RESEARCH ON THE INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON CASTOR (*RICINUS COMMUNIS* L.) YIELD UNDER THE CONDITIONS OF THE CENTER OF MOLDOVA

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Abstract. *In the past, castor was grown in our country on large areas, but today there are few who have heard of this plant and far fewer who rely on the establishment of a castor crop in the field. The experience was placed at Society Agricola Moldoveni from Neamt County, and the preliminary results obtained are the object of study of the doctoral thesis. The average productions obtained in 2021 were directly influenced by the experienced technological factors. The highest seed production was made at the earliest variety, Teleorman sown in the second epoch at the distance of 70 cm between rows (1669 kg / ha). The correlation between the three studied factors (variety, epoch of sowing and distance between rows) and the yield obtained was directly and very close.*

Keywords*: castor, variety, epoch of sowing, distance between row*

INTRODUCTION

The species *Ricinus communis* L. has phenotypic plasticity and adapts to different habitat types (Neha Goyal et al., 2014). Therefore, the risk of introducing and colonizing this species in new habitats remains high.

Castor is widespread in tropical, subtropical and warm temperate regions of the world. It is very common in marginal lands, in rural and urban areas and also at altitudes between 400 and 2700 m. The probable center of origin for castor is Northeast Africa, Ethiopia and Somalia (Anjani, 2012), and it has four centers of diversity, namely Ethiopia-East Africa, North-West and South-West Asia and the Arabian Peninsula, the Indian subcontinent and China (Severino et. al, 2012). It is currently naturalized on the African continent, the Atlantic coast to the Red Sea, Tunisia to South Africa and the islands of the Indian Ocean. It is also widely cultivated and naturalized in tropical and subtropical regions of America and Asia and temperate areas of Europe (Govaerts et al., 2014).

The major castor-growing countries are India, China and Brazil. India is the world's largest producer of castor seeds and meets most of the world's demand for castor oil, contributing over 60% of total global production (Koutroubas et al., 2000; Lim, 2012; Öztürk et al., 2014).

The use of castor oil for biodiesel production is problematic due to its high viscosity and high production and refining costs. However, castor oil has an extraordinary potential as a source of bioenergy and industrial raw materials, with a high oil content, a unique composition of fatty acids (ricinoleic acid) and a wide range of adaptation in conditions of drought and salinity (Swapan 2021).

In Romania, for some reasons, both the cultivated areas and the realized productions have been reduced. Because castor is originally a shrub with a high branching capacity, and Romania is at the northern limit of its cultivation area, it is necessary to obtain genetic forms with a shorter period of vegetation, a lower degree of branching, ensuring stability and consistency of high crop levels (Zamfirescu, 1965; Axinte et al., 1999, 2002).

Sowing crops at an optimal time, along with other technological links, is the key to achieving maximum yield of any crop. Determining the optimal sowing time plays an important role in the growth and development of plants in relation to the desired environmental conditions, which leads to maximum yield (Siadata and Hemayatib , 2009).

Optimizing row spacing and plant density is a simple, low-cost process, but it has a significant influence on seed production (Severino et al., 2006 a and b; Severino et al., 2012; Soratto et al., 2012) .

Increased plant density can result in overcrowding of plants per unit area, while low density can favor weed infestation, late flowering, secondary branching, and thick stems that affect mechanized harvesting (Lopes et al., 2008; Severino et al., 2006b, 2012).

This paper presents new data from the year 2021 on the improvement of technological links for castor cultivation, as this is a matter of great importance for obtaining large yields.

