UDC (UDK) 636.36(48):636.32/.38(497)

***Vera POPOVIĆ, Jegor MILADINOVIĆ, Miloš VIDIĆ, Vojislav MIHAILOVIĆ, Vera ĐEKIĆ, Jela IKANOVIĆ, Aleksandar ILIĆ*[1]**

GENOTIPE X ENVIRONMENT INTERACTION BETWEEN YIELD AND QUALITY COMPONENTS OF SOYBEAN [*GLYCINE MAX*]

SUMMARY

The interaction of genotype x environment on yield and protein and oil content at five NS varieties of soybean was researched in this paper. All studied characteristics significantly varied in dependence of variety and the year. The highest grains yield per area unit had, on an average, Tea and Victoria varieties (4 639 kg ha^{-1}, 4521 kg ha^{-1}). During 2010, statistically significantly higher grain yield per area unit as well as protein and oil yield was achieved, compared with 2009. The highest grain yield per area unit in 2010 had Tea and Balkan varieties (5.296 kg ha^{-1}, 5.237 kg ha^{-1}). Tea variety performed, on an average, the highest content of protein and oil. During 2009, statistically significantly higher oil content was achieved than in the 2010, while during the 2010 statistically significantly higher protein content was achieved. The highest protein content had Tea, Sava and Victoria varieties, while the highest oil content had Tea, Zvezda and Sava varieties. The highest protein and oil yield had Tea variety. These studies represent the basis for further soybean breeding.

Keywords: *Glycine max*, yield, oil content, oil yield, protein content, protein yield.

INTRODUCTION

Soybean [*Glycine max. (*L.) Merr.] has been the most important source of plant proteins and oils in the world since the mid-seventies. Mature soybeans contain about 40 % of proteins, 20 % of oils, 17 % of cellulose and hemicellulose, 7 % of sugar, 5 % of fibers and about 6 % of ash on dry weight basis. Soybean, as legumes, with its ability to fix nitrogen from the air, provides the plant with sufficient quantities of nitrogen, reducing that way nitrogen fertilizers usage and very good fits in the crops rotation [1]. In Serbia, soybean is mostly grown in Vojvodina. Soybean has a well-balanced ratio of protein and oil.

Depending on the variety, environmental conditions and breeding site, soybean contains 37-40 % of protein, 18-21 % of oil, respectively, in total about

[1] Vera Popović (corresponding author: vera.popovic@nsseme.com), Jegor Miladinović, Miloš Vidić, Vojislav Mihailović, Aleksandar Ilić, Institute of Field and Vegetable Crops, Maksima Gorkog St. 30, Novi Sad; Vera Đekić, Small Grains Research Centre, Save Kovacevica 31, Kragujevac; Jela Ikanović, University of Belgrade, Faculty of Agriculture, Nemanjina 6, Zemun-Belgrade, Serbia

60 % of these nutrients. One half of total output of produced protein and one-third of the total vegetable oil produced in the world come from soybeans [2, 3].

Soybean is short day crop, extremely sensitive on daily light length and temperature, so all latitudes are characterized with certain maturity group. During the growing season varieties accumulate a certain amount of temperature sums. If a variety is grown at latitude higher than the one it is adapted to, it will flower and mature later or it might not even reach full maturity until the first frost appears. A variety grown at lower latitude in relation to the area it is adapted to will flower earlier, have decreased vegetative weight and mature earlier, consequently causing decreased yield [1].

For our geographic area (about latitude 45º north), the most suitable are varieties from the first maturity group. There is an "optimal" maturity group for each soybean cultivation area; previous varieties are early varieties, and the following group varieties are late for the certain area. The base of varieties in Vojvodina is: varieties from maturity group I, varieties from maturity group 0 which are early varieties and varieties from maturity group II which are late ones. Along ecological conditions common to Vojvodina region and under the optimal planting date in mid-April, duration of growing season (sprouting – ripening) for maturity group I varieties is 120 to 135 days [1]. Due to the stressful conditions (unusually high or low temperatures, long drought period etc.), apropos variety x environment interaction [4], growing season might be shorter or longer than specified above. High temperatures and short days accelerate, while low temperatures and long days delay reproductive development [1].

