PRODUCTION RESULTS OF SOME DIOIC HEMP GENOTYPES CULTIVATED IN THE PEDOCLIMATE CONDITIONS FROM ARDS LOVRIN, IN THE PERIOD 2017-2019

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Abstract. *Hemp has attracted much attention from the market and from researchers due to its multiple uses, therefore, improving the production of hemp fiber through research will help promote the promotion and competitiveness of hemp products. Like a plant with multiple uses, ubiquitous over history and the evolution of mankind, hemp (Cannabis sativa L.) is a source of: fiber, wood and seeds used in the world for a wide range of products. The desire for a diet rich in natural, organic products entails the use of hemp seeds in various foods. Due to their high nutritional value, hemp seeds are consumed as food or feed, but can be processed as oil, grit or hemp flour. The economic importance of hemp for the seed is highlighted by the content of oil (30-32%), protein (20-25%), carbohydrates (20-30%) and a significant intake of insoluble fiber (10-15%) and minerals. The paper presents the study of the crop behavior of four dioic hemp genotypes under the influence of pedoclimatic conditions within ARDS Lovrin, during 2017-2019. The cultivated hemp varieties were: Lovrin-110, Silvana, Armanca and line Lv-457/08. Production results to the four cultivars, registered in the first year of experience under the influence of climatic conditions of 2017, were: 370 kg / ha Lovrin-110 variety, 327 kg / ha Silvana variety, 355 kg / ha Armanca variety and 464 kg / ha at the Lv- line 457/08. In the second experimental year 2018, the production values are higher compared to the previous year, for all varieties, as follows: 634 kg / ha Lovrin-110, 525 kg / ha Silvana, 607 kg / ha Armanca and 549 kg / ha Lv-457/08. Analyzing the three experimental years, we notice that, in 2018, the highest productions were made in all four genotypes, obtaining productions that exceed the average seed production made in the experimental cycle. The climatic conditions were registered at Lovrin Meteorological Station, during 2017-2019.*

Key words: *seed production, dioic hemp varieties, pedoclimatic conditions.*

INTRODUCTION

In the middle of the 20th century, hemp was banned from cultivation by governments as an illegal drug crop. However, in recent years, governments and researchers became more interested in the cultivation of hemp, as one of the most important crops for green fiber, seed oil (rich in omega-3and omega-6 in the right ratio) and domestic drugs uses (DECORTE, 2010, LIU ET AL., 2017).

Hemp is also used successfully in various other sectors, such as: the food industry - a wide range of products are obtained (CALLAWAY, 2004).

Hemp has attracted much attention from the market and from researchers due to its multiple uses, therefore, improving the production of hemp fiber through research will help promote the promotion and competitiveness of hemp products (AUBIN ET AL., 2016, FAUX ET AL., 2013).

Like a plant with multiple uses, ubiquitous over history and the evolution of mankind, hemp (*Cannabis sativa* L.) is a source of: fiber, wood and seeds used in the world for a wide range of products.

The hemp is also used to obtain bioenergy (VOGL, 2004), in construction (INGRAO, 2015), in the pharmaceutical industry, a recent challenge for the treatment of serious diseases.

The desire for a diet rich in natural, organic products entails the use of hemp seeds in various foods. Due to their high nutritional value, hemp seeds are consumed as food or feed, but can be processed as oil, grit or hemp flour. The economic importance of hemp for the seed is highlighted by the content of oil (30-32%), protein (20-25%), carbohydrates (20-30%) and a significant intake of insoluble fiber (10-15%) and minerals.

Hemp oil is rich in unsaturated acids: oleic acid, linoleic acid, alpha-linolenic acid, but also in saturated acids, such as stearic, palmitic, eicosanoic acid, it is used in the manufacture of varnishes, paints, even in food, having a drought index of 140-170 (CEAPOIU, 1965).

In our country the production of hemp seed is quite low; 300-500 kg / ha although the potential of cultivated hemp varieties is 800-1200 kg / ha (TĂBARĂ, 1984).

