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RESEARCH ON THE EFFECT OF APPLYNG THE SECUIENI METHOD TO THREE VARIETIES OF MONOECIOUS HEMP, IN TERMS OF PRODUCTION (SEED, STEMS, FIBER), IN THE PEDOCLIMATIC CONDITIONS OF A.R.D.S. SECUIENI

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Abstract

In this paper we present the results regarding the evolution of monoecious hemp crop on the yield of seeds, stems and fiber, by fallowing the Secuieni Method under the pedoclimatic conditions in the Agricultural Research and Development Station Secuieni Neamț (A.R.D.S. Secuieni, Neamț). The experience takes place in the experimental field of the unit, and it is a multifactorial experience, of the type 3 x 2 x 3, in three repetitions: A factor - variety (Denise, Diana, Dacia), B factor - distance between rows (25 cm; 50 cm), C factor - „Secuieni metho" (uncut, one cut, two cuts). On average, during the three years of experimentation, the above factors greatly influenced the seed yield obtained, which varied widely, from 806 kg • ha^{-1} (Denise x 50 cm x uncut) to 1117 kg • ha^{-1} (Dacia x 50 cm x two cuttings). Regarding the yield of stems, this also varied quite a lot, from 9219 kg • ha^{-1} (Denise x 50 cm x two cuttings) up to 12634 kg • ha^{-1} (Dacia x 50 cm x uncut).

Key words*: yield, method, monoecious hemp, variety.*

INTRODUCTION

Industrial hemp disappeared almost completely after World War II and, despite a ban by the United Nations, Canada, China and the European Union are cultivating it again. In 2018, industrial hemp recorded record cultivation figures in Europe (48605 ha), Canada and China, registering a total of 150000 ha (EIHA Conference, 2020). Incidentally, cultivation has also begun in the US (EIHA Conference, 2019).

Hemp is considered a plant of increasing importance for Europe (Ranalli, 2004) and is used for the extraction of fiber, oil and as a medicinal herb (Sandru et al., 1996).

The hemp fiber is the most resistant vegetable fiber and as such, in the past, was the most valuable raw material of the textile industry worldwide (Forgo, 1957).

Hemp is an extraordinary crop, with enormous social and economic value, since it can be used to produce food, textiles, clothing, biodegradable plastics, paper, paint, biofuel, and animal feed, as well as lighting oil. Various parts of the hemp plant represent a valuable source of food and ingredients for nutritional supplements (Pellegrino et al., 2021).

Industrial hemp (*Cannabis sativa* L.), is one of the most important traditional natural fiber crops, had almost been forgotten for the last several decades. Nowadays, industrial hemp has many agro-industrial applications, such as agriculture, textile, papermaking, construction, bio-fuel (Xinlin et al., 2021).

The technological properties of fibers in terms of strength (tensile, torsional, friction, rot), extensibility (elastic and plastic), spinning capacity and high length (Sandru, 1996) determine its use in a wide range of areas such as the manufacture of quality paper, braids and fabrics, fine fabrics, plastic castings (Small and Marcus, 2002), fiber-reinforced cement (Zhijian et al., 2004), thermal insulation.

Small in 2015 says that *Cannabis sativa* has been employed for thousands of years, primarily as a source of a stem fiber (both the plant and the fiber termed "hemp") and a resinous intoxicant (the plant and its drug preparations commonly termed "marijuana").

Struik et al. (2000), shows that the fiber hemp may yield up to 25 t above ground dry matter per

hectare (20 t stem dry matter ha^{-1}) which may contain as much as 12 t ha^{-1} cellulose, depending on environmental conditions and agronomy. Its performance is affected by the onset of flowering and seed development.

Cannabinoids represent the most studied group of compounds, mainly due to their wide range of pharmaceutical effects in humans, including psychotropic activities. The therapeutic and commercial interests of some terpenes and phenolic compounds, and, in particular, stilbenoids and lignans, are also highlighted in view of the most recent literature data (Andre et al., 2016).

Kasula et al. (2021) said that the nutrient composition of hemp products provides evidence that these potentially serve as valuable livestock feed ingredients and may enhance human health.

Hemp products available on the market may be used in meat processing as valuable sources of nutrients such as n3 fatty acids, proteins and minerals. They could be used to create functional meat products. The aim of this work was to compare the quality of pork loaves produced with the addition of hemp seeds (5%), de-hulled hemp seeds (5%), hemp flour (5%), and hemp protein (5%). The technological value and the consumers' acceptance were also evaluated (Zajac et al., 2019).

