THE STABILITY OF YIELD AND QUALITY CHARACTERS IN SOME SOYBEAN *GLYCINE MAX* (L. MERR.) GENOTYPES

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Abstract: *Soybean occupies, as importance, the first place in the group of grain legumes due to its use in human nutrition, as a source of very good protein and oil quality, as herb and because it is a very good prior plant to the ground, leaving a reserve of 80 to 140 kg N/ha. The performances evaluation of genotypes for the yield stability and the quality characters (protein and oil content) in various environmental conditions is important in selection processes for the identification of genotypes adapted to large areas of culture. The objective of this study was to identify the soybean genotypes with high stability of yield and quality characters using variance (s^2), the determination of the genotypes stability noticed by high levels of protein and oil content using the cumulative index of selection. The research was conducted between the years 2007-2010, at ARDS Turda, in seven comparative trials (three orientation trials and four competition trials) organized in randomized blocks; each trial was composed of 25 variants, sowed in three repetitions. The chemical analysis (protein and oil content) were determined with NIR analyzer, Dickey-John brand, type INSTALAB 600. Among the varieties created at ARDS Turda, it noticed the high yield stability of the Onix and Mălina TD varieties, under high yield potential and Darina TD variety, with high stability of protein and oil content, but with a reduced stability of yield potential, although this character had an average relatively high. The genotypes Asgrow (with cumulative selection index of 107.4%), Condor (105.5%) and T23-5508 (102.9%) noticed concomitant for the stability of the protein and oil content and a high cumulative selection index. It is quite difficult to incorporate in the same genotype high values for the yield potential, the oil content and protein content, given that the same genotype has stability for all three characters with quantitative genetic determinism.*

Key words: *soybean genotypes, stability, yield, protein content, oil content, variance, cumulative selection index.*

INTRODUCTION

Soybean (*Glycine max* L. Merr.) is one of the most important crops that have the potential to provide the world's increasing demand for food and forage. The spread of soybean from its native land of origin has been mainly due to its adaptability and predominant use as a food crop for human nutrition, as a protein source for animals, as a medicinal plant and lately as an industrial crop (ALGHAMDI, 2004).

The interactions between genotypes and the different environments is one of the main obstacles in the selection of competitive soybean genotypes adapted to a wide range of cultivation. On the other hand, the genotype x environment interaction is also a great opportunity for the selection of positive interactions which associate plant traits with predictable environment conditions, making the identification of adapted, high-yielding genotypes possible (OLIVEIRA, 2006).

The yield and quality stability of cultivars in different environmental conditions is very important for genotypes recommendation. The genotypes must have the genetic potential for superior performance under ideal growing conditions, and must produce acceptable yields under less favorable environments. Therefore, a stable genotype refers to one that is capable to

utilize the resources available in high yielding environments and has acceptable performances that are above the average in all environments (EBERHART and RUSSEL, 1966; ALLARD and BRADSHAW, 1964; GURMU, 2009).

The evaluation of genotypes for performance stability under different environments for yield and quality characters (protein and oil content) is important in soybean breeding programs for the identification of genotypes adapted to large areas of culture. Several studies related to the performance of soybean seeds in different environmental conditions was carried out by RAUT, 1997; TAWARE 1994; SOOD, 2001; RAMANA, 2006.

The concept of stability has defined in different ways and different one-dimensional and multi-dimensional biometric methods have developed. A simple and available indicator is the variance (s^2), a faithful indicator of stability (CEAPOIU, 1968; CIULCĂ, 2006).

The objective of this study was to identify the soybean genotypes with high stability of yield and quality characters using variance (s^2), the determination of the genotypes stability noticed by high level of seed yield, high levels of protein and oil content using the cumulative index of selection.

MATERIAL AND METHODS

The research has been conducted between the years 2007-2010, at Agricultural Research and Development Station Turda, in the experimental field of the Leguminous Breeding Laboratory. We studied seven trials (three orientation trials and four competition trials), respectively 175 soybean genotypes organized in randomized blocks. Each trial was composed of 25 variants, sowed in three repetitions; each variant was due on two rows with a length of 12 m each and a length of 50 cm between them; 1 meter at both ends of each row removed and obtained a harvesting area of 10 m^2.

For the determination of protein and oil content, 50g of grains were weighed for each sample, then were crushed with laboratory mill; the flour resulted was examined using NIR analyzer, Dickey-John brand, type INSTALAB 600.

The identification of genotypes that incorporates high yield potential, high protein and oil content is quite difficult to achieve due to the negative correlations between protein and oil content and between yield potential and oil content (IFRIM et al., 2008). To identify these genotypes was calculated a cumulative index of selection, adapted by HAȘ (1987, 1992):

C.I.S (%) = 0.33*the relative value of yield + 0.33*the relative value of protein content + 0.33*the relative value of oil content.

We considered that the share of those three factors was equal, but you can give different weights for each of the three characters, depending on the importance granted to them in the breeding programs.

