RESEARCHES REGARDING THE INFLUENCE OF THE TECHNOLOGICAL FACTORS ON THE BIOLOGY OF THE SPECIES AND SEED YIELDS AT *CARTHAMUS TINCTORIUS* L. IN A.R.D.S. SECUIENI

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Abstract

The paper aims to highlight the influence of technological factors on the biology of the species and seed production at *Carthamus tinctorius* L. (safflower). The research were carried out in 2019, in the experimental field of A.R.D.S. Secuieni. Due to the higher temperatures from the third epoch and the precipitations recorded in the sowing to emergence period, the plants had a faster evolution. It was necessary 117 days from sowing to harvesting the seeds, the sum of the accumulated temperatures was 2241.9 ° C and the precipitation amounted to 230.7 mm. Under the conditions of A.R.D.S. Secuieni, at the first sowing epoch, there was an increase in production of 156 kg/ha compared to the control of the experience. The interaction of the studied factors influenced the seed production, obtaining the highest seed production at the sown variant at 70 cm between rows and 25 cm between plants per row (1688 kg/ha).

Key words: seed, safflower, epoch of sowing.

Safflower (*Carthamus tinctorius* L.) is an annual, broadleaf oilseed crop of the family *Asteraceae* adapted chiefly to dryland or irrigated cropping systems (Rohini V.K., Sankara K.R. 2000). It is possible to have originated in southern Asia and is known to have been cultivated in China, India, Persia and Egypt almost from prehistoric times.

Safflower was originally grown for the flowers that were used in making red and yellow dyes for clothing and food preparation (Cho and Tae R.H., 2000). Safflower (*Carthamus tinctorius* L.) is an important oilseed crop with 35-40 % oil (Kolsarici Ö. *et al*, 2005).

Safflower oil is composed of unsaturated fatty acids including linoleic acid (18:2) and oleic acid (18:1), and saturated fatty acids as palmitic acid (16:0) and stearic acid (18:0). It is one of the richest sources of linoleic acid among the commercially available oil (Yeilaghi H *et al*., 2012). Safflower seed oil contains about 71– 75% linoleic acid, 16–20% oleic acid, 6–8% palmitic acid, and 2–3% stearic acid (Velasco L., Fernandez-Martinez J.M., 2001).

Different sowing dates caused flowering and seed development to occur during periods of widely different temperatures, radiation, and day length (Mirshekari M. *et al*, 2013). Sowing date can be a major factor that affects oil content and fatty acid composition at the time of seed development (Yeilaghi H. *et al*, 2012).

MATERIAL AND METHOD

A factorial experiment was organized in 2019 in the experimental field of Agricultural Research - Development Station Secuieni, Neamt County, using a randomized blocks in three replications.

The trial was conducte on a typical cambic chernozem soil type, middle texture, acid: pH H_2O– 6.29, characterized as: well- supplied in phosphorus (39 ppm PAL), Ca (13.6 mEq/100 g soil Ca) and Mg (1.8 mEq/100 g soil Mg), middle supplied in active humus (1.88 %) and nitrogen (16.2 ppm N-NO_3) and poorly supplied in potassium (124.6 ppm K2O).

In the conditions of A.R.D.S. Secuieni we experimented three sowing epochs:

V1 - Epoch I, sowing in the first emergence (the first decade of April);

V2 - Epoch II, sowing in the second emergence (the second decade of April);

V3- Epoch III, sowing in the last decade of April.

The second experiment was a bifactorial type, placed in the field according to the method of subdivided plots, in three repetitions. Factor A was represented by the distance between rows with graduations: 25 cm, 50 cm and 70 cm and Factor

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B - the distance between plants per row with graduations: continuous row, 15 cm and 25 cm.

The soil work and the preparation of the germination bed consisted in releasing the soil from the plant debris in the pre-planting, stubble-turning and plowing at a depth of 30 cm. In spring, preparation of the germination bed was made with a harrow disc and the sowing was done manually at a depth of 2 cm.

The research was aimed to establish the optimal epoch of sowing for the species *Carthamus tinctorius* L. in order to develop the technology cultivation.

During the vegetation period of plants, phenological observations were made to establish the sum of the thermal degrees and sum of the precipitations needed to grow and develop the plants.