From the researches carried out by M. Mihoc, in the period 2011-2013, we mention the production results obtained for the Silvana variety, in 2011, the highest production was 798 kg / ha seed, in 2012, 447 kg / ha was obtained, and in 2013, registering a harvest of 571 kg / ha (MIHOC ET AL., 2012, MIHOC, 2013).

Also, from the analysis of the three varieties of dioic hemp for seed, we specify that, for the variety Lovrin-110, the seed production was achieved 376 kg / ha, in 2014, and the lowest seed production 227.33 kg / ha, was obtained in 2015. In 2016, the highest seed production was achieved 603.67 kg / ha. The Silvana variety registered in 2014, the seed production 300kg / ha, and in 2015 the lowest production of only 206.67 kg / ha seed was achieved. In 2016, the largest seed production of 787 kg / ha was achieved. The Armanca variety, two consecutive years 2014-2015, achieved small productions of 264.33-274 kg / ha seed, and in 2016 it registered the highest production of 934.33 kg / ha seed (PANDA ET AL., 2017).

Also, the chemical composition of the hemp seeds obtained depends on several factors technological , climatic, and genetic (ASCRIZZI, 2019; BERTOLI, 2010).

From the specialized literature it appears that the obtained seed productions oscillate from one year to another, so we can conclude that the influence of the climatic conditions from the year of cultivation on the production is very much maintained.

The distribution of precipitation over the vegetation period is a factor that contributes to the formation of production elements. Hemp has higher moisture requirements when the plants reach the budding-flowering phase. During this period, hemp consumes 2/3 of the amount of water needed throughout the growing season. For the hemp crops, the rains that fall in July-August are extremely favorable.

From the point of view of precipitation, hemp meets the best cultivation conditions in areas where during the vegetation period 350-450 mm fall (TABĂRĂ, 2005).

MATERIAL AND METHOD

The study took place in 2017-2019 in the experimental field of the dioecious hemp breeding laboratory at ARDS Lovrin. The soil on which the experimental field was located is a typical chernozem, with a medium clay structure, specific to the area of influence of the resort. The climate is temperate, with an annual average rainfall of around 520 mm and a multiannual average temperature of 10.70C.

A multifactorial experiment was set up, with the following factors: factor A - agricultural year (2017, 2018, 2019), factor B - variety (Lovrin 110, Silvana, Armanca and line Lv 457/08) and factor C - sowing density (7 plants / m^2, 37 plants / m^2 and 150 plants / m^2).

Of all the productivity elements studied, those presented in this paper are the size of the plant and the length of the inflorescence of hemp plants.

The statistical interpretation of the obtained data was performed according to the variance analysis model.

RESULTS AND DISCUSSIONS

Table 1 shows the rainfall regime recorded at Lovrin Meteorological Station in the agricultural year 2016-2017, which indicates an annual deficit of 70.8 mm compared to the multiannual average of the area, classifying the agricultural year in the category of dry years. Starting with November 2016, all the other months until the end of the agricultural year registered a deficit of precipitation, with the largest deviations in December (-37.7 mm) and in the summer months.

Table 1

The main climatic elements between September 1, 2016 - August 31, 2017

Climate elements		Sept. 2016	Oct. 2016	Nov. 2016	Dec. 2016	Jan. 2017	Feb. 2017	March 2017	April 2017	May 2017	June 2017	July 2017	August 2017	Average or total
Rainfall (mm)	Monthly amount	48	112	37	3	20	25	30	54	29	40	30	22.5	450.5
	Multiannual monthly average	42.6	39.5	48.4	40.7	32.2	29.5	32.8	42.7	56.8	67.8	55.8	32.5	521.3
	Deviation	5.4	72.5	-11.4	-37.7	-12.2	-4.5	-7.2	11.3	-27.8	-27.8	-25.8	-10.0	-70.8
Temperature (t^0C)	Monthly average	18.9	10.1	5.5	-0.3	-5.3	3.2	9.4	10.9	16.9	22.1	28.9	24.1	12.0
	Multiannual monthly average	16.8	11.1	5.5	1.1	-1.2	0.8	5.2	10.7	16.3	19.8	22.2	21.7	10.8
	Deviation	2.1	1.0	0	-1.4	-4.1	2.4	4.2	0.2	0.3	2.3	6.7	2.4	+1.2

Regarding the average monthly temperature, January is noted with a negative deviation of 4.10C and February and March with positive deviations of 2.4 ^0C and 4.2 ^0C respectively. The annual average registers a positive deviation of 1.2 ^0C compared to the multiannual average.