In plant populations, variation in the expression of a quantitative trait is due to both genetic and environmental variability and interaction between them. Variation due to genotype and environment interaction (G x E) that stems from differences in ranking of genotypes in environment, reduces heritability and makes if difficult to obtain good estimates of genotypic breeding value. In soybean breeding, the focus has been on yield increasing and stability, i.e. developing cultivars that are well-adapted on various growing conditions. Grain yield and quality are metric traits which are generally quantitatively inherited (polygenetic) and strongly depend on environmental conditions. For this reason, heritability for these traits is relatively low [1], what is the reason for giving attention on yield components in plant breeding, which mostly originated from simpler genetic base and are always more or less correlated with yield. Four main stages can be observed during soybean seed development: morphogenesis and cell division, cell enlargement, seed maturation and release of moisture, and period of seed dormancy. Synthesis of protein and oil takes places during the growth phase of seed cells [5]. Environmental conditions, prevailing during this phase, are in significantly correlation with proteins and oils content [6]. Genetic factors of variety are important factors which affecting on the chemical composition of grain [7]. These characteristics are also strongly influenced by the environment, about 50 % [8].

The aim of this study was to determine the NS soybean varieties productivity as well as genotype x environment interaction. These studies represent the basis for further soybean breeding.

MATERIAL AND METHODS

Yield and chemical composition of soybean grain were analysed in this two-year trial (2009-2010) in Sremska Mitrovica, in the village of Kukujevci (2009) and Lacarak (2010). The trials were set up as randomized block design in three replicates with five NS soybean cultivars, maturity group I. The trial during 2009 was carried out on meadow black soil low in humus, calcareous and moderately alkaline, moderate in P_2O_5 and rich in K_2O. The trial during 2010 was carried out on marshy black soil low in humus, highly calcareous, moderately alkaline, moderate in P_2O_5 and rich in K_2O (Table 1).

Table 1 Agrochemical soil analysis, Sremska Mitrovica, Serbia, 2009-2010

Year	Humus %	pH in KCl	pH in H_2O	$CaCO_3$ %	P_2O_5 mg/100g	K_2O mg/100 g
2009	2.8	7.4	8.2	8.6	12.5	21.7
2010	2.5	7.4	8.2	9.2	10.7	23.2

Soybean was planted on April 14, 2009, and April 25, 2010 on a basic plot size of 10 m^2 with maize as the preceding crop. Plant density for maturity group I was 50 x 4.4 cm (450,000 plants ha^{-1}). Before planting, soybean seeds were inoculated with microbiological preparation NS Nitragin which is produced by Institute of Field and Vegetable Crops, Novi Sad. NS Nitragin contains mixture of symbiotic bacterium strains *Bradyrhizobium japonicum*. During growing period, standard soybean cultivation practices were applied. In order to prevent negative effects of weeds, the trials were treated with herbicides in the phase of 2-3 well-developed leaf blades: Pulsar 40 l/ha + Harmony 8 g/ha in 2009, and Acetogal 1.8 l/ha + Mistral 0.35 kg/ha in 2010. Crops were harvested mechanically on September 4, 2009 and September 24, 2010.

Yield was measured after harvest and average samples were taken from each trial replication to determine oil and protein content in grain. Total oil and protein content in grain was determined by infrared spectroscopy technique on the apparatus PERTEN DA 7000, (NIR/VIS Spectrophotometer) by non-destructive method applying. Experimental data were processed by usage of descriptive and analytical statistics of STATISTICA 12 for Windows. Significance of differences between calculated mean values of the analysed factors (year and genotype) was tested by two-factorial analysis of variance [9]:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}\text{, i=1,2, j=1,2,...,5, k=3}$$

Significance assessment was calculated based on LSD test for probability levels of 0.05% and 0.01%. Relative dependence was defined with correlation analysis method, and the coefficients were t-tested for probability levels of 0.05% and 0.01%. Stability tested traits were evaluated on the basis of the

relative increase in value in a more favorable compared to the less favorable year (%). The results are presented in tables and graphs.

Meteorological conditions. Meteorological data were taken from the Meteorological station in Sremska Mitrovica, Serbia.