MATERIAL AND METHODS

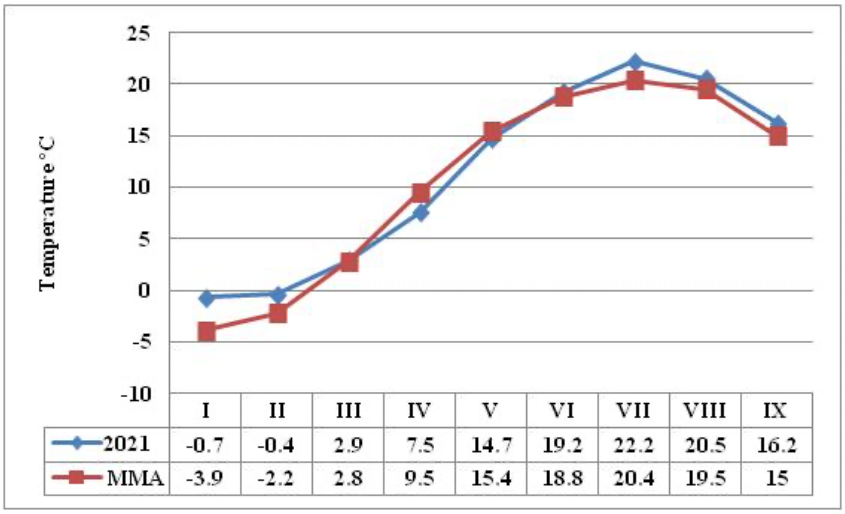
The purpose of the research carried out at the Society Agricola Moldoveni Neamt was to study the influence of technological factors such as: genotype, epoch of sowing and distance between rows.

The experience was performed at the Society Agricola Moldoveni Neamt and is part of the research of the doctoral thesis, on a soil of the faeoziom (chernozem) typical cambic with medium texture, acid: pH H_2O -

5.96, characterized as: well supplied in phosphorus (77.2 ppm PAL), Ca (13.3 meq / 100 g soil Ca) and Mg (1.6 meq / 100 g soil Mg), medium supplied with active humus (1.84%) and nitrogen (16.3 ppm N-NO_3) and poorly supplied with potassium (124.3 ppm K_2O).

The experiment was placed according to the method of subdivided plots, in three repetitions of type A x B x C, and the experimental factors studied were: A - genotype (a_1 - Dragon, a_2 - Rivlas, a_3 – Cristian, a_4 - Teleorman), B – epoch of sowing (b_1 - sown in the first decade of April, b_2 - sown in the second decade of April, b_3 - sown in the third decade of April, b_4 – sown in the first decade of May) and C – distance between rows (c_1 – 50 cm, c_2 – 70 cm, c_3 – 100 cm).

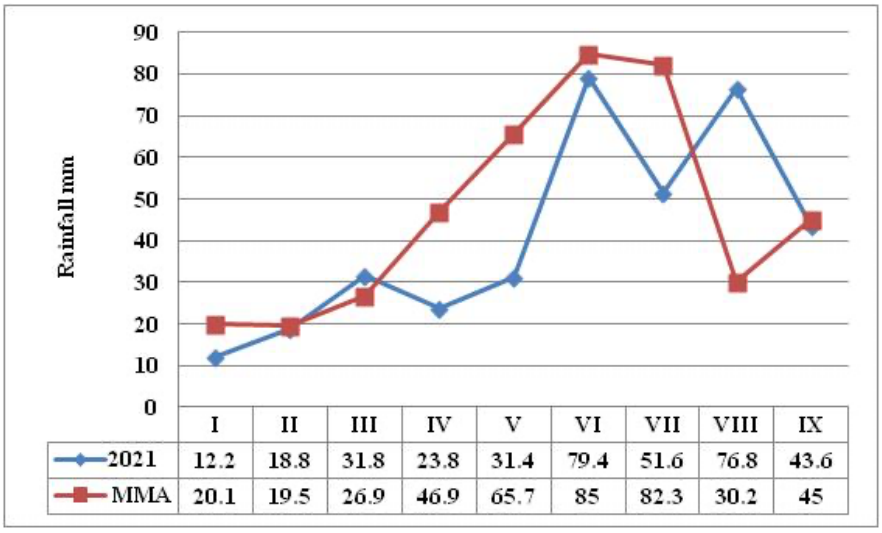
The samples were harvested manually and the data obtained was processed and interpreted statistically according to the method of variance analysis.



