

RESEARCHES REGARDING THE INFLUENCE OF DISTANCE BETWEEN ROWS ON THE STEM AND FIBER YIELDS AT SOME MONOECIOUS HEMP VARIETIES UNDER THE CENTER OF MOLDOVIA PEDOCLIMATIC CONDITIONS

Alexandra LEONTE¹, Simona-Florina ISTICIOAIA¹, Alexandra-Andreea BUBURUZ¹, Adina Cătălina DRUȚU²

e-mail: andra29nt@yahoo.com

Abstract

Hemp is part of the textile plants group with high-value for human and industrial use. Hemp has over 25,000 uses, ranging from food, paints and fuels to clothing and building materials.

Hemp is currently considered to be a plant of increasing importance for Europe, being used for fiber and oil extraction and as medicinal plant. Hemp fibers are the most resistant plant fibers and as such, in the past, they were the most prized raw material of the textile industry worldwide. In this paper we present the results regarding the evolution of monoecious hemp crop on the production of stems and fiber, under the pedoclimatic conditions of the Center of Moldova, between 2012 – 2015. The biological material used was represented by three varieties created at A.R.D.S. Secuieni, respectively, Denise, Diana and Dacia and were sown at a distance of 12.5 cm, 25 cm respectively 50 cm between rows. The obtained results revealed that the studied factors influenced to a great extent the production of stems, which varied widely, ranging from 8113 kg / ha to the Denise variety at a distance of 12.5 cm in 2015 (agricultural year characterized as very dry from pluviometric point of view), and the highest yields were obtained at the Denise variety of 15683 kg / ha, at a distance of 25 cm in 2013 (agricultural year characterized as normal from rainfall point of view). On average, for the four years studied, the highest obtained production of fiber was achieved by Dacia variety, at 12.5 cm, of 3388 kg / ha, and the lowest yield of 2546 kg / ha was achieved by Denise variety at a distance of 50 cm between rows.

Key words: monoecious hemp, yield, distances, stems, fiber.

Hemp is a multipurpose crop with a specificity in the textile industry, with the ramifications of its use expanding in the technical, cosmetic, medical and even food industry (Callaway, 2004).

Hemp is considered to be a plant of increasing importance for Europe (Ranalli, 2004) being used for extracting fibers, oil and as medicinal plant (Șandru I. *et al*, 1996). Hemp fibers are the most resistant vegetable fibers, and as such they used to be the world's most prized raw material in the past (Forgo, 1957).

The technological properties of the fibers as strength (traction, torsion, friction, rotting), extensibility (elastic and plastic), spinning capacity and long length (Șandru, 1996) determine the use in very varied fields such as the manufacture of quality paper, braids and fabrics, fine fabrics, molded plastic products (Small and Marcus, 2002), fiber - reinforced cement (Zhijian *et al*, 2004), thermal insulation.

In recent years, the hemp processing industry has grown a lot, especially in the textile field. However, actual cultivation and processing of hemp is still mainly carried out in China and Eastern Europe (Gibson, 2006).

This paper presents results regarding the influence of the distance between rows on stem and fiber production in some varieties of hemp.

MATERIAL AND METHOD

At A.R.D.S. Secuieni, during 2012 – 2015, a bifactorial experience of the type A x B was established, located in the experimental field according to the subdivision parcel method, in three rehearsals. The A factor was represented by the variety used with three graduations (a_1 - Denise, a_2 - Diana, a_3 - Dacia), and the B factor by the distance between rows with three graduations (b_1 - 12.5 cm, b_2 - 25 cm and b_3 - 50 cm).

The experience was placed on a typical Cambic faeosis soil type with a pH in water of 7.05,

¹ Agricultural Research – Development Station Secuieni

² Agreco RF

humus content of 2.12% and characterized as well supplied in phosphorus (162.4 ppm) and mobile potassium (638.6 ppm) and medium supplied in nitrogen (12.0 ppm).

From the temperature point of view, the hemp vegetation period (from sowing to physiological maturity), there were deviations from the multiannual average of 0.4° C (2014) and 2.3°C (2012). Compared with the multiannual average, the vegetation period was characterized under the temperatures aspect as very warm in 2012, warm in 2015 and normal in 2013 and 2014 (figure 1).

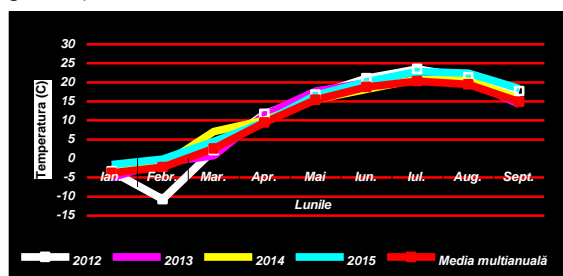


Figure 1 Temperatures recorded at A.R.D.S. Secuieni meteorological station

From the pluviometric point of view, the hemp vegetation period was characterized as a drought (2012), normal (2013, 2014) and very drought (2015). During this period, recorded deviations ranged from -233.3 mm (2015) to 9.9 mm (2013) (figure 2).