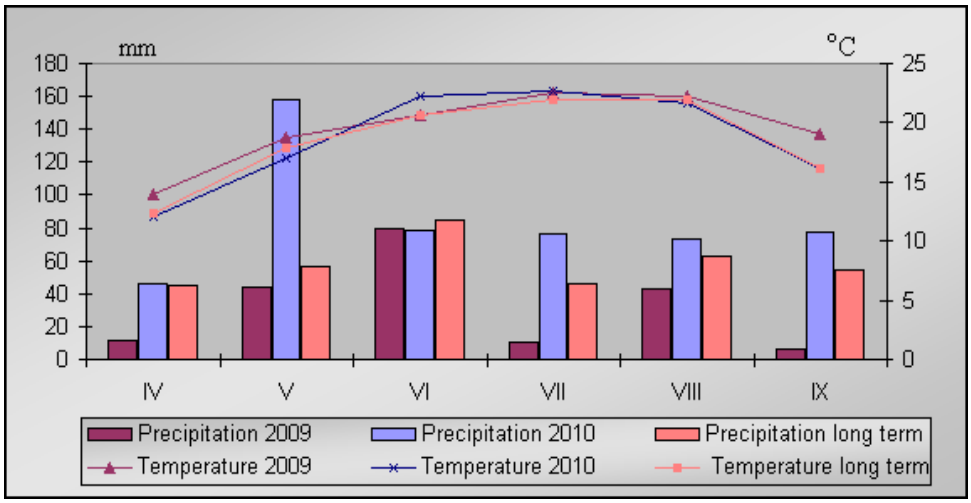

Figure 1. Precipitation sum (mm) and average month temperature (°C), Sremska Mitrovica, Serbia, 2009-2010.

During growing period in 2009 the mean monthly temperature was 19.51°C what exceeded average of 2010 by 0.84°C and what exceeded long-term average of Sremska Mitrovica (18.48°C) by 1.03°C, shown in Figure 1. The mean monthly temperature in 2010 was 18.67°C, what exceeded long-term average by 0.19°C. Meteorological data per year are different [10, 11, 12].

Precipitation quantity during soybean growing period in 2009 was 194.5 mm, what was by 154 mm less than long-term average of Sremska Mitrovica, and 315 mm than 2010. In humid 2010 precipitation quantity was 509.5 mm, what exceeded long-term average by 160 mm of Sremska Mitrovica, 349.5 mm (Fig. 1).

RESULTS AND DISCUSSION

NS soybean grain yield. Considering the average yield value in 2009 and 2010, it was evidently that the yields were highly statistically significantly different between the years ($p<0.01$). On average, in 2010 it was recorded significantly higher yield (5 166 kg ha^{-1}) compared to 2009 (3 873 kg ha^{-1}) (Table 2, 2.1, Figure 2).

Soybean yields had been varied considerably in the 2009-2010 period. All genotypes had statistically significantly higher yield in 2010 compared to 2009. The highest yield in 2010 had Tea and Balkan varieties (5 296 kg ha^{-1}, 5 237 kg ha^{-1}). During the unfavorable year, 2009, Balkan variety had the lowest yield

3653 kg ha^{-1}. Yield increase in 2010, on tested varieties, varied from 28.96% at Sava variety to 43.36% at Balkan variety. The highest average yield, 2009-2010, was achieved by Tea (4 640 kgha^{-1}) and Victoria (4 521 kg ha^{-1}) varieties. Achieved yields on tested varieties were not significantly different. The average yield for all investigated varieties was 4 519 kg ha^{-1}, and varied from 4 445 kg ha^{-1} (Balkan) to 4 640 kg ha^{-1} (Tea) (Table 2).

Table 2. NS soybean grain yield (kg ha^{-1}) and stability of yield (%), 2009-2010

No.	Genotype (A)	Yield (kg/ha)			Stability
		Year (B)		Average 2009-2010	
		2009 (B)	2010 (B)		
1.	Sava	3 909	5 041	4 475	28.96
2.	Balkan	3 653	5 237	4 445	43.36
3.	Victoria	3 936	5 107	4 522	29.79
4.	Tea	3 983	5 296	4 640	32.97
5.	Zvezda	3 885	5 150	4 517	32.56
Average		3 873	5 166	4 519	33.39

Indicator	LSD-test	A	B	A x B
Yield	0.05	334.5051	211.5596	473.0618
	0.01	456.2162	288.5364	645.1873

Table 2.1. Anova for yield

Parameter	Univariate Test of Significance for yield				
	SS	Degr. of Freedom	MS	F	P
Intercept	612821603	4	612821603	7943.935	0.000000
Genotype	131602	4	32901	0.426	0.787732
Year	12540161	1	12540161	162.557	0.00000
G x Y	189848	4	47462	0.615	0.656651
Error	1542867	20	77143		

Achieved statistically significantly higher yield in 2010 were, primarily, the result of heavy rainfalls and their good distribution as well as favorable air temperatures during the vegetation period (Table 2, 2.1, Figure 1 and 2). [2] in his research states that air temperatures, rainfall amount and distribution during the soybean growing season have the greatest impact on high yields and grain quality.

Yield is largely dependent on the genetic potential which could be defined as yield of variety which was grown in conditions on which it had been adapted, with adequately amounts of water and nutrients and efficient control of pests, diseases, weeds and other stresses [13].