The agricultural year 2017-2018 presented in Table 2, was a surplus year in precipitation, with a positive deviation from the normal area of 176.7 mm. The deficit registered between September and December was offset by the precipitation that fell starting with January. Hemp, sown at the end of April had a favorable start, given the optimal soil moisture and high temperatures, favorable for germination, emergence, growth and development of plants. The excess of precipitation in the summer months caused significant losses of production, by shaking, due to the delay of the harvest.

Table 2

The main climatic elements between September 1, 2017 - August 31, 2018

Climate elements		Sept. 2017	Oct. 2017	Nov. 2017	Dec. 2017	Jan. 2018	Feb. 2018	March 2018	April 2018	May 2018	June 2018	July 2018	August 2018	Average or total
Rainfall (mm)	Monthly amount	34.0	32.0	34.0	16.0	53.0	58.0	86.0	40.0	50.0	152	85	58	698.0
	Multiannual monthly average	42.6	40.5	48.0	39.7	32.3	29.8	32.6	42.9	56.8	67.8	55.8	32.5	521.3
	Deviation	-8.6	-10.5	-13.0	-23.7	20.7	28.2	53.4	-2.9	-6.8	84.2	29.2	25.5	176.7
Temperature (t^0C)	Monthly average	17.7	12.5	6.5	2.9	5.3	0.8	3.6	16.5	19.9	21.9	22.3	24.7	12.8
	Multiannual monthly average	16.8	11.1	5.5	1.1	-1.1	0.8	5.2	10.7	16.3	19.8	22.2	21.7	10.8
	Deviation	0.9	1.4	1.0	1.8	6.4	0.0	-1.6	5.8	3.6	2.1	0.1	3.0	+2

In terms of temperatures, the months of January, April and May are particularly noticeable, with record deviations from the multiannual monthly averages. Thus, January registers a positive deviation of 6.4 ^0C, while April and May - 5.8 ^0C and 3.6 ^0C. The monthly average annual temperature was 12.8 ^0C, + 2 ^0C higher than the normal area.

Table 3 shows that the agricultural year 2018-2019 is in line with the trend of the last 10 years, very dry in the spring and autumn months. Regarding the rainfall regime, the year was characterized as an optimal year, as a whole, with an annual total rainfall of 476 mm, with a negative deviation from the multiannual average of only 44.6 mm. However, the monthly and decadal rainfall distribution has created major problems for crops and hemp. Against the background of the accentuated lack of precipitations in the autumn and winter months, the spring registered a number of 48 days without precipitation, with direct consequences on uniformity at emergence of culture, its growth and further development.

Table 3

The main climatic elements between September 1, 2018 - August 31, 2019

Climate elements		Sept. 2018	Oct. 2018	Nov. 2018	Dec. 2018	Jan. 2019	Feb. 2019	March 2019	April 2019	May 2019	June 2019	July 2019	August 2019	Average or total
Rainfall (mm)	Monthly amount	29	10	21	41	58	15	15	34	92	88	55	18	476
	Multiannual monthly average	42.4	40.1	47.6	39.7	32.7	29.6	32.3	42.7	57.3	68.1	55.8	32.3	520.6
	Deviation	-13,4	-30.1	-26.6	+ 0.3	+ 25.3	-14.6	-17.3	-8.7	+34.7	+19.9	-0.8	-14.3	-44.6
Temperature (t^0C)	Monthly average	18.3	15.1	7.8	1.0	-0.4	4.6	9	13.4	15.1	22.3	21.6	23.9	12.6
	Multiannual monthly average	16.8	11.1	5.5	1.1	-1.1	0.8	5.3	10.7	16.3	19.8	22.2	21.7	10.9
	Deviation	+1.5	+4.0	+2.3	-0.1	+0.7	+3.8	+3.7	+2.7	-1.2	+2.5	-0.6	+2.2	+1.7

Also, the temperatures well above the normal of the area and period, accentuated the drought phenomenon, the annual average exceeding the multiannual average by 1.7 ^{0}C.