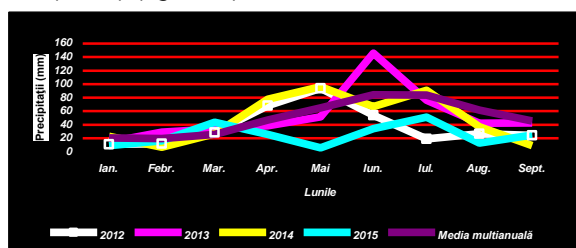


Figure 2 Rainfall recorded at A.R.D.S. Secuieni meteorological station

Sampling was done manually and the harvested area was of 10 m². The experimental production data were processed by statistical and mathematical methods specific to the polyfactorial experiences, and the interpretation of the results was carried out by analysis of the variants (Ceapoiu, 1968).

RESULTS AND DISCUSSIONS

The experimental results obtained in monoecious hemp during the analyzed period indicate a significant difference in stem production depending on cultivated variety and climatic conditions.

In the first year of experimentation, the yields ranged from 10277 kg/ha (Denise x 12.5 cm) and up to 12370 kg/ha (Dacia x 25 cm). Compared to the control variant (Denise x 12.5

cm), two variants produced very significant production increases, respectively Dacia variety sown at 25 cm (12370 kg/ha) and 50 cm (12335 kg/ha) between rows, and at two, distinct significant production increases: Denise x 25 cm (11597 kg/ha) and Diana x 50 cm (11647 kg/ha).

In the second year of experimentation, superior yields were obtained in variants sown with the Denise variety (15683 kg/ha), at a distance of 25 cm between the rows and Dacia variety (15680 kg/ha), sown at a distance of 50 cm between rows, these being statistically assured and interpreted as significant compared to the control variant (Denise x 12.5 cm).

In 2014, the minimum yield level (10360 kg/ha) was recorded in the variant characteristic of the interaction between Denise x 50 cm between the rows, and the maximum (14783 kg/ha), in the variant sown with Dacia variety, at the distance between rows of 12.5 cm. Statistically assured production increases and interpreted as very significant were obtained at Dacia x 12.5 cm interaction, and distinctly significant in Dacia x 25 cm respectively 50 cm between rows (table 1).

In the last year of experimentation (2015), the yields ranged from 8113 kg/ha (Denise x 12.5 cm) to 10027 kg/ha (Dacia x 12.5 cm), this being statistically assured and interpreted as very significant. Significant production increases were achieved in all three hemp varieties Denise, Diana and Dacia, sown at 25 or 50 cm between the rows.

On average, during the four years of experimentation, the studied factors influenced the production of hemp strains which ranged from 10988 kg/ha, at Denise x 12.5 cm control variety and 12660 kg/ha at Dacia x 12.5 cm interaction. From the studied variants, three have achieved distinctly significant production increases in Dacia x 12.5, 25 and 50 cm between rows interactions, and one achieving a significant production increase at Diana x 50 cm between rows interaction (table 1).

In each of the four years of experimentation, the interaction between the Dacia x 12.5, 25 respectively 50 cm distance between the rows was marked by fiber production superior to all variants.

The yield variation in this variant was high, from 2372 kg/ha (2015) to 4155 kg/ha (2013). The least productive variants were those characteristic to the interaction between Denise x 25 cm (2014) and Denise x 50 cm (2013, 2014) (table 2).

Regarding the correlation between the distance between rows and the production of strains obtained, it was observed that it was direct in 2015 and the correlation coefficient (r) interpreted as distinctly significant (figure 1).

The correlation between line spacing and fiber production was indirect, correlation coefficients (r) were statistically assured and

interpreted as very significant in the years 2013 and 2014 (figure 2).

Table 1

Influence of the interaction between the variety x sowing distance on stems production at monoecious hemp, during 2012 - 2015

Variety	Distance between rows (cm)	Stems production kg/ha 2012	Stems production kg/ha 2013	Stems production kg/ha 2014	Stems production kg/ha 2015	Media 2012 - 2015
Denise	12.5	10277 Mt.	14550 Mt.	11013 Mt.	8113 Mt.	10988 Mt.
	25	11597 **	15683 *	10607	9207 **	11773
	50	10490	13610 °	10360	9187 **	10912
Diana	12.5	10060	13950	10960	8447	10854
	25	11237 *	14213	10934	9320 **	11426
	50	11647 **	14950	11273	9583 **	11863 *
Dacia	12.5	11532 *	14300	14783 ***	10027 ***	12660 **
	25	12370 ***	15110	12860 **	9330 **	12417 **
	50	12335 ***	15680 *	12893 **	9330 **	12560 **
DI A x B	5%	867	784	952	601	801
	1%	1283	1174	1391	907	1189
	0.1%	2011	1880	2131	1473	1874