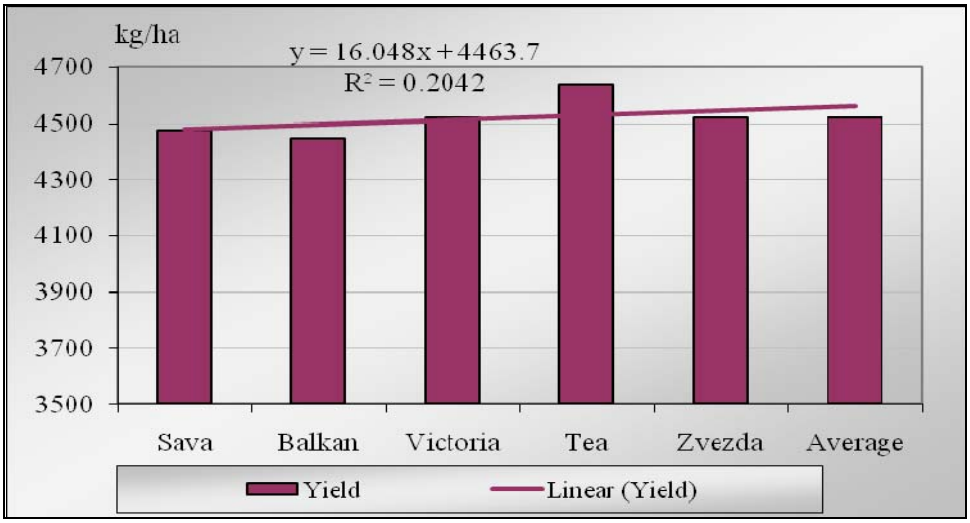

Figure 2. Average NS soybean yield (kg/ha), 2009-2010

Yields considerably vary primarily as a result of agro-ecological conditions during the growing season [3].

Protein content

The protein content was significantly different between years ($p<0.05$). The average protein content was statistically significantly higher in 2010 compared to 2009 for all investigated genotypes.

Table 3. Protein content (%) and stability (%) in soybean grain, 2009-2010

No.	Genotype (A)	Protein content (%)		
		Year (B)		Stability (%)
		2009	2010	
1.	Sava	36.67	37.42	2.04
2.	Balkan	36.48	37.16	1.86
3.	Victoria	36.89	37.04	0.41
4.	Tea	36.62	37.62	2.73
5.	Zvezda	36.65	37.17	1.42
Average		36.66	37.30	1.75

Indicator	LSD-test	A	B	A x B
Protein content	0.05	0.34345	0.54305	0.76799
	0.01	0.46842	0.74064	1.04742

The protein content increasing in 2010 at all investigated varieties ranged from 0.41% (at Victoria) to 2.73% (at Tea variety). Differences among varieties were statistically significant ($p <0.05$). Tea variety had statistically significantly higher protein content in 2010 (37.62%) compared to the Victoria variety

(37.04). The highest protein content had, on an average Tea, Sava and Victoria varieties, Table 3, Figure 3.

Table 3.1. Anova for protein content

Parameter	Univariate Test of Significance for protein content				
	SS	Degr. of Freedom	MS	F	p
Intercept	41033.01	4	41033.01	201818.2	0.000000
Genotype	0.33	4	0.08	0.4	0.799536
Year	3.06	1	3.06	15.0	0.000933
G x Y	0.46	4	0.11	0.6	0.691476
Error	4.07	20	0.20		

External factors have a significant affect on protein content change in soybean grain. Significant interaction among investigated factors was determined, what indicates that examined factors mutually reinforce their affects ($p < 0.05$). Humid 2010 was more favorable year for protein synthesis. Our results are consistent with the results of [14], where the authors state that the protein content in soybean is varietal characteristic, but strongly influenced by environment.

***Protein yield*.** Protein yield differed significantly between years and the average of all genotypes was higher in 2010 (1926 kg ha^{-1}) compared with 2009 (1419 kg ha^{-1}) (Table 4, 4.1, Fig 3).

