RESEARCHES REGARDING THE INFLUENCE OF SOME TECHNOLOGICAL ELEMENTS ON THE YIELD LEVELS OF SOYBEAN CROP IN THE CENTRAL OF MOLDAVIA PEDOCLIMATIC CONDITIONS PAPER TITLE

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Abstract

The laborious researches concerning the soybean technology were developed at ICCPT Fundulea and ARDS Turda, but also at other agricultural research stations in the country, but they were few in the pedoclimatic area of Central Moldavia. Thus, under the A.R.D.S. Secuieni pedoclimatic conditions were performed researches at soybean crop in order to establish the optimum sowing epoch (three sowing epochs: early sowing - 04/09/2015, sowing in the optimum epoch - 20/04/2015 and sowing in the late epoch - 04/30/2015), the optimal seeding density (six sowing densities: 30 g.b./sqm, 40 g.b./sqm, 50 g.b./sqm, 60 g.b./sqm, 70 g.b./sqm and 80 g.b./sqm) and the best distance between rows (four distances: 12.5 cm, 25 cm, 37.5 cm and 50 cm). The biological materials used in these experiments were the Eugen and Onyx varieties, created at A.R.D.S. Turda. The results obtained in 2015 agricultural year, which is several droughty characterized, showed that sowing soybean in late epoch was the best option, the yields obtained in these variants reach 2653 kg/ha at the Eugen variety and 3244 kg/ha at the Onix variety. Regarding the sowing density, the 30 g.b./sqm and the 80 g.b./sqm sown variant were remarked as being the best. The yields obtained in this variants were at Eugen variety of 2994 kg/ha when the variety was sown with 30 g.b./sqm and of 3142 kg/ha when this variety was sown with 80 g.b./sqm. The Onix variety has obtained the maximum yield in the variant sown with 30 g.b./sqm of 3041 kg/ha, and in the variant sown with 80 g.b./sqm, the yield was slightly smaller but big enough of 2937 kg/ha. Given the price of soybean seed, the most convenient variant from the economic point of view is the one sown with 30 g.b./sqm, both at Eugen and Onix variety. The distance between rows also had an influence on the soybean yield. Of the four experimented distances tested, it was proven to be superior to all others, the one with 50 cm between rows. In this variant, the yields obtained amounted to 2530 kg/ha at Eugen variety and 2715 kg/ha Onix variety.

Key words: distance between rows, ensured density, sowing epoch, soybean, varieties

The importance of soybean as agricultural plants derive from its many uses (Gus P. *et al*, 2004), both in human nutrition (oil, mature beans and green pods are used in various culinary recipes), in animal nutrition, in industry (oil for painting, the manufacture of plastics mass, preparation of margarine) and as ameliorative plant of the soil physical characteristics due to the symbiosis which it is installs between the root system and the nitrogen fixing bacteria (*Bradyrhizobium japonicum*). This symbiosis has as result the development of some special formations (nodosity) intended for the atmospheric nitrogen fixation for the benefit of the plant. Improving the soil in nitrogen, the soybean is a good foregoing plant for the plants that does not belong to the *Fabaceae* family, leaving large quantities of nitrogen in the soil, from 60 to 180 kg/ha (Chetan Felicia *et al*, 2014).

The considerable growth of the yield and the improvement of the methods for processing the soya beans have led to obtaining an oil with a high nutritional value and to the supplying of protein, which allows the obtaining of some increased quantities of animal products (Luca Laura, 2012).

In the context of an increasingly generalized crisis of petroleum, by reducing the reserves of conventional fuels, while increasing the fuel demand in the world market and a sharp rise in its price, they are increasingly insistent the research that aimed to identify the unconventional energy sources, where the biodiesel and oils combined they have in their composition vegetable oils in addition to the minerals one, play an increasingly important role.

The soybean is the main feedstock for bio-diesel in the US and Brazil and will remain a precious product in the international markets in the

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coming years. In Romania, in 2013, the cultivated area was of 73.3 thousand hectares, providing an average production of 2052 kg/ha (Romanian Statistical Yearbook, 2013), registering a growth trend in recent years (Chetan Felicia *et al,* 2013).