The agricultural year 2018/2019 was characterized as hot in terms of temperatures and dry in terms of the annual amount of rainfall that was unevenly distributed during the vegetation period of the plants. Regarding the temperatures, the multiannual average for the conditions in Secuieni is 8.9ºC, and the average of the agricultural year 2018 - 2019 was 10.0ºC with 1.1ºC higher, the monthly deviations were between -0.9ºC in November and 4.0 ºC in March. The spring was characterized as dry in terms of heat and rainfall, except for May, which was close to normal in terms of temperature and excess in terms of rainfall, with a deviation of 29.3 mm from the multiannual average.

In terms of rainfall, the annual amount recorded was 430 mm by 114.1 mm less than the multiannual average of 544.3 mm agricultural year 2018/2019 being characterized as dry, the monthly deviations from the multiannual average were between - 39.8 mm in August and 29.3 mm in May (*table 1*).

Table 1

Temperatures and rainfall recorded at A.R.D.S. Secuieni meteorological station

Specification		2018			2019									
		X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	Media
Temperatures °C	Decade I	11.3	8.3	-4.0	-4.2	-0.4	6.4	9.5	11.7	19.2	20.3	20.1	18.6	
	Decade II	11.0	2.9	-2.3	-3.7	2.2	6.8	7.1	15.7	23.1	18.0	21.4	15.2	
	Decade III	11.6	-3.5	0.1	-3.6	0.9	7.2	12.4	18.3	21.5	21.7	22.0	14.8	
	Monthly average	11.3	2.6	-2.0	-3.8	0.9	6.8	9.7	15.3	21.3	20.1	21.2	16.2	10.0
	Multiannual average	9.1	3.5	-1.7	-3.9	-2.2	2.8	9.5	15.4	18.8	20.4	19.5	15.0	8.9
	Deviation	2.2	-0.9	-0.3	0.1	3.1	4.0	0.2	-0.1	2.5	-0.3	1.7	1.2	1.1
Precipitations mm	Decade I	0.4	1.2	9.4	0.2	1.8	1.6	2.2	44.2	32.2	31.4	20.0	18.4	
	Decade II	0.0	29.8	3.0	0.2	14.8	0.6	22.8	27.0	0.4	6.0	0.4	1.0	
	Decade III	0.2	8.6	17.0	14.4	4.4	2.0	13.0	23.8	23.2	9.2	0.0	45.4	
	Monthly average	0.6	39.6	29.4	14.8	21.0	4.2	38.0	95.0	55.8	46.6	20.4	64.8	430.2
	Multiannual average	38.2	28.4	25.4	20.1	19.5	26.9	46.9	65.7	85.0	82.3	60.2	45.7	544.3
	Deviation	-37.6	11.2	4.0	-5.3	1.5	-22.7	-8.9	29.3	-29.2	-35.7	-39.8	19.1	114.1

RESULTS AND DISCUSSION

The *Carthamus tinctorius* L. species sowing in the first epoch the plants have sprung after 25 days from the sowing, accumulating a sum of the degrees of 316.1°C and 38.2 mm precipitations. From the emergence to the appearance of flowering rods, the sum of accumulated degrees was 521.2° C and 125.2 mm precipitations.

In the case of *Carthamus tinctorius* L. in 2019, from the appearance of the flowering rods until the beginning of blooming passed 23 days, the sum of the thermal degrees recorded for this period was 509.9° C and 25 mm precipitation.

Harvesting the seed was carried out 21 days after the beginning of fructification, accumulating 328.7° C and 27.8 mm of precipitation. Due to higher temperatures from the second epoch of sowing the plants had a faster evolution. From sowing to seed harvesting 128 days were required, the sum of the accumulated temperatures was 2250.7° C and the rainfall amounted to 234 mm.

Due to the high summer temperatures, the plants harvested for seeds from the epoch III of sowing had a vegetation period with 11 days less than the second epoch of sowing. The sum of thermal degrees was 2241.9º C and 230.7 mm precipitation (*table2*).