Table 4. Protein yield (kg ha^{-1}) and stability (%) in soybean grain, 2009-2010

No.	Genotype (A)	Protein yield (kg/ha)		
		Year (B)		Stability (%)
		2009	2010	
1.	Sava	1 433.45	1 886.34	31.59
2.	Balkan	1 332.20	1 946.07	46.03
3.	Victoria	1 451.99	1 891.63	30.28
4.	Tea	1 458.57	1 992.35	36.60
5.	Zvezda	1 423.85	1 914.25	34.44
Average		1 419.91	1 926.13	35.65

Indicator	LSD-test	A	B	A x B
Protein content	0.05	149.596	233.581	334.506
	0.01	204.027	322.595	456.218

The highest protein yield had, on an average, Tea variety while the lowest protein yield had Balkan variety. The protein yield increasing in 2010 at all

investigated varieties ranged from 30.28% at Victoria variety, to 46.03% in Balkan variety (Table 4, 4.1, Graph 3).

Table 4.1. Anova for protein yield

Parameter	Univariate Test of Significance for protein yield				
	SS	Degr. of Freedom	MS	F	p
Intercept	86523290	4	86523290	2243.171	0.000000
Genotype	46167	4	11542	0.299	0.874975
Year	1569568	1	1569568	40.692	0.000003
G x Y	22862	4	5715	0.148	0.961662
Error	771437	20	38572		

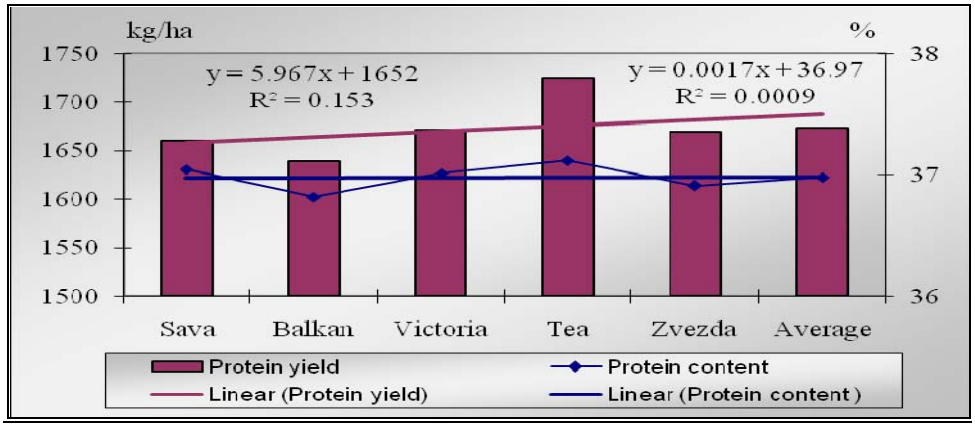

Figure 3. Average protein yield (kg/ha) and protein content (%) in soybean grain, 2009 - 2010

Oil content. Oil content in soybean differed significantly between years ($p<0.01$). In 2009, oil content was statistically significantly higher (21.97%) compared with 2010 (20.26%), Table 5, 5.1, Graph 4.

Table 5. Oil content (%) and stability (%) in soybean grain, 2009-2010

No.	Genotype (A)	Oil content (%)		
		Year (B)		Stability (%)
		2009	2010	
1.	Sava	21.80	20.58	5.92
2.	Balkan	21.82	20.07	8.72
3.	Victoria	21.53	20.44	5.33
4.	Tea	22.28	20.25	10.03
5.	Zvezda	21.74	19.99	5.44
Average		21.83	20.27	7.70

Indicator	LSD-test	Genotype	Year	Interaction
Oil content	0.05	0.54660	0.34570	0.77301
	0.01	0. 74548	0.47148	1.05428

The oil content increasing in 2009 at all investigated varieties ranged from 5.33% at Victoria variety to 10.03% at Tea variety. The average oil content among genotypes differed significantly ($p<0.05$). In 2010 Sava variety had significantly higher oil content then Zvezda variety (19.99%). In 2009 Tea variety had statistically significantly higher oil content (22.28%) compared to the Victoria variety (21.53%). The highest average oil content had varieties Sava and Tea (21.27% and 21.19%) while the lowest content had Zvezda variety (20.86%) (Table 5, 5.1, Graph 4).

Table 5.1. Anova for oil content

Parameter	Univariate Test of Significance for oil content				
	SS	Degr. of Freedom	MS	F	p
Intercept	13377.41	4	13377.41	64943.08	0.000000
Genotype	0.49	4	0.12	0.59	0.673292
Year	21.71	1	21.71	105.39	0.000000
G x Y	1.88	4	0.47	2.28	0.096843
Error	4.12	20	0.21		

Temperature and precipitation have a significant affect on the change in oil content of soybeans grain. Favorable year for oils synthesis was semi-arid 2009, at all investigated genotypes. Significant interaction among the investigated factors was established, suggesting that they mutually reinforce their affects ($p<0.05$).

