YIELD AT 75 EUROPEAN SOYBEAN VARIETIES FROM DIFFERENT MATURITY GROUPS IN THE CLIMATIC CONDITIONS OF THE TRANSYLVANIAN PLAIN

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Abstract

Soybean being the most important legume plant for grains, the high protein and oil content determines many uses, which leads to expansion of soybean crop areas. The experiment was conducted at Agricultural Research and Development Station Turda (ARDS Turda) in the climatic conditions of the 2018 and 2019. Biological material included 75 Romanian varieties (12) and foreign genotypes (63), from different maturity groups (000 - II). The rainfall and temperature varied in the two-year study which determined differences on average yield obtained for each maturity group. The highest average yield for the maturity groups 00, 0, I, II was obtained in the climatic conditions of the year 2019, instead the behavior of the very early genotypes (000) was different, the year 2018 being more favorable. The maturity group recommended till now for the Transylvanian Plain was very early (000) and early (00), but from the data presented the highest yields were obtained by the maturity groups 0 (2719 kg/ha), I (2895 kg/ha) and I + II (2732 kg/ha). A continuation of the study is required, to establish the suitable maturity group for the new conditions of Transylvanian Plain.

Key words: soybean, maturity group, yield, climatic conditions

Soybean is the most important legume plant for grains, and one of the most important protein crops in the world. Its great economic importance leads from its many uses, but also from the chemical composition of the grains: approximately 40% protein, 20% lipids, 17% cellulose and hemicelluloses, 7% sugars and about 6% ash (Pratap A. *et al*, 2011).

These qualitative traits corroborated with the special role it plays in crop rotation and atmospheric nitrogen fixation determined the increased of the areas with soybean crop worldwide. The process of plant growth and development is important to the successful adaptation of a species to its geographic and climatic environment. Adaptation of a species to the growing season of a region ensures the species' reproductive success. The breeding process can also be important in improving a crop's yield potential (Guriqbal S., 2009). Genotype × environment interactions (G × E) induce differential response of soybean in variable environmental conditions (Carrera C. et al, 2011).

High temperature and water deficit are the major abiotic factors that restrict plant growth (Jumrani K. and Bhatia V.S., 2018).

In Europe, about 40 million tons of soybeans are consumed annually, most of them coming from imports (Dima D.C., 2015). Europe has great potential for soybean cultivation in the Danube region, Romania being one of the countries with high potential for soybean cultivation. By establishing the Donau Soja Association, various programs for farmers, consumers and research programs have been developed. With a lack of information on the favorable conditions for each maturity group in the Danube region, following the Friesing researchers meeting, the European trials soybean varieties was initiated.

Several European countries, such as Romania, Croatia, Austria, Switzerland, Italy, Serbia, Slovakia, France, Germany, Poland, the Czech Republic and the Netherlands, took part in this study. Each country participating in this study had several test centers, their total number was 34 centers.

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MATERIAL AND METHOD

The biological material studied included 75 soybean genotypes, of foreign and Romanian origin, from different maturity groups (000 - II). The genotypes studied were representative of each country, so from Romania there were 12 varieties from maturity groups very early, early, medium, tardive and very tardive. The biological material of foreign origin represented 63 genotypes from maturity groups 000, 00, 0, I and II, from countries such as: Croatia (11), Austria (13), Switzerland (9), Italy (17), Serbia (6) and France (7).

The experience was carried out for a period of 6 years (2014 - 2019) in the Soybean Breeding Laboratory at ARDS Turda. In 2014, the experience was performed respecting the established protocol as three-meter row in two randomized repetitions for each maturity group. The observations were made according to Fehr and Caviness (American rating scales). From 2015 the genotypes were analyzed also from yield point of view, each variety was mechanized sown on 2 rows with a length of 12 m, the distance between rows of 50 cm the harvestable surface being 10 m^2. The present paper is a review of the yield data obtained and the behavior of each maturity group in climatic condition of ARDS Turda in the years 2018 and 2019.

RESULTS AND DISCUSSION

The climatic conditions during vegetation season can have either negative or positive impact on soybean plant development and also crop yield.

The impact of climate variability on soybean yield is very important not only at national but also at global scales. The vegetation stages and grain yield of the studied soybean genotypes were influenced by atypical climatic conditions of the experimental years.