Cannabidiol (CBD) oil are low tetrahydrocannabinol product derived from *Cannabis sativa* that have become very popular over the past few years. Patients report relief for a variety of conditions, particularly pain, without the intoxicating adverse effects of medical marijuana (Harrison et al., 2019).

During the last decade, the popularity of hemp products has been rising rapidly. Products containing cannabidiol (CBD) are of predominant interest. Traditional hemp products are frequently enriched by CBD due to their potential therapeutic effects. Cannabidiol occurs naturally in hemp juice together with other biologically active substances, such as terpenes, flavonoids, and stilbenoids (Tremlova et al., 2021).

The byproducts of industrial hemp (*Cannabis sativa* L.), including inflorescences, represent an exploitable material to produce niche products for the pharmaceutical, nutraceutical, cosmetic and pesticide industry (Fiorini et al., 2019).

Alexa et al. (2012) are aiming with a study to determine the nutritional value of hemp seeds expressed by oil content and metal concentration (Ca, Mg, K, Fe, Mn, Zn and Cd), for five approved Romanian monoecious and dioecious hemp.

Currently, the cultivation of hemp varieties with multifunctional capacity, both for seed production and for obtaining stems and fiber, has opened new challenges in many research sectors such as breeding (Baldini et al., 2018).

MATERIALS AND METHODS

During 2018-2021 period, a multifactorial experiment was set up at Agricultural Research and Development Station Secuieni (A.R.D.S. Secuieni), the purpose of which was to establish the yields capacity of stems, fiber and monoecious hemp seeds, by applying the "Secuieni method" at different distances between rows. The experiment was of the type 3 x 2 x 3, in three repetitions, where A Factor - varieties - a1 - Denise, a2 - Diana, a3 - Dacia, B Factor - distances between rows - b1 - 25 cm and b2 - 50 cm, and C Factor - "Secuieni method" - c1 - uncut, c2 - one cut, c3 - two cuts (Figure 1).

Figure 1. Applied Secuieni method and shoot formation (source: original photo)

The Secuieni method was applied when the plants go into the phase of intense growth and have 5-6 floors with opposite leaves. (Figure. 1). Following the pruning applied from the insertion of the leaves, 2-6 lateral shoots develop, which

remain in culture in this form, but the height of the plants will not exceed 3 m. After the first pruning, when the shoots have developed enough, the second pruning above the first cut, at 15-20 cm (Găucă et al., 1990).

The experience was placed on a typical cambic faeoziom (chernozem) soil, with medium texture, characterized as being well supplied with phosphorus (P_2O_5 - 39 ppm) and mobile potassium (K_2O - 161 ppm), moderately supplied with nitrogen, the soil nitrogen index being 2.1, weakly acidic, with pH values (in aqueous suspension) of 6.29 and poorly fertile, with a humus content of 2.3% (Leonte et al., 2021).

The experiment was done on subdivided plots, and the applied technology was the one specific to the conditions in the Center of Moldavia. The content of hemp fiber extracted from the stem was determined in the laboratory, and specific biometric measurements were made during the vegetation period. The experimental production data were processed by statistical-mathematical methods specific to the multifactorial experiments, and the interpretation of the results was performed by analyzing the variations (Ceapoiu, 1968; Jităreanu, 1999).

RESULTS AND DISCUSSIONS

During the vegetation period, a series of observations were made about the number of branches on the plant following the application of the "Secuieni method" and how the length and diameter of the stem was influenced.

Of the three varieties studied, the largest size of 2.9 m, with a diameter of 10.7 mm was recorded at the interaction of the Dacia variety x 25 cm x uncut, but by applying two cuttings its size was reduced to 2.0 m, with a stem diameter of 4.3 mm (Table 1).

By applying the "Secuieni method", the plants developed branches, which varied within fairly large limits, from 1.5 branches/plant (Diana x 25 cm x two cuttings) and up to 3.3 branches/ plant (Denise x 25 cm x two cuttings) (Table 1).

Correlating the plant height with the stem diameter (average), it is observed that it is a direct link, the correlation coefficients (r) were statistically assured and interpreted as very significant (Figure 2).

The yield of the stems varies quite a bit from one year to the next, so the lowest yield of 7537 kg·ha^{-1} was obtained in 2021, at the interaction of the Denise variety x 25 cm x two cuttings, and the highest yield was obtained in 2019, of 15680 kg·ha^{-1}, at the Dacia x 50 cm x uncut interaction.