Oil yield. Oil yield in soybean differed significantly between years ($p<0.01$). All investigated genotypes had statistically significantly higher oil yield in 2010 compared with 2009, Table 6.

Table 6. Oil yield (kg/ha) and stability (%) in soybean grain, 2009-2010

No.	Genotype (A)	Oil yield (kg/ha)		
		Year (B)		Stability (%)
		2009	2010	
1.	Sava	852.16	1 037.43	21.74
2.	Balkan	797.08	1 051.06	31.86
3.	Victoria	847.42	1 043.87	23.18
4.	Tea	887.41	1 072.44	20.85
5.	Zvezda	844.60	1 029.48	21.89
Average		845.52	1 047.14	23.85

Indicator	LSD-test	Genotype	Year	Interaction
Oil content	0.05	78.875	49.885	111.545
	0.01	107.573	68.035	152.132

Oil yield increasing in 2010 at all investigated varieties ranged from 20.85% at Tea variety to 31.86% at Balkan variety. The average oil yield in 2010 (1 047 kg ha^{-1}) was higher by 202 kg ha^{-1} or 23.9% compared to 2009 (845 kg ha^{-1}). Studied genotypes achieved, on an average, relatively uniform oil yield (Table 6).

The highest average oil yield, 2009-2010, had Tea variety, 979 kg ha^{-1}, while the lowest yield had Zvezda variety, 937 kg ha^{-1} (Table 6, 6.1., Figure 4).

Table 6.1. Anova for oil yield

Parameter	Univariate Test of Significance for oil yield				
	SS	Degr. of Freedom	MS	F	p
Intercept	27021826	4	27021826	6300.116	0.000000
Genotype	9810	4	2452	0.572	0.686196
Year	285773	1	285773	66.628	0.000000
G x Y	7678	4	1919	0.448	0.772948
Error	85782	20	4289		

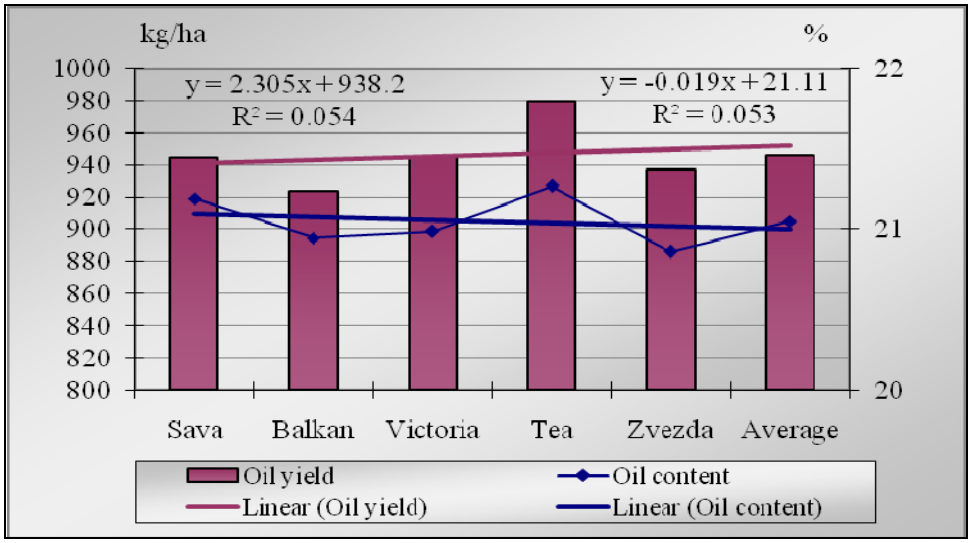

Figure 4. Average oil yield (kg/ha) and oil content (%) in soybean, 2009-2010

The total protein and oil content, at all tested varieties, 2009-2010, was 58.13%. Zvezda variety achieved the highest total protein and oil content in 2009 (59.39%) and the lowest in 2010 (57.16%) (Figure 5).

These results lead us to conclude that there is a huge influence of environmental conditions besides the genotype, and that examined factors mutually reinforce their affects ($p < 0.05$).

Obtained results indicate that besides the chemical composition of soybean and growing conditions are highly significant, in addition to genetic factors, what is consistent with the results of [7].

Correlations between individual characteristics. The significant interactions of the examined factors suggest that the factors mutually synergized their effects ($p<0.01$). Yield in 2009 was positively highly significantly correlated with oil and protein yield ($p= 0.99^{**}$, $p= 0.96^{**}$). Oil content was positively significantly correlated with oil yield ($p= 0.66^{**}$) Table 7.