Table 2

Influence of the interaction between the variety x sowing distance on fiber production at monoecious hemp, during 2012 - 2015

Variety	Distance between rows (cm)	Fiber production kg/ha 2012	Fiber production kg/ha 2013	Fiber production kg/ha 2014	Fiber production kg/ha 2015	Media 2012 - 2015
Denise	12.5	2727 Mt.	3692 Mt.	2829 Mt.	1877 Mt.	2781 Mt.
	25	2783	3492	2480 °	2288 *	2761
	50	2486	3203 °	2398 °	2098	2546
Diana	12.5	2711	3603	2950	2055	2829
	25	2888	3368	2913	2302 **	2868
	50	3110	3391	2903	2448 **	2963
Dacia	12.5	3155 *	3913	4014 ***	2471 **	3388 **
	25	3378 **	4155 *	3605 ***	2376 **	3378 **
	50	3228 *	4124 *	3307 *	2372 **	3258 **
DI A x B	5%	403	337	330	277	337
	1%	614	490	485	413	501
	0.1%	1012	743	749	658	791

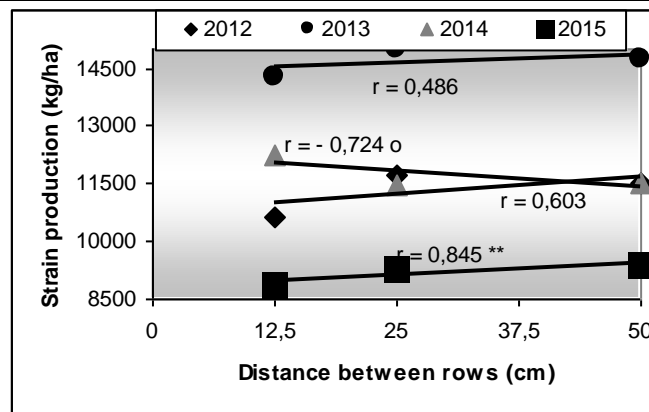


Figura 3 The correlation between the distance between rows and stems production at monoecious hemp

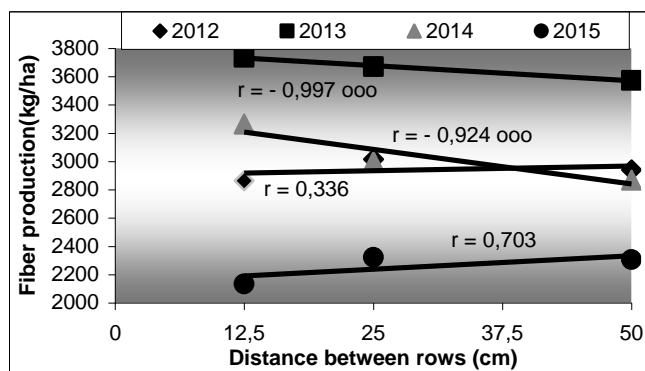


Figura 4 The correlation between the distance between rows and fiber production at monoecious hemp

CONCLUSIONS

The production of hemp stems was influenced by the climatic conditions, tested varieties and the distance between the rows;

In the experimental period 2012-2015, the highest yields were recorded in the Dacia x 12.5, 25 and 50 cm between rows interactions (12660 kg/ha, 124717 kg/ha and 12560 kg/ha), production increases being distinctly significant compared to the control variant (Denise x 12.5 cm).

In terms of fiber production, over the four years of experimentation, distinct significant production increases were obtained at Dacia x 12.5, 25 respectively 50 cm distance between rows interaction.

REFERENCES

- Ceapoiu N., 1968. *Statistical methods applied in agricultural and biological experiments*, Edit. Agro - Silvică, București
- Callaway J.C., 2004. *Hempseed as a nutritional resource: An overview*. Euphytica, 140:65-72
- Forgo F., 1957. *Hemp and flax, Culture and preliminary processing*. editura Agro-Silvică de stat, București
- Gibson K., 2006. *From invisible to multi-coloured: A recent history of the hempen apparel industry*, Journal of Industrial Hemp, vol.11, nr. 1, p. 35-41
- Ranalli P., 2004. *Current status and future scenarios of hemp breeding*. Euphytica, nr. 140, p. 121-131
- Small E. and Marcus D., 2002. *Hemp: A new crop with new uses for North America*. Trends in new crops and new uses, editura ASHS Press, p. 284-326
- Șandru I., Paraschivoiu, Rodica, Găucă, C., 1996. *Hemp crop*. Editura Helicon, Timișoara
- Zhijian L., Lijing W., Xungal W., 2004. *Compressive and Flexural Properties of Hemp Fiber Reinforced Concrete*. Fibers and Polymers, vol. 5, nr. 3, pg. 187-197.