The experiences located at S.C.D.A. Lovrin, in the climatic conditions of 2017, presented in table 4, pointed out that two varieties, Silvana and Armanca register a slight decrease in production (a difference of 15 and 43 kg / ha), and the line Lv-457 / 08, exceeded the production of the control variety by 95 kg / ha, the production differences being statistically insignificant.

Table 4

The seed yield from Lovrin-110, Silvana, Armanca and Lv-457/08 in 2017

No.	The hemp variety	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance
1	LOVRIN - 110	370	100	-	-
2	SILVANA	327	89	-43	ns
3	ARMANCA	355	96	-15	ns
4	LV-457/08	464	12	95	ns

DL 5%- 176 kg/ha; DL 1% - 267 kg/ha; DL 0,1% - 429 kg/ha

The climatic factors in 2017 favorably influenced the seed production of all varieties, the Lv-457/08 line reacting with a higher production increase, respectively 464 kg / ha compared to the average production of 379 kg / ha, of the experimental years.

The analysis of the average seed productions made in hemp taken in the study from table 5, highlights the fact that they are between 525-634 kg / ha, the highest production achieved the variety Lv 110, and the Silvana variety recorded the lowest production obtained .

Table 5

The seed yield from Lovrin-110, Silvana, Armanca and Lv-457/08 in 2018

No.	The hemp variety	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance
1	LOVRIN - 110	634	100	-	-
2	SILVANA	525	83	-110	ns
3	ARMANCA	607	96	-27	ns
4	LV-457/08	549	87	-85	ns

DL 5%- 270 kg/ha; DL 1% - 409 kg/ha; DL 0,1% - 658 kg/ha

The average production of 2018 was 579 kg / ha, two varieties of hemp achieved a higher amount of seed exceeding the average of the year, respectively the Armanca variety with 607 kg / ha and the Lovrin-110 variety with 643 kg / ha, and the others two cultivars being with the values obtained below the average of the year.

The data presented in Table 6 indicate that, in terms of seed production in the four genotypes, close values were recorded, the harvest results do not differ in terms of statistical significance.

Table 6

The seed yield from Lovrin-110, Silvana, Armanca and Lv-457/08 in 2019

No.	The hemp variety	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance
1	LOVRIN - 110	163	100	-	-
2	SILVANA	156	96	-7	ns
3	ARMANCA	155	95	-8	ns
4	LV-457/08	153	94	-10	ns

DL 5%- 17 kg/ha; DL 1% - 26 kg/ha; DL 0,1% - 41 kg/ha

The interaction of climatic factors led to obtaining seed production with values close to the average production of 157 kg / ha recorded in 2019.

Table 7

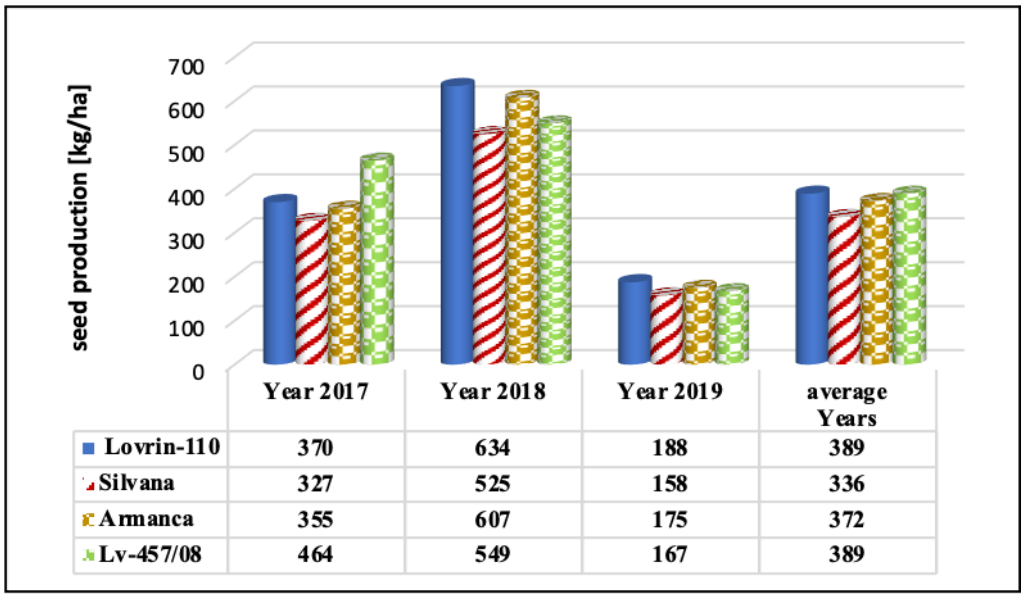
The seed yield from Lovrin-110, Silvana, Armanca and Lv-457/08 - average years