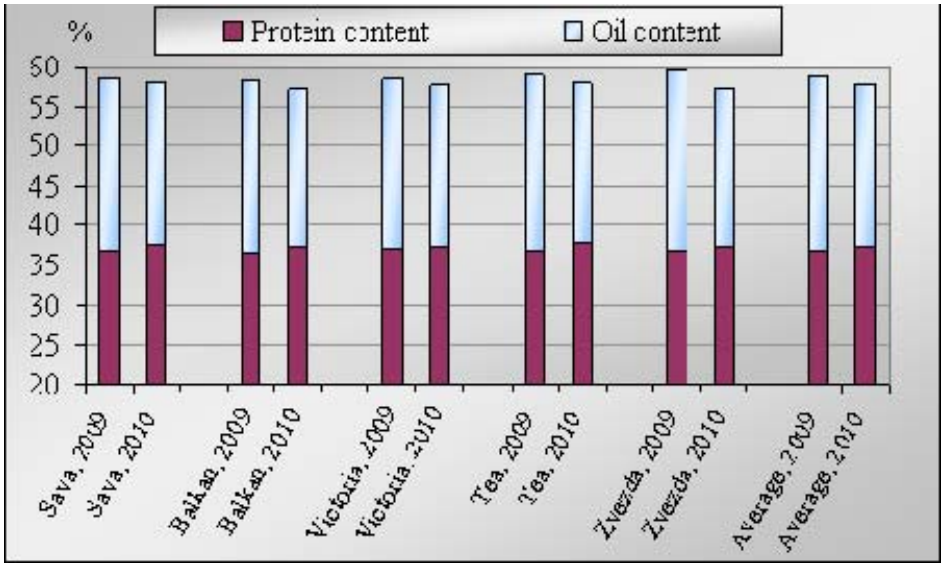

Figure 5. Total protein and oil content (%) in NS soybean grain, 2009-2010

Table 7. Correlations between tested parameters (2009-2010) (Correlation parameters for 2009 above diagonal and for 2010 below diagonal)

Parameter	Yield	Protein content	Oil content	Protein yield	Oil yield
Yield	1.00	-0.26 ^{ns}	0.46 ^{ns}	0.99**	0.96**
Protein content	-0.04^{ns}	1.00	-0.01 ^{ns}	0.40^{ns}	-0.28^{ns}
Oil content	0.36 ^{ns}	-0.10^{ns}	1.00	0.44^{ns}	0.66**
Protein yield	0.98**	0.15 ^{ns}	-0.36 ^{ns}	1.00	0.95**
Oil yield	0.54*	-0.12	-0.11	-0.35	1.00
^{ns} – non significant; * and ** - significant at $p<0.05$ and $p<0.01$					

Yield in 2010 was positively highly significantly correlated with oil and protein yield ($p= 0.98^{**}$, $p= 0.54^{*}$). Oil content was negatively nonsignificantly correlated with protein content ($p= 0.10$), Table 7.

The positive correlations between yield and protein and oil yield in grain soybean, and negative correlations between protein and oil content corroborates the results of [11, 12].

CONCLUSIONS

On the renewal of the obtained results, the following conclusions can be performed:

The interaction of the investigated factors (year x genotype) exhibits a statistically significant affect on yield, protein and oil content in soybean grain, what shows that the examined factors mutually reinforce their affects ($p<0.05$). On an average, in humid 2010, significantly higher grain yield per unit area was achieved, as well as oil and protein yield and protein content, while in 2009 significantly higher oil content was achieved.

The highest average yields were achieved at Victoria and Tea varieties (4 639 kg ha^{-1}, 4521 kg ha^{-1}). The highest grain yield had Tea and Balkan varieties in 2010 (5 296 kg/ha, 5 237 kg ha^{-1}).

- The protein and oil content in soybeans grain were significantly different between years ($p<0.01$). The average protein content was at all genotypes significantly higher in 2010 compared to 2009, while the oil content was significantly higher in 2009.

The total yield of protein and oil differed significantly between years and the average of all genotypes was higher in 2010 (1 926 kg ha^{-1}) compared to 2009 (1 419 kg ha^{-1}).

Investigation on genotype x environment interaction presents the basis for further refinement and soybeans zoning.

ACKNOWLEDGEMENTS

Research presented in this papers financed by the Ministry of Education and Science on Republic of Serbia (Project TR 31022).

