.1
Total average		4,579	4,773	4,284	4,545	-
Indeks (%)		100.0	104.2	93.6	-	-

LSD	year 2003				year 2004			
	A	B	BxA	AxB	A	B	BxA	AxB
0.05	61.53	56.92	98.59	101.06	165.74	123.62	214.11	240.21
0.01	93.21	93.21	135.05	143.33	251.08	169.34	293.3	344.23

On average for studied row spacing, the highest yield of soybean in a two-year period was achieved at cultivar Balkan (4,773 kg/ha). The yield was increased to 194 kg/ha in comparison to cultivar Bosa and 489 kg/ha relative to Dragana cultivar (Table 3).

The seed yield in less favorable year 2003, on average for the tested factors, was 3.424 kg/ha. The highest yield of soybean was achieved at lowest spacing (20 cm between rows) and amounted to 3,671 kg/ha. It was higher by 8.3% compared to standard sowing (45 cm between rows) and 11.9% compared to wide sowing (70 cm between rows). These differences in grain yield are evaluated as a statically significant.

Observing the interaction AxB in this year, its presence at the variant of smallest sowing (20 cm) and between all three genotypes was noted, as well as the standard sowing (45 cm) between cultivars Bosa and Balkan (Table 3).

Analyzing the cultivars individually, the highest grain yield, on average for tested spacing, is recorded at cultivar Balkan (3,496 kg/ha) and was higher by 4.0% or 135 kg/ha compared to cultivar Bosa, and only 25% or 83 kg/ha in comparison

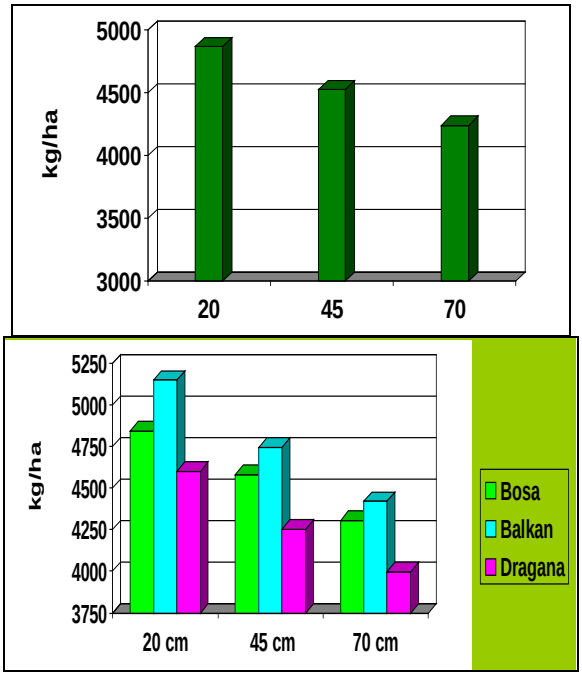
to cultivar Dragana. However, in this case, a statistically very significant difference in grain yield was noted.

The interaction of cultivar x row spacing is present on the following variants: at the cultivar Bosa between small (20 cm) and standard spacing (45 cm) at a significance level of 99%; at the cultivar Balkan, between all varieties of sowing at a very high significance; at cultivar Dragana between variants of standard (45 cm) and wide sowing (70 cm) is highly significant (95%), and among others is statistically very highly significant (Table 3).

Year 2004 was much more favorable for soybean cultivation, both in temperature and in amount and distribution of rainfall during vegetation period. Soybean yield, on the average of tested parameters, was 5,595 kg/ha and was higher by as much as 63.4% compared to less favorable year 2003. The highest grain yield, similar to the year 2003, on average of varieties included in study, was achieved at the lowest row spacing (20 cm between rows) and amounted to 6,064 kg/ha. The difference compared to yield in standard sowing (45 cm spacing) is 6.2% and compared to wide sowing (70 cm between rows) 13.5%. Statistically significant differences in grain yield were also present at the level of very high significance (99%). The interaction of row spacing x cultivar was not present in variants of standard (45 cm) and wide sowing (70 cm) between cultivars Bosa and Balkan (Table 3).