Table 2

Phenological observations at *Carthamus tinctorius* L. in 2019

Phenological observations	The date from which the phenophase began	Duration in days for seeds	Σ of thermal degrees (^{0}C)	Σ of precipitations (mm)
Epoch I				
Sowing	08.04.2019	-	-	-
Emergence	02.05.2019	25	316.1	38.2
The appearance of flowering rods	04.06.2019	33	521.2	125.2
The beginning of blooming	27.06.2019	23	509.9	25.0
The beginning of fructification	22.07.2019	29	488.5	38.2
Harvesting for seeds	07.08.2019	21	328.7	27.8
TOTAL	-	131	2164,4	254.4
Epoch II				
Sowing	18.04.2019	-	-	-
Emergence	06.05.2019	19	277.6	49.2
The appearance of flowering rods	04.06.2019	32	463.4	92.8
The beginning of blooming	22.06.2019	21	398.3	2.2
The beginning of fructification	17.07.2019	27	494.6	58.0
Harvesting for seeds	15.08.2019	29	616.8	32.0
TOTAL	-	128	2250.7	234.2
Epoch III				
Sowing	28.04.2019	-	-	-
Emergence	15.05.2019	18	279.0	65
The appearance of flowering rods	18.06.2019	28	664.7	75.4
The beginning of blooming	03.07.2019	19	329.6	53.9
The beginning of fructification	23.07.2019	24	376.9	15.6
Harvesting for seeds	20.08.2019	28	591.7	20.8
TOTAL	-	117	2241.9	230.7

The influence of the sowing epoch on the seed production in safflower was materialized by obtaining productions between 1075 kg/ha (the third epoch) and 1400 kg/ha (the first epoch). From a statistical point of view, compared to the control (average experience), the increase in production (156 kg/ha) statistically ensured was achieved in the variant from the first epoch, this being very significant positive. At the variant sown in the third epoch, was achieved a production difference negative very significant (169 kg/ha) compared to the control (*table 3*).

Table 3

The influence of the sowing epoch on the production of seeds at *Carthamus tinctorius* L. in 2019

Variant	Average production of seeds (kg/ha)			
	Kg/ha	%	Diff. (Kg/ha)	Significance
Epoch I	1400	112.54	156	***
Epoch II	1257	101.04	13	
Epoch III	1075	86.41	-169	ooo
Average	1244	100	Ct.	
	LSD 5%= 70.43 (kg/ha) LSD 1%= 95.95 (kg/ha) LSD 0.1%= 128.96 (kg/ha)			

Table 4

The influence of interaction from the distance between rows and the distance between plants per row on the average seed production (kg/ha) at *Carthamus tinctorius* L. (safflower) species at A.R.D.S. Secuieni in 2019

Distance between rows (A)	Distance between plants per row (B)	Production (kg/ha)	% compared to control	Diff.	Significance
a1-25 cm	b1- continuous row	608	50.50	-596	ooo
	b2-15 cm	679	28.48	-525	ooo
	b3-25 cm	762	18.02	-442	ooo
a2-50 cm	b1- continuous row	1094	16.38	-110	o
	b2-15 cm	1319	17.94	115	*
	b3-25 cm	1478	22.02	274	***
a3-70 cm	b1- continuous row	1591	29.10	387	***
	b2-15 cm	1615	39.04	411	***
	b3-25 cm	1688	54.73	484	***
Average		1204	100	Ct.	
LSD 5%= 92.1 kg/ha LSD 1%= 126.9 kg/ha LSD 0.1%= 174.7 kg/ha					

Regarding the seed yields, it can be observed that the highest production was obtained at the interaction the distance between rows of 70 cm x 25 cm between plants per row (1688 kg/ha), and the lowest at the interaction of 25 cm x continuous row (608 kg/ha). Very significant positive increases were achieved in the variant sown at 70 cm between rows and at all three distances between plants per row (from 387 kg/ha to 484 kg/ha) compared to the control (average experience) (*table 4*).

CONCLUSION

The climatic conditions of 2019 influenced the growth and development of the species *Carthamus tinctorius* L. and the seed production obtained. The highest seed production was obtained at the variant sown in the first decade of April (1400 kg/ha). Ensuring the nutrition space is very important for obtaining high productions for safflower.The highest seed production materialized at the variant sown at a distance of 70 cm between rows and 25 cm between plants per row.

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