



Comparison of soybean variety mixtures vs. pure lines for agronomic value in Southern part of Romania

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INTRODUCTION

- Soybean is demanding on climate and soil, having the ability to adapt to different climate and soil conditions, but it gives the best results in the temperate zone, with sufficient heat and humidity. In terms of temperature, it has high requirements, close to those of beans and corn. It germinates at 7-8°C, and for the sowing-emergence period it needs 120-130°C (temperatures higher than 0°C).
- Through the research works carried out within the soybean improvement program at INCDA Fundulea, a series of objectives were pursued, the achievement of which depended on the introduction and expansion of domestic soybean varieties. Among these objectives we mention: improving productivity, improving the ability to adapt to environmental and cultural conditions, improving the content and quality of proteins and oil, improving resistance to diseases.
- Regarding the improvement of the vegetation period, from the results of the research undertaken within INCDA Fundulea and based on the experimental results with lines and varieties in different cultivation areas in our country, it turned out that the varieties that can be cultivated in our country must belong to the following groups of maturity:
 - very early (000), early (00) and semi-early (0) for the main crop, in colder and wetter areas (northern or hilly);
 - semi-late (I), semi-early (0) for the main crop, in southern areas and west;
 - early (000) and early (00) strengths for successive crops in the south, in the perimeter of the irrigation systems.
- Soybean varieties grown in Southern Europe, whose maturity ranges from class 000 (mainly for spring crops after an autumn-early spring crop) to class II, are grown as pure lines.
- Studies on the possible agronomic advantages of heterogeneous soybean material are essentially relatively few, so an experiment was carried out with different soybean varieties to highlight their behavior cultivated as pure lines or in a mixture.

Material and methods

The experimental site is the Center for Ecological Agriculture from INCDA Fundulea, cambic chernoziom soil. The experimental factors were: the soybean crop cultivated as mixtures of two, three and four varieties compared to the soybean crop of a single variety.

The next analyses were performed:

- plant density (number of plants/m², measured with the metric frame);
- the degree of cover was determined with the Canopeo app (<https://canopeoapp.com/>) which uses a digital photo processing algorithm to measure the percentage of land covered by vegetation;
- the production (by weighing) and the protein content (with the Infratech device).



Results

Results obtained in 2022

Plant density in the field was from 13 pl/m² (F 13-114) to 29 pl/m² (Fabiana and Ovidiu) for soybeans sown in pure culture (table 1). In the variants where mixtures of two varieties were used, the plant density was still quite low, the differences compared to the variant with varieties sown in pure culture being insignificant (table 2). It was noted that in the variants with mixtures in which the varieties F13-1114 (subvariant B) and Triumf (subvariant G) were used, the achieved density did not exceed the value of 20 plants/m², which shows that the other two varieties in the mixture did not succeed to compensate for their reduced capacity regarding the installation of culture. Only in the mixture of four varieties did the negative effect fade, the crop density being 27 respectively 26 pl/m², above the value achieved by the two varieties in pure culture (table 3).

Table 1. Plant density and degree of cover for soybean sown in pure culture

Subvariants	Genotype	Plants/m ²	Degree of cover	Maturity group
A	F13-908	28	40	00
B	F13-1114	13	25	00
C	F15-1026	26	38	00
D	Ovidiu F	29	41	00
E	10053S1	21	32	I
F	11005S1	19	26	I
G	Trumf	18	26	I
H	Fabiana F	29	42	I

Table 2. Plant density and degree of cover for soybean sown in mixtures of two varieties

Mixture	Plants/m ²	Degree of cover	Mixture	Plants/m ²	Degree of cover
A+B	20	32	E+F	20	32
A+C	26	36	E+G	18	25
A+D	26	37	E+H	21	29
B+C	20	30	F+H	25	32
B+D	19	30	G+H	23	30
C+D	29	31			

Table 3. Plant density and degree of cover for soybean sown in mixtures of three and four varieties

Mixtures	Plants/m ²	Degree of cover
A+B+C	19	25
A+B+D	20	27
A+C+D	26	39
B+C+D	20	26
E+F+G	18	22
E+F+H	26	38
F+G+H	17	20
A+B+C+D	27	40
E+F+G+H	26	40

Results obtained in 2023

The soybean varieties used in 2023 in the pure and mixed culture were F13-908 Line, Ovidiu, Triumf and Fabiana

The density of the plants in the field was from 28 pl/m² (Triumf) to 30=9 pl/m² (Ovidiu) in soybeans sown in pure culture and in the mixture of the four varieties the density was 37 pl/m² and in the mixture of varieties the production was higher than the average of the pure culture varieties (table 4). The means for oil and protein content are shown in table five. It is worth noting that the average of the oil and protein content of the mixture of soybean genotypes is higher or approximately equal to the average of the best genotype (table 5)

Table 4. Crop density and production for the varieties sown in pure and mixed culture

Variants	Genotype	Plants/m ²	The yield (kg/ha)
Cultură pură	F13-908	38	1200
Cultură pură	Ovidiu F	39	1300
Cultură pură	Trumf	28	950
Cultură pură	Fabiana F	29	870
Mixtures	F13-908+ Ovidiu F+ Trumf+ Fabiana F	37	1250

Table 5. Oil and protein content from seed

Variants	Genotype	Protein content (%)	Oil content (%)
Cultură pură	F13-908	36,19	22,56
Cultură pură	Ovidiu F	39,38	21,45
Cultură pură	Trumf	36,15	22,12
Cultură pură	Fabiana F	37,20	21,06
Mixtures	F13-908+ Ovidiu F+ Trumf+ Fabiana F	39,25	22,14

Average air temperature (°C) and monthly distribution of precipitation (mm). Fundulea, 2022-2023

Month	March	April	May	June	July	Sum
Temperature 2022	4.4	12.1	17.9	22.6	25.0	
Temperature 2023	8.2	10.8	16.9	22.3	26.1	
Multi-annual average	4.9	11.3	17	20.8	22.7	
Precipitation 2022	12.3	47.6	30.1	59.6	29.2	178.8
Precipitation 2023	10.0	77.2	32.4	40.2	43.8	203.6
Multi-annual average	37.4	45.1	62.5	74.9	71.1	291

Conclusions

When using a mixture of four soybean genotypes (Ovidiu, Triumf, Fabiana varieties and the F 13-908 line) the level and quality of the productions obtained exceeded the average of the pure lines that make it up, which suggests that the use of a mixture of several soybean varieties can be a viable strategy for the success of this culture.

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