	I	II	III	IV	V	VI	VII	VIII	IX
2021	-0.7	-0.4	2.9	7.5	14.7	19.2	22.2	20.5	16.2
MMA	-3.9	-2.2	2.8	9.5	15.4	18.8	20.4	19.5	15

Figure 1. The graph of temperatures recorded in 2021 at the meteorological station A.R.D.S. Secuieni

The year 2021 was characterized as a warm and dry, the annual amount of rainfall that was non-uniformly distributed during the growing season of castor. The monthly averages of temperatures recorded during the vegetation period were similar to the multiannual average, the deviations being between 0.4° C in June and 1.8° C in July. From a rainfall of view, the precipitations were lower than the multiannual average, registering deviations of - 23.1 mm in April and - 34.3 mm in May (Figure 1 and Figure 2).



	I	II	III	IV	V	VI	VII	VIII	IX
2021	12.2	18.8	31.8	23.8	31.4	79.4	51.6	76.8	43.6
MMA	20.1	19.5	26.9	46.9	65.7	85	82.3	30.2	45

Figure 2. The graph of precipitation recorded in 2021 at the meteorological station A.R.D.S. Secuieni

Throughout the growing season of castor crop, the deviations from the multiannual average were different. The distribution of precipitation was extremely uneven, on the phenophases of growth and development of the plant (Figure 2).

RESULTS AND DISCUSSIONS

At the Dragon variety, the average height of the plants was between 131 cm (Ist epoch x 50 cm) and 171 cm (IInd epoch x 100 cm).

Table 1. Biometric measurements performed during the vegetation period, for experienced castor varieties, 2021

Variety	Epoch of sowing	Distance between rows (cm)	Plant height (cm)	Main racem length (cm)	No. capsule/pl	No. seeds/ pl.
Dragon	Ist epoch	50	131	28.8	41	123
		70	147	27.8	42	126
		100	161	27.3	39	117
	IInd epoch	50	151	28.7	43	129
		70	162	39.6	45	136
		100	171	28.6	41	122
	IIIrd epoch	50	143	26.9	40	119
		70	153	30.5	42	127
		100	166	26.5	37	112
	IVth epoch	50	138	25.4	36	109
		70	147	26.3	39	118
		100	160	25.1	33	100
Rivlas	Ist epoch	50	134	24.3	39	118
		70	149	26.7	41	122
		100	164	25.6	37	112
	IInd epoch	50	151	28.3	42	126
		70	162	35.6	44	133
		100	172	27.5	38	115
	IIIrd epoch	50	145	27.3	38	114
		70	155	31.2	40	121
		100	168	25.1	34	103
	IVth epoch	50	140	24.8	34	102
		70	149	31.5	37	110
		100	162	24.3	31	93
Cristian	Ist epoch	50	141	28.9	43	129
		70	139	28.3	44	133
		100	168	25.5	41	123
	IInd epoch	50	140	29.4	45	136
		70	158	38.6	48	143
		100	168	26.4	42	127
	IIIrd epoch	50	151	25.7	41	124
		70	140	29.8	44	131
		100	159	24.6	38	115
	IVth epoch	50	135	23.1	38	113
		70	143	27.9	40	120
		100	156	23.6	34	102
Teleorman	Ist epoch	50	94	27.8	51	154
		70	103	26.8	49	147
		100	118	27.1	49	146
	IInd epoch	50	108	29.8	54	161
		70	119	30.1	56	168
		100	129	27.3	50	149
	IIIrd epoch	50	100	26.9	49	147
		70	110	28.7	52	156
		100	123	24.6	46	137
	IVth epoch	50	95	24.3	45	135
		70	104	25.1	48	143
		100	118	18.3	41	124

During the vegetation period the length of the main raceme varied between 25.1 cm (IVth epoch x 100 cm) and 39.6 cm (IInd epoch x 70 cm). A number of capsules reached maturity between 33 at the variant sown in the IVth epoch at a distance of 100 cm and 45 in the variant sown in the IInd epoch at a distance of 70 cm.

From the results obtained, it can be seen that between the number of capsules / plant and the number of seeds/ plant, in the Dragon variety, at the four sowing epochs there is a direct correlation, the calculated correlation coefficients were statistically assured and interpreted as very significant (Figure 3).

