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Yield and Quality of Grain of Some Domestic and Foreign Soybean Cultivars in Agroecological Conditions of Eastern Slavonia

Urod i kakvoća zrna nekih domaćih i inozemnih sorti soje u agroekološkim uvjetima istočne Slavonije

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Summary

During the growth season of 1992–1993 both grain yield and quality of 29 soybean cultivars were investigated by means of macrotrials in the area of eastern Slavonia (Osijek and Donji Miholjac). The results of the research showed high variations both in grain yield and grain quality among tested cultivars with variations per growth season and locations. The grain yield ranged from 1.68 to 3.78 t/ha (mean: 2.58 t/ha). In the both years of testing, the average grain yields were higher for all the cultivars tested on the location D. Miholjac in comparison with Osijek. Grain quality depended on cultivars, growth season and locations. The protein content of the analysed grain ranged from 32.48 % to 47.92 % (mean 40.71 %). The oil content of grain ranged from 15.67 to 25.27 % (mean: 20.75 %). These values were calculated on the dry matter basis. The study showed significant differences among cultivars in the grain yield and its quality as well as great impact of the agroecological factors.

Sažetak

Tijekom 1992–1993. godine na području istočne Slavonije (Osijek i Donji Miholjac) ispitana je makropokusima kakvoća zrna 29 sorti soje. Dobiveni su rezultati potvrdili velike razlike u urodu i kakvoći zrna ispitivanih sorti, ovisno o godini i lokalitetu.

Prinos zrna bio je od 1,68 do 3,78 t/ha (prosjek 2,58 t/ha). U obje godine ispitivanja prosječni je prinos zrna ispitivanih sorti uzgajanih na području Donjeg Miholjca bio viši nego na području Osijeka. Kakvoća zrna ovisi o sorti, godini uzgoja i lokalitetu. Maseni udjel proteina i ulja u zrnu (računajući na suhu tvar uzorka) iznosio je od 32,48 do 47,92 % (prosjek 47,71 %) proteina te 15,67 do 25,27 % (prosjek 20,75 %) ulja.

Utvrđeno je da postoje značajne razlike između sorti u urodu zrna i njegovoj kakvoći, kao i veliki utjecaj agroekoloških činitelja.

Introduction

Soybean *Glycine max (L)* Merr. is one of the world's most important crops. World production of the soybeans has reached 56 million hectares with an average grain yield of 1.8 t/ha *(1)*. World-wide interest in soybean continues to increase because both soybean protein and oil are important sources of animal and human food. Generally, commercial soybean cultivars usually contain about 40 % high quality protein and about 20 % oil. The growing of soybean in Croatia has a rather short tradition of over 50 years, continually about 24 years. In the last seven years the growing area under soybean in Croatia has stabilised at about 25–27000 hectares with a yield range of 2.5 to 2.6 t/ha *(2)* which meets only 50 % of the country's demand. The main soybean production is in eastern Croatia, whereas major research programs have been conducted in the institutes of Osijek and Zagreb *(3,4)*.

The soybean breeding programme has been particularly developed at the Osijek Agricultural Institute and has expanded considerably during the last 20 years. As a result, 19 soybean cultivars belonging to the 00 to II maturity groups have been registered so far; several cultivars have been grown in large-scale production, among which the domestic cultivars prevail *(5,6)*. In spite of the war damage at the Osijek Agricultural Institute, this institution is still capable of creating new and even better soybean cultivars suitable for all growing regions of Croa-

Climatic data over the growing season in Osijek and Donji Miholjac, Croatia, in 1992 and 1993

Table 1. Average air temperature during growing season of soybean
Tablica 1. Prosječna temperatura zraka tijekom uzgoja soje

Month	Temperature of air / °C			
	Year			
	1992		1993	
	Location			
	Osijek	Donji Miholjac	Osijek	Donji Miholjac
IV	12.3	12.3	11.9	11.6
V	16.9	16.9	19.0	19.1
VI	20.6	20.6	20.0	20.1
VII	22.5	22.5	21.1	21.1
VIII	25.4	25.4	21.1	21.9
IX	17.7	17.7	16.5	17.0

Table 2. Precipitation during growing season of soybean
Tablica 2. Količina oborina tijekom uzgoja soje