Table 1. Biometric measurements on monoecious hemp culture after applying the "Secuieni method", (*Cannabis sativa* L.), year average

Variety	Row distance (cm)	Applied work	Ramif. /plant	Height (m)	Stem Diam. (mm)
1	2	3	6	7	8
Denise	25	NR	-	2.7	10.7
		R1	1.8	2.1	6.2
		R2	3.3	1.8	4.5
	50	NR	-	2.7	10.1
		R1	1.6	2.2	6.9
		R2	3.0	1.7	4.1
Diana	25	NR	-	2.6	8.5
		R1	1.5	2.2	5.6
		R2	3.0	1.8	3.8
	50	NR	-	2.7	8.4
		R1	1.6	2.4	6.1
		R2	2.5	2.0	4.2
Dacia	25	NR	-	2.9	7.4
		R1	1.5	2.6	6.1
		R2	2.7	2.0	4.3
	50	NR	-	2.9	8.6
		R1	1.7	2.6	6.5
		R2	2.4	2.1	4.8

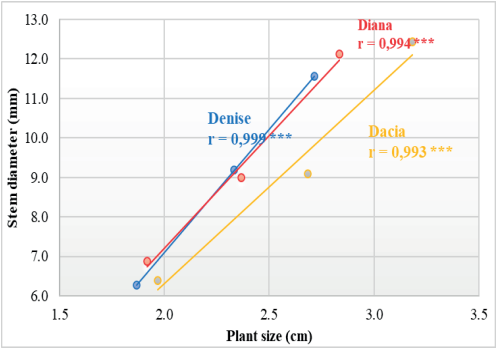
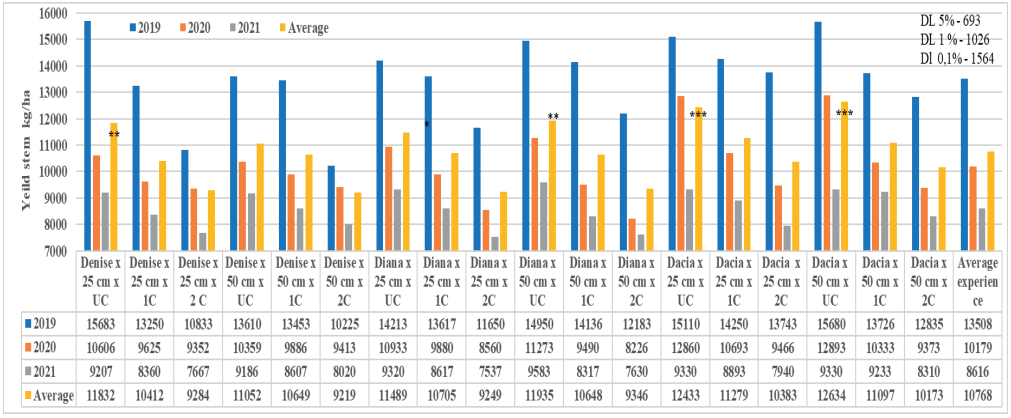


Figure 2. Correlation between plant size and stem diameter

On average, over the three years studied, the studied factors highly influenced the yield of strains obtained, which ranged from 9219 kg·ha^{-1} to the Denise interaction x 50 cm x two cuttings, up to 12634 kg·ha^{-1} (Dacia x 50 cm x uncut). Yield increases were also obtained in five interactions, two being very significant (Dacia x 25, respectively 50 cm x uncut), two being distinctly significant (Denise x 25 cm x uncut, Diana x 50 cm x uncut) and one significant (Diana x 25 cm x uncut) (Figure 3).