No.	The hemp variety	Average yield (kg/ha)	Relative yield (%)	Difference (kg/ha)	Significance
1	LOVRIN - 110	389	100	-	-
2	SILVANA	336	86	-53	ns
3	ARMANCA	372	96	-17	ns
4	LV-457/08	389	100	0	ns

DL 5%- 53 kg/ha; DL 1% - 81 kg/ha; DL 0,1% - 130 kg/ha

The average seed production obtained from the experiences carried out in 2017-2019 is in the range 336-389 kg / ha.

The average of seed productions from 2019 have suffered significant decreases compared to the production from 2018 and 2017, because the year 2019 is very dry in the spring and autumn months. Regarding the rainfall regime, the spring recorded a number of 48 days without precipitation, with direct consequences on the uniformity at sunrise of the culture, its growth and subsequent development.



	Year 2017	Year 2018	Year 2019	average Years
Lovrin-110	370	634	188	389
Silvana	327	525	158	336
Armanca	355	607	175	372
Lv-457/08	464	549	167	389

Figure 1. The average of dioic seed yields obtained in 2017, 2018, 2019 and the mean of the three years of study

The distribution of precipitation at monthly and decadal level created major problems for the hemp crop for seed and against the background of the accentuated lack of precipitation in the autumn and winter months, registering a negative deviation from the multiannual average of 44.6 mm.

The comparative analysis of the average seed productions, from the agricultural years 2017 and 2018 showed that the dioic hemp varieties for seed, are adapted to the pedoclimatic conditions from Lovrin, show a very significant increase in production in 2018 compared to the average of the three years. experimental.

The dioic hemp variety Lovrin-110 and the line Lv -457/08, led to the highest amount of seed 389 kg / ha in the conditions of the experience carried out at ARDS Lovrin, being equal in terms of average production over three years experimental, followed by the Armanca variety with a production of 372 kg / ha and the Silvana variety with 336 kg / ha.

From the analysis of the data presented in figure 6, we notice the fact that, in 2018, the highest seed production was achieved for all four cultivated varieties, and in 2019, the lowest average seed production for hemp was registered.

The values recorded in 2019 are much lower compared to the average productions obtained in the experimental cycle 2017-2019.

The climatic conditions of 2019 negatively influenced the growth and development of plants, causing the decrease of seed production.

CONCLUSIONS

The results regarding the seed production for the four genotypes of dioic hemp, obtained at RADS Lovrin in the period 2017-2019, allow us to draw some conclusions:

The seed productions obtained in 2019 are lower than in the productions made in the first two years: 163 kg / ha Lovrin-110, 156 kg / ha Silvana, 155 kg / ha Armanca and 153 kg / ha Lv-457/08.

In 2017, the highest seed production was obtained at the Lv-457/08 line, and in the next two years 2018-2019 the variety with the highest seed production was Lovrin-110. In the experimental cycle 2017-2019, the variety that recorded the lowest seed production is the Silvana variety.

From a climatic point of view, the experimental years were very different from each other.

Seed production of specific dioic hemp varieties is strongly influenced by the environmental conditions of the growing year.

The climatic conditions of the 2018 crop year ensured statistically assured production increases, and the climatic conditions of 2019 determined the decrease of production in all four genotypes studied.

Unfavorable environmental conditions of the crop year block the expression of the production potential of the varieties, leveling the yields.

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