Also, it was determined the yield and the quality stability for the soybean varieties designed in A.R.D.S. Turda and for the genotypes noticed through cumulative index of selection, on the variance basis (s^2) of string variation calculated on the four experimental years. It is known that, if the value of the variance (s^2) is smaller, the stability of a genotype is higher.

RESULTS AND DISCUSSION

In table 1 are presented the mean yields, the protein and oil contents and the variance obtained for each character examined at the soybean varieties designed in A.R.D.S. Turda.

The lowest variance values were registered in Onix, Diamant, Opal and Mălina TD (T22-4577) variety, registered latter in the Official Catalogue of varieties of plants growing in Romania, in 2012. It should be noticed that Onix and Mălina TD, which registered the lowest

variance values, had the largest yield in the four experimental years (2514 kg/ha, respectively 2635 kg/ha).

Table 1

The stability of yield, protein and oil content (expressed by s^2) in soybean varieties designed in ARDS Turda (2007-2010)

Nr. crt.	Variety	No. of cases	Yield potential		Protein content		Oil content	
			kg/ha	s^2	%	s^2	%	s^2
1.	DIAMANT	28	1914	441138.325	41.2	3.6424	20.2	1.3158
2.	PERLA	36	1988	602979.209	41.5	3.9964	20.8	1.8814
3.	AGAT (GRANAT)	36	2175	742148.088	41.2	5.1445	20.3	1.5832
4.	SAFIR	36	2128	882009.029	41.4	5.4761	20.6	1.8024
5.	OPAL (EUGEN)	36	2371	564548.524	41.1	6.7716	20.8	2.7249
6.	ONIX	36	2514	381812.524	41.5	5.8482	21.0	3.0033
7.	FELIX	36	2381	826161.492	40.9	5.5139	21.0	2.5209
8.	T22-4525 (DARINA TD)	36	2685	780416.624	41.1	2.9574	20.8	1.6165
9.	T22-4430 (CRISTINA TD)	12	2908	747608.279	41.3	6.0091	20.4	2.8390
10.	T22-4577(MĂLINA TD)	12	2635	414433.257	41.2	5.5827	20.4	2.1566

The variety Darina TD (T22-4525), registered in the Official catalogue of varieties of plants growing in Romania in 2011, earned a higher mean yield (2730 kg/ha) for those 36 testing conditions, but the value of the variance was higher, indicating a lower stability of the yield potential. Instead, this new variety had reduced variance values for the protein and oil content; it should be noticed, however, the protein content (41.1%) and the oil content (20.8%), with mean values over the entire experimental system. The largest yield from soybean varieties designed in Turda, in the four experimental years (2908 kg/ha), was to Cristina TD (T22-4430) variety, also registered in the Official Catalogue of varieties of plants growing in Romania, in 2012.

With higher protein content and lower values of the variance (s^2), noticed Perla variety, from early maturing varieties group. For the oil content, the lower value of the variance (s^2) recorded the Diamant variety. Unfortunately, this reduced amount of variance is accompanied by a mean content of oil content by 20.2%, the lowest of the values obtained in SCDA Turda varieties. A relatively low value of variance and higher mean oil content recorded at Darina TD variety.

With reduced values of variance for all characters studied was Diamant variety, indicating a high stability; unfortunately, the high stability is to low mean yields, the lowest oil content and relatively low mean values of protein content.

In table 2 were presented the results for yield potential, protein content, oil content and the variance values (s^2) for the characters above, at the soybean genotypes noticed by high values of the cumulative index of selection.

Between the varieties studied for yield potential, noticed for low values of the variance (s^2), Onix and Crusader varieties and between the perspective lines with a high stability, the following lines: T97-8025 (2696 kg/ha), T23-5608 (2737 kg/ha), T22-4364 (2556 kg/ha) and T23-5175 (2627 kg/ha).

For the protein content, with low values of variance concomitant with high values of the character studied, have been remarked the varieties Ecudor (41.4%), Asgrow (41.7%), Condor (41.0%).

Between the perspectives lines, with high values of the cumulative index of selection, were noticed for high protein content and a small variance, the following genotypes: T25-6051 (42.5%), T21-2972 (42.0%), T23-5508 (41.5%) and T23-5605 (41.3%).

For the oil content and a reduced value of the variance were noticed the varieties Borostyan (21.0%), Darina TD (20.8%), Asgrow (20.7%), Dekabig (20.5%) and the perspective lines T97-8220 (20.4%), T23-5605 (20.6%), T23-5151 (20.4%) and T21-3164

(20.4%).