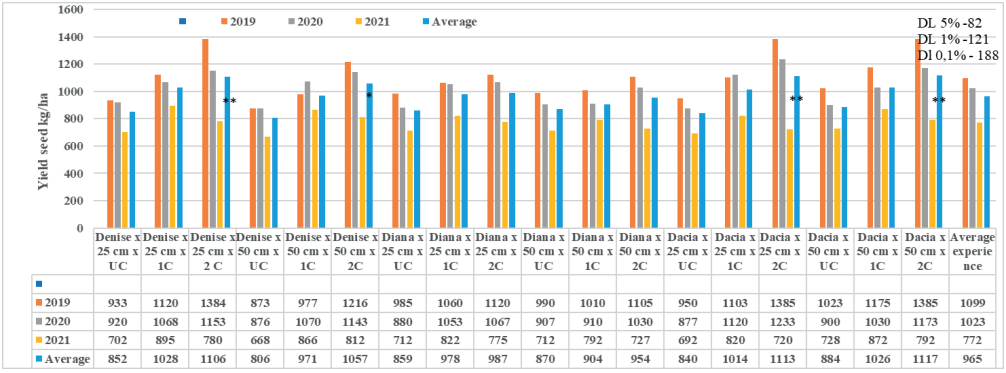
Seed yield varied quite a bit year-on-year, so the lowest yield was obtained with the Denise x 50 cm x uncut interaction of 668 kg•ha^{-1} (2021), and the highest yield was obtained at the Dacia interaction x 25 cm x two cuttings, of 1386 kg•ha^{-1} (2019). In the three years studied, the factors influenced the seed yield obtained, which ranged quite a lot, from a maximum of 1117 kg•ha^{-1}, at Dacia x 50 cm x two cuttings to 806 kg•ha^{-1} in the uncut version sown at a distance of 50 cm with the Denise variety.

Distinctly significant yield increases were obtained, compared to the control (average experiment) in some variants in which two cuttings were applied, namely Denise x 25 cm and Dacia x 25, 50 cm, and significant at the interaction Denise x 50 cm (Figure 4).



	Denise x 25 cm x UC	Denise x 25 cm x 1C	Denise x 25 cm x 2 C	Denise x 50 cm x UC	Denise x 50 cm x 1C	Denise x 50 cm x 2C	Diana x 25 cm x UC	Diana x 25 cm x 1C	Diana x 25 cm x 2C	Diana x 50 cm x UC	Diana x 50 cm x 1C	Diana x 50 cm x 2C	Dacia x 25 cm x UC	Dacia x 25 cm x 1C	Dacia x 25 cm x 2C	Dacia x 50 cm x UC	Dacia x 50 cm x 1C	Dacia x 50 cm x 2C	Average experience
2019	15683	13250	10833	13610	13453	10225	14213	13617	11650	14950	14136	12183	15110	14250	13743	15680	13726	12835	13508
2020	10606	9625	9352	10359	9886	9413	10933	9880	8560	11273	9490	8226	12860	10693	9466	12893	10333	9373	10179
2021	9207	8360	7667	9186	8607	8020	9320	8617	7537	9583	8317	7630	9330	8893	7940	9330	9233	8310	8616
Average	11832	10412	9284	11052	10649	9219	11489	10705	9249	11935	10648	9346	12433	11279	10383	12634	11097	10173	10768

Figure 3. Stem yield obtained at monoecious hemp



	Denise x 25 cm x UC	Denise x 25 cm x 1C	Denise x 25 cm x 2 C	Denise x 50 cm x UC	Denise x 50 cm x 1C	Denise x 50 cm x 2C	Diana x 25 cm x UC	Diana x 25 cm x 1C	Diana x 25 cm x 2C	Diana x 50 cm x UC	Diana x 50 cm x 1C	Diana x 50 cm x 2C	Dacia x 25 cm x UC	Dacia x 25 cm x 1C	Dacia x 25 cm x 2C	Dacia x 50 cm x UC	Dacia x 50 cm x 1C	Dacia x 50 cm x 2C	Average experience
2019	933	1120	1384	873	977	1216	985	1060	1120	990	1010	1105	950	1103	1385	1023	1175	1385	1099
2020	920	1068	1153	876	1070	1143	880	1053	1067	907	910	1030	877	1120	1233	900	1030	1173	1023
2021	702	895	780	668	866	812	712	822	775	712	792	727	692	820	720	728	872	792	772
Average	852	1028	1106	806	971	1057	859	978	987	870	904	954	840	1014	1113	884	1026	1117	965