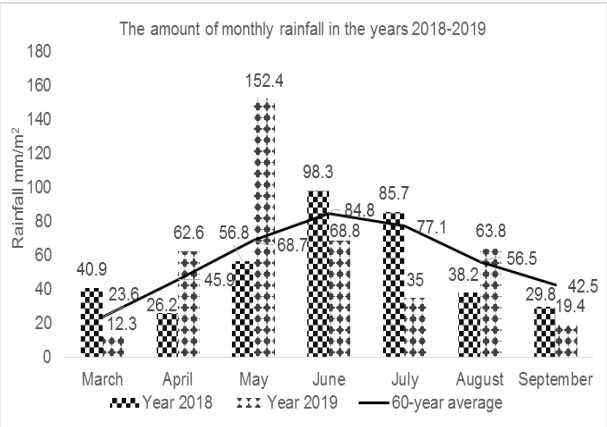

Figure 1 **The amount of monthly rainfall in the years 2018 – 2019**

Average monthly rainfall at Turda during the cropping periods (March to September) was lower than average over the last 60 years in the first experimental year, and higher in the second year (*figure 1*).

With respect to monthly temperature for two years during the experimental periods in 2018 and 2019 we notice a general tendency of warming of the weather, the months of June and August being not only droughts but also very warm (*figure 2*).

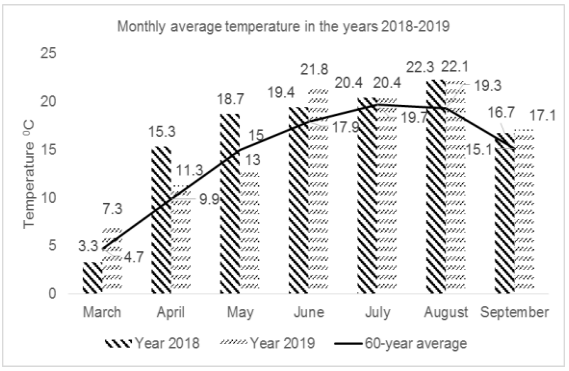

Figure 2 **Monthly average temperature in the years 2018 – 2019**

The experimental data are summarized in *table 1*, *table 2*, *table 3*, *table 4* and *table 5* highlighting genotypes from each maturity group with the maximum values for grain yield: Diamant (MG 000) with 3059 kg/ha in 2019 year; Flavia (MG 00) with 3257 kg/ha in 2019; Valjevka (MG 0) with 3691 kg/ha in 2018; Astafor (MG I) with 3693 kg/ ha in 2018; Ecudor (MG II) with 3598 kg/ha in 2018.

The highest average yield for the maturity groups 00, 0, I and II was obtained in the climatic conditions of 2019, instead the behavior of the very early genotypes (000) was different, the year 2018 being favorable. Although the highest yields were registered for maturity groups 0, I, and II, they did not significantly exceed the average yield of the 00 (early) the maturity group recommended for the Transylvanian Plain.

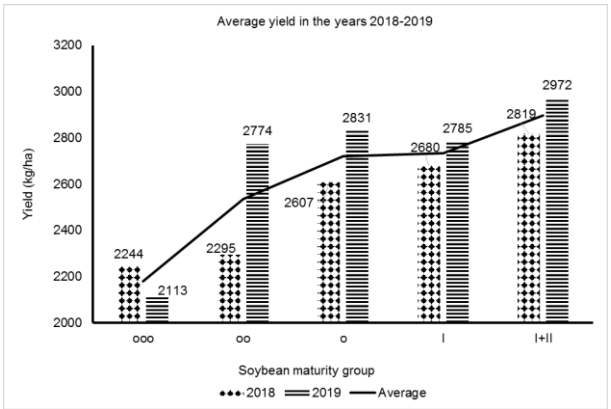

Figure 3: **Average yield in the years 2018 – 2019**

The yield of soybean genotypes from MG 000 (*table 1*) varied in the first experimental year

between 1460 kg/ha (Sultana) and 2716 kg/ha (Tourmeline) and between 1355 kg/ha (Amandine) and 3059 kg/ha (Diamant) in 2019. The average yield in the experimental years of the 15 very early soybean genotypes was 2179 kg/ha.

The obtained data for the MG 00 (*table 2*) reveals varieties yield with higher than 3 t/ha like: Cristina TD, Flavia, Christine with: 3035 kg/ha (2018 year), 3257 kg/ha (2019 year) respectively 3023 kg/ha (2019 year).

The highest yielding MG were 0, I and II with an average production of: 2719 kg/ha, 2732 kg/ha and 2895 kg/ha (*table 3, 4, 5*). According to the climatic conditions for the experimental years, the yield obtained for the tardy maturity groups (0, I and II) was higher than the results for maturity groups recommended for the Transylvania Plain (00 and 000) but the difference was small and nonsignificant (*figure 3*).