Besides the many uses from energy, food industry and animal husbandry fields, soybean has therapeutic and curative effects, especially preventive, having a beneficial influence on the human body (Fabrizzi K.P. *et al,* 2005; Ibanez J.J. *et al,* 2008).

The soybean has a special importance in that it is an excellent foregoing plant for most crops and in particular for winter cereals due to its particularities in improving soil characteristics (Muresanu E. *et al,* 2003).

Given the particular importance of the soybean crop and by the prospects that this crop can have in Center of Moldova conditions, at S.C.D.A. Secuieni were initiated together with Soybean Association Donau Soja, a cycle of experiences that would bring new technological solutions for this area, in soybean crop. In the experiments organized in 2015 agricultural year, three factors were primarily studied: the sowing era, sowing density and distance between rows. The biological material used in these studies was created at the Agricultural Research and Development Station Turda and were represented by Eugen and Onix varieties.

MATERIAL AND METHOD

The researches were conducted in 2015 agricultural year, year considered extremely drought and which for Moldova farmers was extremely difficult, especially regarding the soybean crop, in the pedoclimatic conditions of Center of Moldova.

The experiments were placed in the experimental field of A.R.D.S. Secuieni, on a faeoziom (mold) cambic typical soil type, with medium texture and neutral ($pH_{H2}o$ – 7.26). Before setting up the experiments were conducted soil analysis in order to develop a fertilization plan for the crop. The soil in which the experiences were placed has been characterized from the analyzes results as well stocked in active humus (2.33%), well stocked in phosphorus (189 mg/kg), potassium (304 mg/kg), excessive stocked in Mg (253 mg/kg) and Mn (369 mg/kg) and poorly stocked in nitrogen (9,4 mg/kg N – NO_3) and Zn (1 mg/kg). As a result of this analysis was carried out the crop fertilization with 60 kg a.s./ha nitrogen, 24 kg/ha P_2O_5 and 31 kg/ha K_2O.

Three polifactorial experiences were placed after the subdivided parcels method, in three repetitions. In the first experience we studied the influence of sowing epoch on the soybean yield. The experience was 2 x 3 type, where the A factor was represented by the Eugen (a_1) and Onix (a_2) varieties, and the B factor was represented by the sowing epoch, respectively b_1 - early sowing (9.04.2015), b_2 - sown in optimum epoch (20.04.2015) and b_3 - late sowing (30.04.2015).

In the second experience was observed the influence of the sowing density on the soybean yield and it was 2 x 6 type. The A factor was represented by the Eugen (a_1) and Onix (a_2) varieties, and the B factor was represented by the sowing density, respectively b_1 - 30 g.s./sqm, b_2 - 40 g.s./sqm, b_3 - 50 g.s./sqm, b_4 - 60 g.s./sqm, b_5 - 70 g.s./sqm and b_6 - 80 g.s./sqm.

The influence of the distance between rows was observed in a third experience that was 2 x 4 type. The A factor was represented by Eugen (a_1) şi Onix (a_2) varieties, and the B factor was represented by the distances between rows, respectively 12.5 cm (b_1), 25 cm (b_2), 37.5 cm (b_3) and 50 cm (b_4).

Within the experiences were complied all the technological links, and the data obtained were statistically processed and interpreted after the variance analysis method (ANOVA, 2013).

RESULTS AND DISCUSSIONS

a) The influence of sowing epoch on soybean yield

The sowing of the first epoch was done on 9.04.2015, in good sowing conditions, given that March was a very rainy month. Seedbed preparation was carried out smoothly. April was dry, and the crop emergence was rated at 15 days after sowing and was very.

The second epoch was sown on 20.04.2015, the soil water supply was rather low which resulted in an uneven emergence that was noted to approx. 17 days after sowing.