In addition, on the average for row spacing, similar to the year 2003, the highest yield of soybean gave cultivar Balkan (I maturity group) and amounted to 6,050 kg/ha. It was higher by 4.4% compared to cultivar Bosa and 15.5% compared to cultivar Dragana. The difference in grain yield between studied cultivars in this year's survey is statistically significant.

Interaction BxA, at a significance level of 95%, was found at early-maturing cultivar Bosa between square (20 cm) and standard spacing (45 cm), and other types of interaction cultivar x row spacing are statistically very highly significant (99%). The results of our study show that grain yield nearly equally decreased in both years with increasing distance between the rows.



a. b.

Figure 1. Average yield of soybean in different row spacing (a) and average yield of estimated soybean cultivars in different row spacing (cm) (b)

Our results are recorded by Bowers et al. (2000), Bullock et al. (1998), Holshouser and Whittaker (2002), Heatherly et al. (2002), Nenadic et al. (2003), as well as under irrigation conditions, noting that medium and smaller distances of sowing soybean are more favorable for achieving high yields.

Planting soybean row spacing of 25 cm was achieved on average for both years a higher yield of 11.74% in relation to the sowing row spacing of 70 cm of row (Dozet and Crnobarac, 2007).

Conclusion

Based on our two-year research of influence of row spacing and cultivar on grain weight and yield of soybean, following conclusions may be suggested:

- Planting at different spacing, as well as selected soybean cultivars, had a significant impact on productivity parameters of soybean.
- Grain weight per plant was 12.26 g in two-year's average. The highest grain weight per plant was at the smallest spacing (20 cm), i.e. 13.22 g. With increase of distance to 45 cm and 70 cm, grain weight per plant decreased by 8.2% and 13.5%. Cultivar Balkan had, averagely, the largest

grain weight per plant, which was higher by 7.4% compared to cultivar Dragana and 14.3% compared to cultivar Bosa.

- The average grain yield of soybean was 4,545 kg/ha. The yield was significantly higher in the second year of study (5,595 kg/ha) by 63.4% as compared to the first year of research. The average yield of a thick crop was increased by 7.5% as compared to standard sowing (45 cm), and by 14.8% as compared to wide sowing (70 cm). The highest average yield of soybean was achieved by cultivar Balkan (4,773 kg/ha). The yield was increased by 4.2% in comparison to cultivar Bosa and 11.4% in relation to cultivar Dragana. The highest yield of soybean in both years was achieved by cultivar Balkan (3,496 kg/ha and 6,050 kg/ha).
- It can be concluded from our study that in terms of arid and semiarid climate, which encompasses the majority of the country, significantly higher productivity can be achieved with a smaller spacing, which in our studies is 20 cm.

Acknowledgements

Experiment needed for this work is part of the projects TR 31078 and TR 31022 financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Uticaj međurednog rastojanja i sorte na produktivnost soje

Lj. Kolarić, Lj. Živanović, V. Popović, J. Ikanović, M. Srebrić

Rezime

Istraživanja uticaja međurednog rastojanja i sorte na produktivnost soje obavljena su na oglednom polju Instituta za kukuruz u Zemun Polju.

Najveća masa zrna po biljci (13,22 g) zabeležena je pri najmanjem međurednom rastojanju. Ravnomerno se smanjivala sa povećanjem međurednog rastojanja, izuzev sorte Balkan. Kod ove sorte ujedno je zabeležena i najveća vrednost ovog parametra, 13,09 g.

Uskorednom setvom ostvaren je i najveći prinos zrna soje (4.868 kg/ha). Sa povećanjem rastojanja između redova skoro ravnomerno se smanjivao za 7,0 do 12,9%. Najveći prinos dala je sorta Balkan (4.773 kg/ha), a najmanji sorta Dragana (4.284 kg/ha).