Figure 4. Seed yield obtained at monoecious hemp

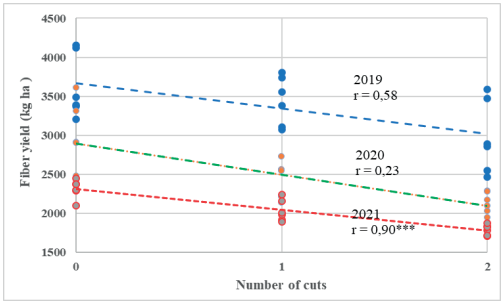
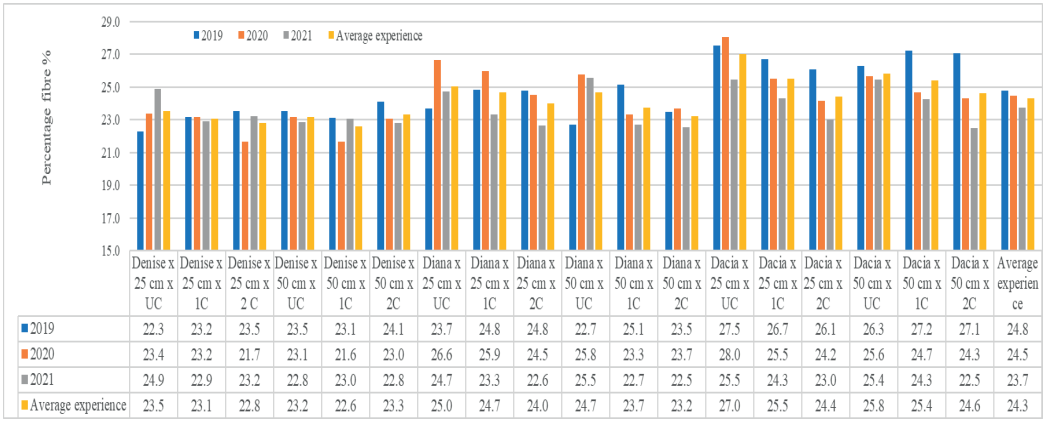


Figure 5. Correlation between number of cuts and fiber yield

Correlating the number of cuttings applied with the yield of hemp fiber obtained, it can be observed that in 2021 it was directy influenced, statistically assured and interpreted as very significant, and in the other two years of experimentation they had no significance (Figure 5).

The percentage of hemp fiber obtained in the three years of experimentation varied from 21.6% in 2020 (Denise x 50 cm x one cut) to 27.5% in 2019 (Dacia x 25 cm x uncut). In the three years studied, the factors influenced the fiber percentage obtained, which ranged quite a

lot, from a minim of 22.6%, at the interaction Denise x 50 cm x one cut to 27.0% at the uncut version sown at a distance between rows of 25 cm, with the Dacia variety (Figure 6).



	Denise x 25 cm x UC	Denise x 25 cm x 1C	Denise x 25 cm x 2 C	Denise x 50 cm x UC	Denise x 50 cm x 1C	Denise x 50 cm x 2C	Diana x 25 cm x UC	Diana x 25 cm x 1C	Diana x 25 cm x 2C	Diana x 50 cm x UC	Diana x 50 cm x 1C	Diana x 50 cm x 2C	Dacia x 25 cm x UC	Dacia x 25 cm x 1C	Dacia x 25 cm x 2C	Dacia x 50 cm x UC	Dacia x 50 cm x 1C	Dacia x 50 cm x 2C	Average experience
2019	22.3	23.2	23.5	23.5	23.1	24.1	23.7	24.8	24.8	22.7	25.1	23.5	27.5	26.7	26.1	26.3	27.2	27.1	24.8
2020	23.4	23.2	21.7	23.1	21.6	23.0	26.6	25.9	24.5	25.8	23.3	23.7	28.0	25.5	24.2	25.6	24.7	24.3	24.5
2021	24.9	22.9	23.2	22.8	23.0	22.8	24.7	23.3	22.6	25.5	22.7	22.5	25.5	24.3	23.0	25.4	24.3	22.5	23.7
Average experience	23.5	23.1	22.8	23.2	22.6	23.3	25.0	24.7	24.0	24.7	23.7	23.2	27.0	25.5	24.4	25.8	25.4	24.6	24.3

Figure 6. Fiber content extracted from monoecious hemp stalks

CONCLUSIONS

By applying the "Secuieni method" to the hemp crop, for the three varieties studied, this had a negative effect on the stem yield and on the fiber percentage, but positively influencing, instead, the seed yield.

By reducing the size but also the diameter of the stem, the seed can be harvested more easily by the fact that the ivy of the combine reaches the inflorescence of the plant.

In the three years of study, the highest yield was recorded during year 2019, the research carried out showed superiority of the Dacia x 50 cm x uncut interaction, of 15680 kg·ha^{-1}, the increases observed being very significant for the stem crops, and also at the level of the same year, the seed yield were significantly better for the same variety, Dacia, but at a distance between rows of 25 cm and by applying two cuttings (1386 kg·ha^{-1}).

The combination of the three factors studied, in the three years, generated the highest stem yield in the case of the Dacia x 50 cm x uncut variant (12634 kg·ha^{-1}), as well as the highest seed yields, for the established using the Dacia x 50 cm (1115 kg·ha^{-1}), to which two cuttings were applied.

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