The third epoch was established on 30.04.2015, at which time the soil had a very low water reserves, the crop emergence was rated at 18 days from sowing, after a rain occurred in the first decade of May. The crop emergence in this epoch was more uniform compared to previous epochs.

The yields in this experience ranged from 2218 kg/ha (Eugen x first epoch) upt to 3244 kg/ha (Onix x third epoch). Compared with the control variant, experience average, the Onix variety achieved statistically production increases in all three experienced epochs. The increase achieved by Onix variety sown in the first epoch, was significant, that achieved in the second epoch - has been significantly distinct, and the third epoch was achivied a very significant increase (*table 1*).

The results obtained in this experience highlights the ability of Onix variety to achieve good yields even in less favorable environmental

conditions and also highlights the variant sown in the third epoch.

Table 1

Results regarding the influence of sowing epoch on soybean yield

Variety (A)	Epoch (B)	Yield (kg/ha)	Relative yield (%)	The difference compared to the control variant (kg/ha)	Significance
Eugen	I	2218	81	-524	ooo
Onix	I	2934	107	192	*
Eugen	II	2337	85	-405	ooo
Onix	II	3065	112	323	**
Eugen	III	2653	97	-89	
Onix	III	3244	118	502	***
Experience average (Control)		2742	100	Mt.	
DL 5 % (kg/ha) =				181 kg/ha	
DL 1 % (kg/ha) =				263 kg/ha	
DL 0.1 % (kg/ha) =				397 kg/ha	

b) The influence of sowing density on soybean yield

The sowing density had heavily inluenced the soybean yield. Thus, the yields obtained have ranged from 2457 kg/ha (Eugen x 60 g.s./sqm) and 3139 kg/ha (Onix x 70 g.s./sqm) (*table 2*).Compared with the control variant, experience average, four variants have achieved production increases statistically ensured ie, the interactions between Eugen x 30 g.s./sqm (very significant), Onix x 70 g.s./sqm (very significant), Eugen x 80 g.s./sqm (significant şi Onix x 80 g.s./sqm (significantly distinct) (*table 2*).

Table 2

Results regarding the influence of sowing density on soybean yield

Variety (A)	Sowing density (g.s./sqm) (B)	Yield (kg/ha)	Relative yield (%)	The difference compared to the control variant (kg/ha)	Significance
Eugen	30	3142	110	289	***
Onix	30	2937	103	84	
Eugen	40	2946	103	93	
Onix	40	2740	96	-113	o
Eugen	50	2830	99	-23	
Onix	50	2710	95	-143	o
Eugen	60	2457	86	-396	ooo
Onix	60	2635	92	-218	oo
Eugen	70	2665	93	-188	oo
Onix	70	3139	110	286	***
Eugen	80	2994	105	141	*
Onix	80	3041	107	188	**
Experience average		2853	100	Mt.	
DL 5 % (kg/ha) =				102 kg/ha	
DL 1 % (kg/ha) =				187 kg/ha	
DL 0.1 % (kg/ha) =				261 kg/ha	

On average, the variants sown with 30 g.s./sqm and 80 g.s./sqm stood out through higher yields compared to the other tested variants. It is recommended to sow soybean at a density of 30 g.s./sqm, given the fact that to achieve a density of 80 g.s./sqm we need a quantity of seed almost three times higher than that for creating a 30 g.s./sqm density.

c) The influence of the distance between rows on soybean yield

The yields recorded in the experimental variants ranged from variety to variety and especially depending on the distance between rows. Thus, the yields ranged from 1490 kg/ha (Eugen x 12.5 cm between rows) to 2744 kg/ha (Onix x 50 cm between rows). Statistically ensured increases were achieved only in the variants sown at a distance of 50 cm between rows, and these have been interpreted as very significant in both varieties. The lowest yields were achieved in the variants sown at a distance of 12.5 cm between rows, the yield differences being in these variants very significantly negative (Eugen) and significantly negative (Onix) (*table 3*).Although, the sowing density influenced grain yield achieved, the correlation between them being indirect, the variation coefficient (r) was not statistically assured. In terms of distance between rows provided at sowing it was observed that it positively influences the production of grain, the correlation between these variables is direct and very close and the correlation coefficient (r) has been enhanced statistically and interpreted as very significant (*figure 1*).