Table 1

Average of the obtained yields for the maturity group 000 in the years 2018 – 2019

No.	Variety	Yield kg/ha 2018	Yield kg/ha 2019	Average yield kg/ha
1	SULTANA	1460	1913	1687
2	PERLA	2320	2752	2536
3	AMANDINE	1875	1355	1615
4	MERLIN	2475	2141	2308
5	LISSABON	2599	2068	2334
6	GALLEC	2301	1895	2098
7	TOURMELINE	2716	2532	2624
8	CH 22/174	2581	2081	2331
9	MALAGA	2288	2001	2145
10	CH 21414	2200	2046	2123
11	CAPNOR	2239	2056	2148
12	ABELINA	2339	1529	1934
13	CH 22/172	2088	1833	1961
14	ES SENATOR	2204	2439	2322
15	DIAMANT	1971	3059	2515
Average		2244	2113	2179

Table 2

Average of the obtained yields for the maturity group 00 in the years 2018 – 2019

No.	Variety	Yield kg/ha 2018	Yield kg/ha 2019	Average yield kg/ha
1	CARLA TD	2181	2659	2420
2	FORTUNA	1853	2664	2259
3	SIGALIA	1918	2763	2341
4	FELIX	2412	2954	2683
5	EUGEN	2684	2902	2793
6	KORANA	2550	2984	2767
7	OANA F	1922	2848	2385
8	ES MENTOR	2187	2797	2492
9	CRISTINA TD	3035	2946	2991
10	FLAVIA	2945	3257	3101
11	CHRISTINE	1843	3023	2433
12	ONIX	2738	2716	2727
13	PROTEIX	2150	2128	2139
14	AMPHOR	2323	2905	2614
15	JOSEFINE	1689	2070	1880
Average		2295	2774	2535

Table 3

Average of the obtained yields for the maturity group 0 in the years 2018 – 2019

No.	Variety	Yield kg/ha 2018	Yield kg/ha 2019	Average yield kg/ha
1	BAHIA	3249	3404	3327
2	ESG 121	2772	3118	2945
3	TERRAPRO	3595	3517	3556
4	AIRES	1665	2264	1965
5	HILARIO	2828	2698	2763
6	LUCIJA	2950	3026	2988
7	DACIANA	2291	2843	2567
8	PICOR	2444	2796	2620
9	PEPITA	2448	2472	2460
10	BUGA	2709	2443	2576
11	GALINA	2174	2958	2566
12	PEDOR	1892	2668	2280
13	COLUMNA	2011	2702	2357
14	VALJEVKA	3691	3126	3409
15	ANA	2393	2432	2413
Average		2607	2831	2719

Table 4

Average of the obtained yields for the maturity group I in the years 2018 – 2019

No.	Variety	Yield kg/ha 2018	Yield kg/ha 2019	Average yield kg/ha
1	ZLATA	2718	2710	2714
2	SAVA	2707	3048	2878
3	CASTETIS	2448	2148	2298
4	SG EIDER	2025	2616	2321
5	ADONAI	3350	2583	2967
6	IKA	2628	2705	2667
7	ZORA	3114	2975	3045
8	TRIUMF	2096	2927	2512
9	ASTAFOR	3693	2825	3259
10	ISIDOR	3268	2324	2796
11	ZAGREPCANKA	2343	2926	2635
12	RUZICA	2317	3208	2763
13	CRINA F	2087	2961	2524
14	SANSA	2276	3564	2920
15	OPTIMUS	3128	2252	2690
Average		2680	2785	2732

Table 5

Average of the obtained yields for the maturity group I + II in the years 2018 – 2019

No	Variety	Yield kg/ha 2018	Yield kg/ha 2019	Average yield kg/ha
1	ASCASUBI	2714	2640	2677
2	TENA	2877	2858	2868
3	BLANCAS	2974	2716	2845
4	EIKO	3231	3014	3123
5	VENERA	3136	3204	3170
6	PACO	1976	2451	2214
7	SPONSOR	2624	2837	2731
8	PACIFIC	2451	2832	2642
9	MITSUKO	2691	3271	2981
10	BUENOS	2984	3029	3007
11	HIROKO	2406	3068	2737
12	ECUDOR	3598	2980	3289
13	DEKABIG OPT	2527	3169	2848
14	LUNA	3124	3285	3205
15	CELINA PZO	2968	3229	3099
Average		2819	2972	2895

CONCLUSION

In the climatic conditions from ARDS Turda in the years 2018-2019 the average yields obtained were between 2179 kg/ha (000) and 2895 kg/ha (I + II).

The highest average yield for the maturity groups 00, 0, I, II was obtained in the climatic conditions of the year 2019, instead the behavior of the very early genotypes (000) was different, the year 2018 being more favorable.

Although the highest yields were registered for maturity groups 0, I, and II, they did not significantly exceed the average yield of the 00 (early) the maturity group recommended for the Transylvanian Plain.

The conditions of the experimental years 2018 and 2019 are favorable for maturity groups 0, I and II, but there is a risk that the material will not reach maturity when the amount of degrees useful for plant development is not reached.As the climate is in a continuous process of change and the years are more difficult, with uneven amount of rainfall, high temperatures that influence the development of plants, a continuation of the study is required, to establish the suitable maturity group for the new conditions of Transylvanian Plain.

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