Table 2

The stability of yield, protein and oil content (expressed by s^2) in soybean genotypes noticed by synthetic index of cumulative selection

Nr. crt.	Genotype	No. of cases	Yield potential		Protein content		Oil content		Synthetic index of cumulative selection (%)
			kg/ha	s^2	%	s^2	%	s^2	
1	92 B63/92 B63	12	2861	582045.149	41.5	3.9208	19.3	1.8717	103.2
2	ASGROW	12	2720	607066.447	41.7	1.6154	20.7	1.4015	107.4
3	B.S.31	12	2969	479781.119	40.3	9.2384	21.2	3.8670	109.1
4	BALKAN	12	2689	895798.093	40.8	4.3052	20.6	2.7542	102.4
5	BOBIȚĂ	12	2648	1151701.657	39.2	7.8655	20.8	2.5008	103.0
6	BOROSTYAN	12	2506	644432.234	40.3	5.1997	21.0	1.6315	102.3
7	COLUMNA	24	2452	1019110.226	40.8	4.2597	21.1	2.4282	102.1
8	CONDOR	12	2963	537463.965	41.0	1.2208	20.1	1.1142	105.5
9	T22-4430(CRISTINA TD)	12	2908	747608.279	41.3	6.0091	20.4	2.8390	106.4
10	CRUSADER	12	2503	406395.274	40.0	11.1624	21.0	3.5311	102.2
11	T22-4525 (DARINA TD)	36	2685	780416.624	41.1	2.9574	20.8	1.6165	107.5
12	DEKABIG	24	2918	947893.465	41.6	2.8472	20.5	1.5573	106.3
13	ECUDOR	12	2802	915409.834	41.4	1.4897	19.6	1.0209	102.8
14	FELIX	36	2381	826161.492	40.9	5.5139	21.0	2.5209	104.2
15	T22-4577 (MĂLINA TD)	12	2635	414433.257	41.2	5.5827	20.4	2.1566	102.6
16	ONIX	36	2514	381812.524	41.5	5.8482	21.0	3.0033	103.2
17	OPAL (EUGEN)	36	2371	564548.524	41.1	6.7716	20.8	2.7249	102.8
18	VENERA	24	2519	517388.176	40.8	2.2874	20.6	2.5055	104.4
19	SAPORO	12	2540	1187404.568	39.7	5.3309	21.5	2.2424	103.2
20	T20-2073	12	2597	377377.510	41.2	6.8093	21.1	3.4242	102.9
21	T21-2798	12	2732	428758.406	41.4	6.2624	20.4	1.8439	104.0
22	T21-2847	12	2641	334985.546	41.5	6.6002	20.4	4.1511	102.7
23	T21-2956	12	2569	650549.154	40.8	8.4990	21.2	3.3579	102.6
24	T21-2972	36	2392	628227.627	42.0	2.6351	20.1	2.1406	103.2
25	T21-3164	12	2559	808562.171	42.3	3.1809	20.4	1.6642	102.3
26	T22-4161	12	2664	500317.464	41.2	6.2306	21.0	2.8166	104.0
27	T22-4364	12	2556	278530.108	41.4	4.7518	21.0	3.5524	102.5
28	T23-5151	12	2717	548688.417	41.3	3.4354	20.4	1.3579	103.7
29	T23-5175	12	2627	331079.329	41.2	2.9806	20.4	1.9972	102.5
30	T23-5331	12	2729	732581.059	41.5	3.2148	20.6	2.1608	102.9
31	T23-5424	12	2682	576111.286	41.1	5.1057	21.1	3.7242	102.8
32	T23-5508	12	2722	571063.400	41.5	2.4627	20.6	1.6227	102.9
33	T23-5605	12	2774	881949.358	41.3	2.3755	20.6	1.9018	103.4
34	T23-5607	12	2866	333889.586	41.2	3.0263	20.5	1.7879	104.3
35	T23-5608	12	2737	218040.382	41.9	8.0515	20.1	2.6481	102.5
36	T25-6051	12	2735	565169.146	42.5	1.4384	20.2	1.1542	103.2
37	T97-8025	12	2696	216050.613	41.5	6.2227	20.0	2.8063	104.3
38	T97-8029	12	2650	558814.542	41.4	6.2645	20.0	1.8627	102.1
39	T97-8076	12	2619	623062.156	41.4	6.7624	21.1	3.7081	103.4
40	T97-8175	12	2694	459861.618	41.9	4.4748	20.8	2.8761	104.5
41	T97-8220	12	2700	872321.052	41.7	3.7572	20.4	1.0345	103.8

CONCLUSIONS

Among the soybean varieties design in A.R.D.S. Turda must be noted the high yield stability of Onix and Mălina TD in the conditions of high yield potential and Darina TD variety with high stability values of protein and oil content, but with a reduced stability of yield potential, although this character has been a relatively high average value.

None of the genotypes noticed for the stability of the yield potential has not been noticed also for the stability of the protein and oil content; instead there were a few genotypes that stood out at the same time for the stability of the protein and oil content and a high cumulative index of selection: Asgrow (cumulative index of selection by 107.4%), Condor (105.5%), T23-5495 (102.9%).

It is quite difficult to incorporate in the same genotype high values for the yield potential, the oil content and protein content, given that, the same genotype to have stability for all three characters with quantitative genetic determinism.

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