Month	Precipitation / mm			
	Year			
	1992		1993	
	Location			
	Osijek	Donji Miholjac	Osijek	Donji Miholjac
IV	58.2	50.0	37.9	58.4
V	45.9	71.8	44.9	32.6
VI	53.6	59.9	51.6	92.2
VII	47.5	47.5	52.7	92.5
VIII	49.5	40.5	63.0	54.7
IX	47.7	22.0	53.0	107.8
Total	303.4	291.7	303.1	328.2

Table 3. Average grain yield of tested soybean cultivars
Tablica 3. Prosječni prinos zrna ispitivanih sorti soje

Num.	Cultivar	Grain yield of soybean / (t/ha)						
		Year						
		1992		1993				
		Location				Mean value	Sd	Cv / %
		Osijek	D.M.*	Osijek	D.M.*			
1.	OS-66	2.10	2.45	2.16	3.36	2.52	0.58	23.12
2.	OS-50	2.42	3.25	2.98	3.51	3.04	0.47	15.35
3.	Neretva	2.32	2.95	2.54	3.16	2.74	0.38	13.91
4.	Mirna	2.39	2.78	2.84	3.21	2.81	0.33	11.97
5.	Iva	1.74	2.62	2.82	3.74	2.73	0.82	30.06
6.	Kaja	2.59	3.42	2.41	3.44	2.96	0.54	18.28
7.	Una	1.68	2.43	2.08	3.53	2.43	0.79	32.71
8.	Evans	1.77	2.86	2.29	2.27	2.30	0.44	19.39
9.	Crusader	1.87	3.27	2.23	3.39	2.69	0.75	28.06
10.	Boly-44	1.47	2.85	1.83	2.72	2.22	0.67	30.38
11.	OS-158	1.65	2.56	2.24	3.10	2.39	0.61	25.40
12.	OS-488	1.64	1.73	2.64	3.52	2.38	0.88	37.05
13.	Sava	2.15	2.57	3.10	2.75	2.64	0.39	14.95
14.	Sivka	2.10	3.35	1.91	2.99	2.59	0.69	26.78
15.	Jošava	1.83	2.43	2.34	2.54	2.26	0.46	20.40
16.	Bara	1.68	2.30	2.27	2.81	2.26	0.46	20.40
17.	OS-34	2.28	2.98	2.86	3.16	2.82	0.38	13.49
18.	OS-31	2.19	2.19	2.47	3.30	2.53	0.52	20.69
19.	OS-492	2.29	3.28	2.47	2.96	2.75	0.45	16.46
20.	Lika	2.04	3.02	2.81	3.13	2.75	0.49	17.88
21.	Tisa	2.77	2.61	3.14	2.99	2.87	0.23	8.14
22.	Drina	1.97	2.99	3.78	3.00	2.93	0.74	25.29
23.	Eszter	2.25	2.79	2.36	2.51	2.48	0.23	9.45
24.	Boly-56	2.39	2.71	1.70	3.29	2.52	0.62	26.28
25.	Aura	1.96	3.02	2.29	2.61	2.47	0.45	18.32
26.	BS-31	2.61	2.88	2.39	2.68	2.64	0.20	7.65
27.	BS-105	2.34	2.79	2.49	2.61	2.56	0.19	7.44
28.	Vuka	2.10	3.02	2.33	2.97	2.61	0.46	17.68
29.	Corsoy-79	1.62	1.95	3.09	2.47	2.28	0.64	28.13
	Mean value	2.08	2.77	2.51	3.02	2.58		
	Sd	0.34	0.41	0.44	0.38	0.22		
	Cv / %	16.30	14.70	17.20	12.40	8.72		
LSD (0.05)						0.086		
LSD (0.01)						0.116		

* D.M. – Donji Miholjac

tia due to high scientific potential and extensive soybean breeding programmes. This paper reports on the results of a study on 29 soybean cultivars tested by means of macrotrials in the area of eastern Slavonia (Osijek and Donji Miholjac). The main objective was to evaluate the agronomic characters of new soybean cultivars under prevailing growing conditions.