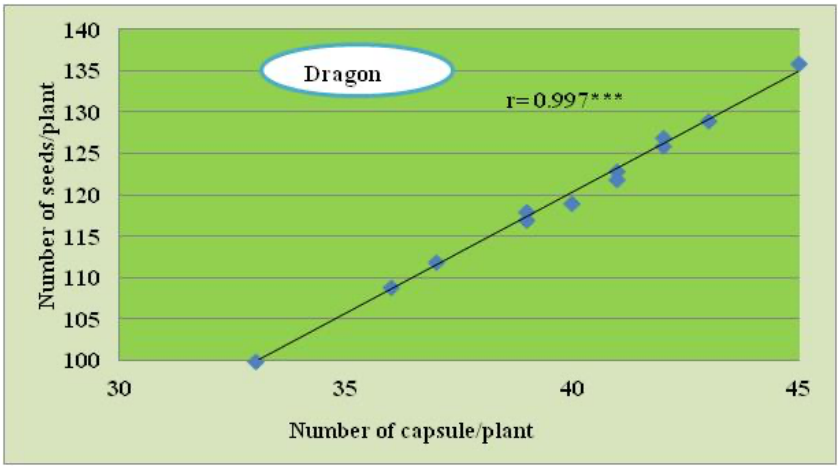


Figure 3. The correlation between the number of capsules / plant and the number of seeds / plant at Dragon variety, 2021

The Rivlas variety recorded a plant height of 134 cm (epoch I x 50 cm) and 172 cm (epoch II x 100 cm). The length of the main raceme ranged from 24.3 cm (epoch IV x 100 cm) to 35.6 cm (epoch II x 70 cm). Also, the number of capsules / plant and the number of seeds / plants varied between 31, respectively 93 (epoch IV x 100 cm) and 44, respectively 133 (epoch II x 70 cm) (Table 1).

At the Rivlas variety, the number of seeds / plant was influenced by the number of capsules / plant, the correlation between these two variables was direct and interpreted as very significant (Figure 4).

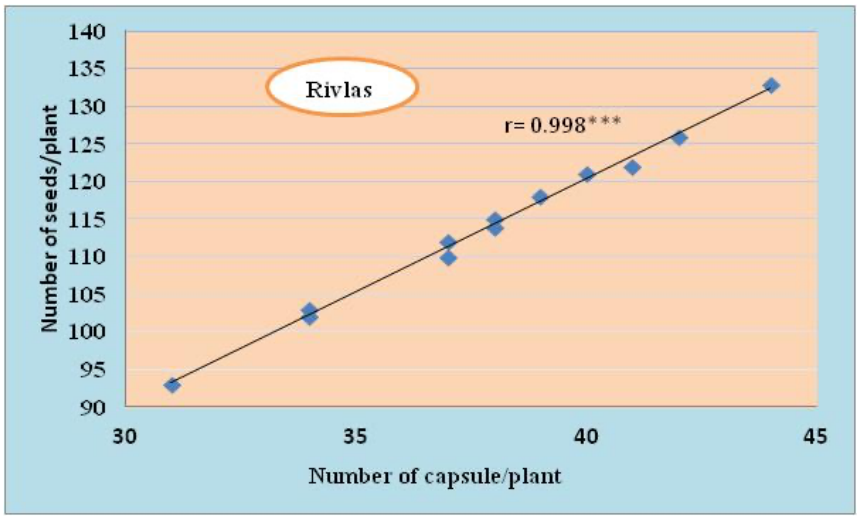


Figure 4. The correlation between the number of capsules / plant and the number of seeds / plant at Rivlas variety, 2021

The Cristian variety recorded a plant height between 135 cm (IVth epoch x 50 cm) and 168 cm (IInd epoch x 100 cm). As in the case of the Rivlas variety, the number of capsules / plant and the number of seeds / plant varied between 34, respectively 102 (IVth epoch x 100 cm) and 48, respectively 143 (IInd epoch x 70 cm) (Table 1).