REFERENCES

1. J. Miladinovic, M. Hrustic, M. Vidic (2011): Soybean. Institute of Field and Vegetable Crops, Novi Sad and Becej, AMB Graphics, Novi Sad, Serbia. 510.
2. V. Popovic (2010): Influence of Agro-technical and agro-ecological practices on seed production of wheat, maize and soybean. University of Belgrade, Faculty of Agriculture in Zemun, Serbia, Doctoral thesis, 64-73.
3. V. Popovic, M. Vidic, DJ. Jockovic, J. Ikanovic, G. Cvijanović (2012): Variability and correlations between yield components of soybean [*Glycine max* (L.) Merr.]. Genetika, Belgrade, 44, 1, 33-45. DOI: 10:2298/GEN SR1201033P.
4. J. Miladinovic (1997): Components of phenotypic variation for photoperiod in soybean [*Glycine Max* (L.) Merr.] University of Novi Sad, Faculty of Agriculture, Serbia. M.Sc. thesis. 1-54.
5. T. Blanuša, R. Stikić, B. Vucelić-Radović, M. Barać, D. Veličković (2000): Dinamics of seed protein biosynthesis in two soybean genotypes differing in drought susceptibility. Biologia Plantarum 43. : 55-59.
6. CR. Hurburgh (2000): Quality of the 2000 soybean crops from the USA. American Soybean Association Asia Quality Seminar. December 5.
7. V. Popovic, M. Tatić, V. Đekić, M. Kostić, A. Ilić (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.
8. JT. Brumm & CR Hurburgh (2002): Quality of the 2002 soybean crop from the United States. American Soybeans Association Quality Mission to Asia, December 13.

9. R Maletic (2005): Statistics. Faculty of Agriculture, Zemun, Belgrade, Serbia.
10. M. Bran, I. Dobre, M. Stefan, D. Bobac, C.M. Papuc (2008): Long-term development of agriculture in micro-area „Dobrotfor-Pojorâta" Romanian Agricultural Research, 25: 97-105.
11. V. Popovic, M. Vidic, M. Tatic, S. Jaksic, M. Kostic (2012): The Effect of Cultivar and Year on Yield and Quality Components in Soybean. Field and Vegetable Crops Research. Novi Sad, Serbia. 49 (1), 132-139.
12. V. Popovic, M. Malešević, J. miladinović, V. Marić, LJ. Živanović (2013): Effect of agro ecological factors on variations in yield, protein and oil contents in soybean grain. Romanian Agricultural Research, No. 30, DII 2067-5720.
13. J. HL. Chung, PE Barka, S Taswick, DJ Lee, PB Gregan, RC Shoemaker, JE Specht (2003): The seed protein, oil and yield QTL on soybean linkage group I. Crop Sci. 43: 1053-1067.
14. V. Poysa, L. Woodrow, K. Yu (2006): Effect of soy protein subunit composition on tofu quality. Food Research International, 39: 309-317.

Vera POPOVIĆ, Jegor MILADINOVIĆ, Miloš VIDIĆ, Vojislav MIHAILOVIĆ, Vera ĐEKIĆ, Jela IKANOVIĆ, Aleksandar ILIĆ

INTERAKCIJA GENOTIP X SPOLJASNJA SREDINA IZMEĐU PRINOSA I KOMPONENTI KVALITETA SOJE - *GLYCINE MAX* (L.) MERR.

SAŽETAK

U radu je proučavana interakcija genotip x spoljna sredina na prinos i sadržaj proteina i ulja kod 5 NS sorti soje. Sva proučavana svojstva signifikantno su varirala u zavisnosti od sorte i godine. Najviši prinos zrna po jedinici površine imale su u proseku sorte Tea i Victoria (4 639 kg/ha, 4.521 kg/ha). U 2010. godini ostvaren je statistički značajno viši prinos zrna soje po jedinici površine kao i prinos proteina i ulja u odnosu na 2009. Najviši prinos zrna po jedinici površine u 2010. imale su sorte Tea i Balkan (5.296 kg/ha, 5.237 kg/ha). Sorta Tea ostvarila je u proseku najviši sadržaj proteina i ulja. U 2009. ostvaren je statistički značajno viši sadržaj ulja u odnosu na 2010. dok je u 2010 ostvaren statistički značajno viši sadržaj proteina. Najviši sadržaj proteina imale su sorte Tea, Victoria i Sava, dok su najviši sadržaj ulja imale sorte Tea, Zvezda i Sava. Najviši prinos proteina i ulja imala je sorta Tea. Ova istraživanja predstavljaju osnov za dalje oplemenjivanje soje.

Key words: Soja, prinos, sadržaj proteina, sadržaj ulja, prinos bjelančevina, prinos ulja.