Materials and Methods

The macrotrials with 20 domestic and 9 foreign soybean cultivars (0-II maturity groups) were conducted on two locations (Osijek and Donji Miholjac) during the growth seasons 1992 and 1993. The macrotrials were set up by an uniform method. Each cultivar was planted on a plot of 0.25 ha with the spacing of 45 cm between the rows and 3–5 cm within the rows, which depended on the maturity group of cultivars. Currently accepted levels of management and cultural practices were applied in all trials. All of the trials were planted and harvested by machine. All plots in each trial were harvested on the same day after these all had reached the full harvest maturity, but before any shattering was detected in early cultivars. Grain was weighed and then converted to kg/ha with 13 % moisture. The protein and oil contents were determined from a composite dry grain sample of each cultivar from each location in each year at the laboratory of PZC IPK Osijek. The protein content in grain was determined by using the Micro Kjeldahl procedure (factor 6.25) and the oil content by using the Soxlet procedure. All obtained data were subjected to statistical analyses of variance for different cultivars and their various characters was done. Standard deviation (Sd) and variation coefficient (Cv) were used as indicators of variability of examined properties.

Table 4. Average protein content in grain of the tested soybean cultivars
Tablica 4. Prosječni maseni udjel proteina u zrnu ispitivanih sorti soje

Num.	Cultivar	Protein content in grain of soybean / %					
		Year					
		1992		1993			
		Location				Mean value	Cv / %
		Osijek	D.M.*	Osijek	D.M.*		
1.	OS-66	37.90	40.82	37.85	43.50	40.02	6.76
2.	OS-50	39.50	40.28	43.75	43.85	41.85	5.45
3.	Neretva	37.15	40.11	36.65	36.65	37.64	4.42
4.	Mirna	36.54	38.91	38.08	38.10	37.91	2.61
5.	Iva	43.79	41.29	40.14	43.73	42.24	4.31
6.	Kaja	38.16	42.25	32.48	32.48	36.42	13.10
7.	Una	39.52	42.98	42.44	44.76	42.43	5.13
8.	Evans	41.76	43.16	39.24	43.60	41.94	4.68
9.	Crusader	42.59	43.80	36.84	43.17	41.60	7.72
10.	Boly-44	38.28	44.80	36.81	44.17	41.02	9.89
11.	OS-158	37.15	39.40	37.64	42.16	39.09	5.79
12.	OS-488	40.12	42.10	43.22	43.19	42.16	3.45
13.	Sava	42.94	43.48	37.59	43.89	41.97	7.02
14.	Sivka	37.62	43.27	31.55	42.30	38.65	13.85
15.	Jošava	40.09	44.30	35.60	47.92	41.98	12.67
16.	Bara	40.10	41.80	35.20	41.25	39.59	7.60
17.	OS-34	38.50	40.12	38.90	38.90	39.11	1.79
18.	OS-31	41.30	43.19	42.56	42.56	42.40	1.86
19.	OS-492	42.80	44.50	45.37	45.37	44.51	2.72
20.	Lika	41.23	41.60	39.63	40.21	40.67	2.23
21.	Tisa	39.09	43.27	34.42	40.82	39.40	9.48
22.	Drina	43.19	47.78	36.57	42.15	42.42	10.85
23.	Eszter	41.89	44.15	36.45	42.71	41.30	8.15
24.	Boly-56	38.27	44.30	35.39	43.25	40.30	10.42
25.	Aura	39.90	44.16	36.15	43.67	40.97	9.11
26.	BS-31	39.87	42.83	37.02	42.84	40.64	6.86
27.	BS-105	43.79	44.25	36.47	43.43	41.98	8.79
28.	Vuka	35.43	37.86	38.56	38.20	37.51	3.78
29.	Corsoy-79	40.89	44.02	42.23	44.86	43.00	4.15
	Mean value	39.98	42.58	38.03	42.16	40.71	
	Sd	2.27	2.12	3.15	2.96	1.90	
	Cv / %	5.69	4.97	8.30	7.02	4.67	
LSD (0.05)						0.72	
LSD (0.01)						0.98	

* D.M. – Donji Miholjac

Table 5. Average oil content in grain of tested soybean cultivars
Tablica 5. Prosječni maseni udjel ulja u zrnu ispitivanih sorti soje