The correlation between the number of capsules / plant and the number of seeds / plant, in the Cristian variety, was direct and interpreted as very significant (Figure 5).

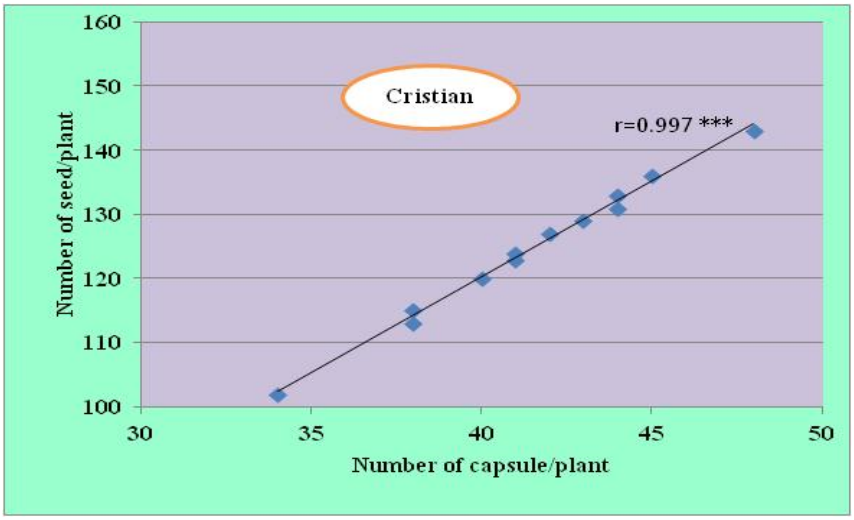


Figure 5. The correlation between the number of capsules / plant and the number of seeds / plant at Cristian variety, 2021

Regarding the average height of the plants at the Teleorman variety, it was from 94 cm (epoch I x 50 cm) to 129 cm (epoch II x 100 cm). As in the case of the other varieties experienced, the maximum number of capsules / plant and the number of seeds / plant were obtained in the variant sown in the second epoch at 70 cm between rows (56, respectively 168) (Table 1).

For the Teleorman variety, a direct correlation was established for the four sowing epoches. The correlation coefficients were statistically assured and interpreted as very significant (Figure 6).

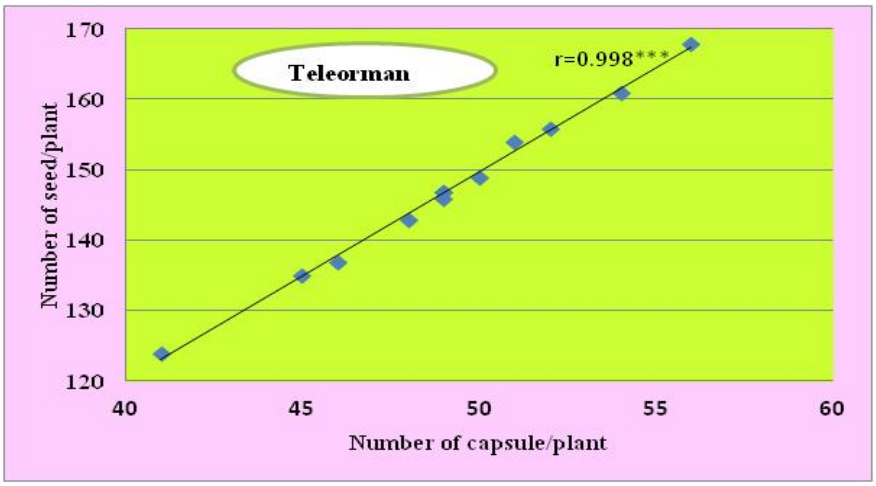


Figure 6. The correlation between the number of capsules / plant and the number of seeds / plant at Teleorman variety, 2021

In the agricultural year 2021, the experimental factors studied have greatly influenced the yields obtained. Thus, this year the seed production varied in very wide limits, being between 912 kg / ha (Rivlas x IVth epoch x 100 cm between rows) and 1669 kg / ha (Teleorman x IInd epoch x 70 cm between rows).