Table 3

Results regarding the influence of the distance between rows on soybean yield

Variety (A)	Distance between rows (cm) (B)	Yield (kg/ha)	Relative yield (%)	The difference compared to the control variant (kg/ha)	Significance
Eugen	12,5	1490	74	-523	ooo
Onix	12.5	1695	84	-318	o
Eugen	25	1718	85	-295	
Onix	25	1852	92	-161	
Eugen	37,5	1961	97	-52	
Onix	37,5	2115	105	102	
Eugen	50	2530	126	517	***
Onix	50	2744	136	731	***
Media experienţei		2013	100	Mt.	
DL 5 % (kg/ha) =				311 kg/ha	
DL 1 % (kg/ha) =				387 kg/ha	
DL 0.1 % (kg/ha) =				453 kg/ha	

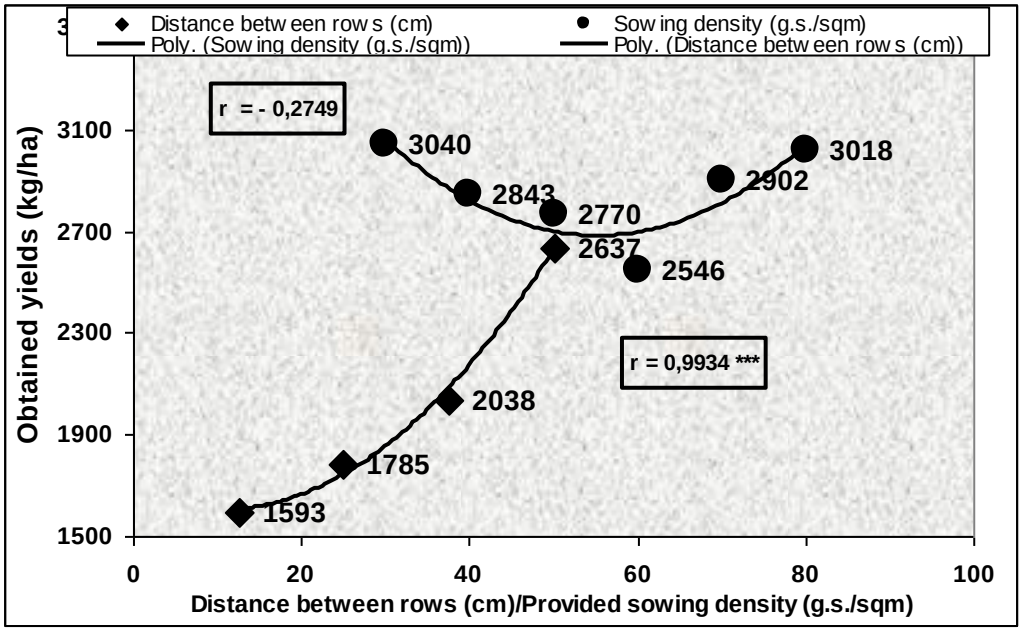

Figure 1 **Correlation between the provided sowing density/distance between rows and the grain yield obtained at soybean**

CONCLUSIONS

The results obtained during the researches revealed the following conclusions:

- The yields obtained in the third sowing epoch were the highest and the Onix variety recorded higher yields than the Eugen variety in each of the three experimented epochs;

- The highest yields are achieved in the variants sown with 30 g.s./sqm and 80 g.s./sqm, and the most economically efficient variant is the one sown with 30 g.s./sqm;

- soybean seeding at 50 cm between rows is the best option for the climatic conditions of Central Moldavia.

We recommend the introduction in soybean cultivation technology for Center of Moldova conditions of the variant sown with Onix variety in late epoch and sown at a distance between rows of 50 cm and a sowing density of 30 g.s./sqm.

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