Num.	Cultivar	Oil content in grain of soybean / %					
		Year					
		1992		1993			
		Location				Mean value	Cv / %
		Osijek	D.M.*	Osijek	D.M.*		
1.	OS-66	21.39	19.38	20.99	19.98	20.44	4.51
2.	OS-50	20.10	19.19	20.03	21.18	20.13	4.05
3.	Neretva	20.10	21.02	22.10	23.12	21.58	6.06
4.	Mirna	20.58	22.11	21.09	22.02	21.70	5.13
5.	Iva	17.86	21.21	20.18	19.00	19.81	7.09
6.	Kaja	21.98	20.57	21.18	21.10	21.21	2.74
7.	Una	18.92	19.96	19.11	19.02	19.25	2.48
8.	Evans	22.56	20.78	25.56	20.78	22.42	10.06
9.	Crusader	22.16	20.94	21.10	20.70	21.23	3.04
10.	Boly-44	18.86	20.97	19.25	20.93	20.00	5.52
11.	OS-158	20.70	22.02	21.96	22.18	21.72	3.14
12.	OS-488	19.10	20.10	20.08	21.92	20.30	5.80
13.	Sava	18.48	18.34	20.19	20.38	19.35	5.62
14.	Sivka	23.12	17.94	22.10	25.27	22.11	13.93
15.	Jošava	19.47	19.22	20.58	20.83	20.01	3.98
16.	Bara	19.45	20.18	20.26	21.02	20.23	3.17
17.	OS-34	21.39	22.18	22.46	23.19	22.31	3.33
18.	OS-31	18.00	18.09	19.48	21.31	19.22	8.06
19.	OS-492	19.33	21.08	20.10	20.12	20.16	3.55
20.	Lika	21.61	19.73	20.18	19.61	19.78	1.37
21.	Tisa	22.65	21.22	21.02	20.48	21.34	4.33
22.	Drina	18.09	20.15	20.18	21.08	19.87	6.36
23.	Eszter	23.24	21.60	20.43	19.27	21.14	8.02
24.	Boly-56	21.89	15.67	24.21	21.41	20.79	14.45
25.	Aura	23.37	21.60	19.87	20.73	21.39	6.99
26.	BS-31	23.70	21.50	22.40	20.93	22.13	5.45
27.	BS-105	21.00	20.52	23.58	20.57	21.42	6.81
28.	Vuka	18.43	21.37	19.36	20.25	19.80	10.54
29.	Corsoy-79	19.20	20.40	20.86	21.40	20.46	4.58
	Mean value	20.51	20.31	21.03	21.03	20.73	
	Sd	1.81	1.45	1.52	1.30	0.95	
	Cv / %	8.81	7.16	7.21	6.20	4.60	
LSD (0.05)						0.36	
LSD (0.01)						0.49	

* D.M. – Donji Miholjac

Results and Discussion

Grain yield is the most important character in soybean. Along with grain quality (content of protein and oil) it is a quantitative character that is strongly influenced by environment (7). The data obtained in this study are presented in Tables 3, 4 and 5. As can be seen in Table 3, the differences in grain yields among cultivars were highly significant. Grain yield varied between 1.68 and 3.78 t/ha (mean: 2.58 t/ha) with respect to the cultivar, location and year. The highest grain yield was obtained from Drina cultivar. In both years of testing, the average grain yield for all the cultivars investigated was higher on the location Donji Miholjac than on the location Osijek. In terms of years, the average grain yield was higher in 1993 than in 1992 year. It has been obvious that the climate (Tables 1 and 2) strongly affects grain yield, among other factors, during the growth season. The cultivars studied also showed significant differences in their protein and oil content in grain. Protein content varied between 32.48 % and 47.92 % (mean: 40.71 %), and depended on cultivar, location and year (Table 4). Oil content in grain varied between 15.64 % and 25.27 % (mean: 20.75 %) and also depended on cultivar, location and year (Table 5). These values were calculated on the basis of dry matter. The differences between minimum and maximum values for grain yield and content of protein and oil in grain, as well as calculated standard deviation (Sd) and coefficient of variation (Cv) showed very high variability for investigated agronomic characters of each cultivar with great differences among cultivars.

Conclusion

According to the results obtained during the two-year investigation of 29 soybean cultivars in Slavonia region the following conclusion may be drawn: the cultivars tested in macrotrials varied significantly both in the grain yield and grain quality, and were greatly influenced by the agroecological factors.

Generally, it may be stated that almost all the investigated soybean cultivars, especially the high-yielding ones, can be successfully grown as a main crop in Eastern Slavonia.

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