Compared to the control variant (average experience), most of the variants sown in the IVth epoch had very significant negative production differences (between -85 kg / ha and -387 kg / ha). The highest difference in production for the variants sown in the IVth epoch was made for the variant sown with the Rivlas variety at a distance of 100 cm between rows (- 387 kg / ha) (Table 2).

The Teleorman variety, being the earliest variety in our country, obtained production increases in all three sowing epoches, and the highest increase was recorded at the interaction between it and the second sowing epoch x 70 cm between rows (370 kg / ha) (Table 2).

Table 2. The results obtained regarding the influence of the interaction between genotype x sowing epoch x distance between rows on castor yield, 2021

Variety	Epoch of sowing	Distance between rows (cm)	Yield (kg/ha)	%	Diff. (kg/ha)	Sign.
Dragon	Ist epoch	50	1322	101.77	23	
		70	1368	105.31	69	**
		100	1248	96.05	-51	o
	IInd epoch	50	1410	108.57	111	***
		70	1500	115.45	201	***
		100	1297	99.85	-2	
	IIIrd epoch	50	1275	98.18	-24	
		70	1365	105.06	66	**
		100	1162	89.45	-137	ooo
	IVth epoch	50	1125	86.61	-174	ooo
		70	1214	93.48	-85	ooo
		100	1012	77.88	-287	ooo
Rivlas	Ist epoch	50	1222	94.10	-77	oo
		70	1268	97.64	-31	
		100	1148	88.38	-151	ooo
	IInd epoch	50	1311	100.90	12	
		70	1400	107.78	101	***
		100	1197	92.17	-102	ooo
	IIIrd epoch	50	1176	90.51	-123	ooo
		70	1265	97.38	-34	
		100	1062	81.78	-237	ooo
	IVth epoch	50	1025	78.93	-274	ooo
		70	1115	85.81	-184	ooo
		100	912	70.21	-387	ooo
Cristian	Ist epoch	50	1349	103.82	50	*
		70	1395	107.36	96	***
		100	1274	98.10	-25	
	IInd epoch	50	1437	110.62	138	***
		70	1526	117.50	227	***
		100	1324	101.90	25	
	IIIrd epoch	50	1302	100.23	3	
		70	1391	107.11	92	***
		100	1189	91.51	-110	ooo
	IVth epoch	50	1152	88.66	-147	ooo
		70	1241	95.54	-58	o
		100	1038	79.93	-261	ooo
Teleorman	Ist epoch	50	1491	114.81	192	***
		70	1537	118.35	238	***
		100	1417	109.08	118	***
	IInd epoch	50	1580	121.61	281	***
		70	1669	128.48	370	***
		100	1466	112.88	167	***
	IIIrd epoch	50	1445	111.21	146	***
		70	1534	118.09	235	***
		100	1331	102.49	32	
	IVth epoch	50	1294	99.64	-5	
		70	1384	106.52	85	***
		100	1181	90.92	-118	ooo
Average experience			1299	100	Ct.	
LSD A x B x C (kg/ha)				5%=	42.76	
				1% =	59.50	
				0.1 % =	83.93	

Statistically assured production increases were within wide limits from 50 kg / ha (Cristian x epoch Ia x 50 cm between rows), an increase interpreted as significant, up to 370 kg / ha (Teleorman x epoch II x 70 cm between rows), increase interpreted as very significant (Table 2).

CONCLUSIONS

From the results obtained, it can be seen that between the number of capsules / plant and the number of seeds / plant, in the four varieties and in the four sowing epoches there is a direct correlation, the calculated correlation coefficients were statistically assured and interpreted as very significant.

The second sowing epoch positively influenced the seed production, and its level was influenced by the climatic conditions registered in the agricultural year 2021.

Analyzing the influence of the distance between rows on castor, it results that at greater distances production deficits are obtained, so when the nutrient surface of the plants increases, the branching is stronger and the production obtained from the main raceme decreases, increasing instead the production of secondary racemes. The density should be set so as to greatly reduce the production of secondary racemes, which do not always reach maturity.

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