References

ANĐELOVIĆ S., MAKSIMOVIĆ S., SAVIĆ D., TOMIĆ Z., DELIĆ D. (2013): The effect of the first fertile floor on qualitative – quantitative properties of soybean seed. Biotechnology in Animal Husbandry 29 (1), p. 173-181, Belgrade-Zemun. DOI: 10.2298/BAH1301173A

BOWERS, R.G., RABB, L.J., ASHLOK O.L and SANTINI, B. J (2000): Row spacing in the early soybean production system. Agronomy Journal, 92: 524-531.

BULLOCK, D., KHAN, S., and RAYBURN, A. (1998): Soybean yield response to narrow rows as largely due to enhanced early growth. Crop Science, 38: 1011-1016.

GLAMOČLIJA, Đ. (2004): Posebno ratarstvo. Draganić, Beograd.

HEATHERLY, L.G., SPURLOCK, R.S, ELMOR, C. D. (2002): Row width and weed management system for early soybean production systems plantings in the mid-southern USA. Agronomy Journal, 94: 1172-1180.

DOZET, G., CRNOBARAC, J. (2007): Uticaj međurednog razmaka na broj bočnih grana kod soje u uslovima navodnjavanja. Zbornik radova Instituta za ratarstvo i povrtarstvo, vol. 43, br. 1, str. 217-223

HOLSHOUSER, L.D. AND WHITTAKER, P.J. (2002): Plant population and row spacing effects on early soybean production systems in the mid-Atlantic USA. Agronomy Journal, 94: 603-611.

KOLARIĆ Lj. (2010): Uticaj međurednog rastojanja i sorte na produktivnost fotosinteze, prinos i kvalitet soje. Magistarski rad. Univerzitet u Beogradu, Poljoprivredni fakultet Zemun, 1-56.

MILADINOVIĆ, J., HRUSTIĆ, MILICA, VIDIĆ, M. (2008): Soja, Institut za ratarstvo i povrtarstvo, Soja-protein, Novi Sad-Bečej. 510.

NENADIĆ, N., NEDIĆ, M., ŽIVANOVIĆ, LJ., KOLARIĆ, LJ., SIMIĆ, A., JOVANOVIĆ, B., VUKOVIĆ, Z. (2003): Uticaj oblika vegetacionog prostora na prinos semena i osobine rodnosti sorata soje. Zbornik naučnih radova Instituta PKB Agroekonomik, Vol. 9, br. 1, 73-80.

POPOVIĆ Vera (2010): Influence of agro-technical and agro-ecological practices on seed production of wheat, maize and soybean. Doctoral thesis, University of Belgrade, Faculty of Agriculture, Zemun, 55-66.

POPOVIĆ Vera, TATIĆ M., ĐEKIĆ V., KOSTIĆ M. (2012): Productivity and quality of the newly developed NS soybean varieties and lines in Pancevo region, Serbia, Bilten za alternativne biljne vrste, 44, 85, 21-27.

POPOVIC Vera, MILADINOVIĆ J., MALEŠEVIĆ M., MARIĆ V., ŽIVANOVIĆ Lj. (2013): Effect of agro-ecological factors on variations in yield, protein and oil contents in soybean grain. Romanian Agricultural Research, Nardi Fundulea, Romania. No. 30, DII 2067-5720 RAR 207

STANIŠIĆ N., PETROVIĆ M., ŽIVKOVIĆ D., ŽIVKOVIĆ B., PARUNOVIĆ N., GOGIĆ M., NOVAKOVIĆ M. (2011): The effect of gender on properties of belly-rib part of pigs fed diet containing soybean oil. Biotechnology in Animal Husbandry, Belgrade-Zemun, 27 (3), p 825-833, DOI: 10.2298/BAH1103825S

Received 13 May 2014; accepted for publication 22 September 2014