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Yield of Marketable Seeds of Technical Hemp Depending on the Impact of Sowing Rates and Variety

Oleksandr Horash, Rita Klymyshena*, Vasyl Suchek

Podillia State University

32316, 13 Shevchenko Str., Kamyanets-Podilskyi, Ukraine

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Abstract. At the present stage of ensuring the development of technology for growing non-narcotic hemp, the constant task is to study the response of new varieties to the development of agrophytocenosis at different parameters of plant density per unit area. The potential of monoecious non-narcotic varieties of hemp, bred at the Institute of Bast Cultures of the National Academy of Agrarian Sciences, in the technology of growing seeds in the western agricultural zones of Ukraine has been insufficiently studied. The aim of the research is to establish the dependence of commercial hemp seed yield on technical factor A, namely sowing rates based on their differentiation, including biological factor B, i.e. monocotyledonous hemp varieties in the organization of agrophytocenosis by wide sowing in Western Forest-Steppe. Data on the study of monoecious non-narcotic hemp of modern varieties were obtained on the basis of organised field experiment within experimental units under different sowing rates. Methods used to summarise the results of research: general, based on objectivity, provability, reproduction and mathematical and statistical – to process experimental data. The dependence of hemp seed yield on the variety, where the difference in data is on average up to 25% on the experiment. It is proved that the norms of sowing seeds by wide-row sowing method are an effective factor in ensuring the implementation of the productivity of hemp varieties in crops. The obtained results give grounds to claim that the differentiation of the seeding rate factor by the experimental step of 0.3 million units/ha provides an effective distribution of the obtained data into separate static groups. This allows identifying the best options for seeding rates to recommend production. Prospects for further research are an expanded study of Glesia cultivation of technical hemp at the same time on the yield of commercial seeds and fibrous products, i.e. for bilateral use directly in the Western Forest-Steppe of Ukraine

Keywords: row spacing, crop productivity, factors, monoecious hemp varieties, non-narcotic hemp, regularity of influence, efficiency

*Corresponding author

INTRODUCTION

Hemp is one of the oldest and most famous diverse crops. It was grown all over the world as a fibrous crop, which was sown in large quantities in large areas (McPartland *et al.,* 2018; Struik *et al.,* 2000). But conditioned upon the high content of drugs, it was banned. However, since the 1990s in Ukraine, namely at the Institute of Bast Cultures of NAAS, a number of new varieties of technical hemp that do not contain drugs have been bred (Bazyl, 2019). This contributed to the restoration and significant spread of hemp cultivation, and varieties of Ukrainian selection began to be valued on the world market.

Hemp is a multifunctional crop, and it is this characteristic that has recently increased interest in its cultivation. Today it is a crop grown in more than 30 countries, including China, the United States, France, Italy, the Netherlands, Estonia and others. The revival of the hemp industry in the world is happening faster than in Ukraine.

Hemp is a universal crop, all parts of the plant – seeds, flowers, leaves, stems, roots – are used in the textile, pharmaceutical, aviation, paints and construction industries (Tsaliki *et al.,* 2021; Rehman *et al.,* 2021; Adesina *et al.,* 2020). It should be noted that hemp is a highly profitable crop, and the seeds and stems of which can be fully used and produce about 50,000 different products, including biocomposite, bioplastic, biofuels (Vyrovets *et al.,* 2021). This plant, according to scientists, could become an ecological raw material of the future. Industrial needs in hemp are of increasing interest around the world (Baraniecki *et al.,* 2022; Rahemi *et al.,* 2021).

The direction of use of the plant depends on the content of the psychoactive substance tetrahydrocannabinol (THC). Technical hemp is hemp in which the content of the psychoactive component of tetrahydrocannabiol (THC) does not exceed 0.3% (according to European legislation – 0.2%) (Boyko *et al.,* 2018; Vyrovets, 2015).

BRDO has prepared a whole study – the Green Paper on the regulation of the technical hemp market in Ukraine (Hruzinska *et al.,* 2020). It is noted that hemp contains about 200 active substances, of which 18 have been studied. Such substances include, in particular, CBD (cannabidiol) and THC (tetrahydrocannabiol), which are the most studied cannabinoids. According to Ukrainian legislation, hemp with a THC content of up to 0.08% belongs to the technical ones, and plants with a TCG content exceeding this value are automatically considered narcotic (Hruzinska *et al.*, 2020). In Europe and America, the THC content is 0.2 and 0.3%, respectively.

Quite an interesting study was conducted by American scientists at Oregon State University. They investigated that certain cannabinoid compounds of cannabis prevent the pathogenic effects of coronavirus infection on the human body (van Breemen *et al.,* 2022). It is also emphasised that cannabinoid acids, which are contained in hemp and many of its extracts, are safe for humans.

The main areas of cultivation of technical hemp include the need for commercial seeds and fibrous products. Recently, the technology of growing to ensure bilateral use is becoming widespread (Żuk-Gołaszewska & Gołaszewski, 2017; Zhang *et al.,* 2011; Primakov *et al.,* 2013).

Scientific publications state that monoecious hemp varieties are much better suited for seed production, while dioecious varieties are unsuitable conditioned upon their heterogeneity, excessive size and, as a result, difficulties with mechanical harvesting. But the potential of monoecious varieties for seed yield has been much less studied. It is known that in hemp, yield indicators, in addition to genotype, are strongly influenced by growing conditions, and often the end result depends on the seed propagation environment, where a particular variety was bred (Tang *et al.,* 2016; Baldini *et al.,* 2020).

Recently, in some countries, the technology is aimed at one-sided cultivation of hemp, ie only to obtain seeds for commercial purposes, for this purpose, low seeding rates are observed. The authors note that combine harvesters are used for harvesting (Kabanets & Kabanets, 2018; Kraszkiewicz *et al.,* 2019; Prade, 2011).

Hemp has attracted a lot of attention from the world market, including breeders and specialists in cultivation technology due to new opportunities for its wide use.

The cultivation of any agricultural crop is not without the production of seeds of this crop. In seed production the task of seed propagation, preservation of varietal purity on the basis of conformity of morphological features and formation of high sowing, and also productive properties of seed material is set. However, no less important task is the cultivation of technical hemp for seed to meet production needs, ie as raw materials for the relevant industries, namely food, pharmaceuticals and cosmetics. Accordingly, the cultivation of technical hemp for commercial seeds is an urgent issue that requires additional research, both in connection with the introduction of new monoecious non-narcotic varieties and in connection with the expansion of sown areas of these varieties within certain agricultural areas of Ukraine.

The volume of production of any plant products depends on many factors. They are primarily affected by market conditions and the need for a specific type of technical raw materials (Radishchuk, 2015). At the same time, not only the biological features of cultivated plants are important, but also the perfection of cultivation technology.

To obtain a high level of yield of hemp products, various agricultural techniques are introduced, aimed at creating optimal conditions for plant growth and development (Ferfuia *et al.,* 2021; Tang *et al.,* 2017). That is

why research to find new ways to increase crop yields, including industrial hemp, is an urgent task today.

Hemp cultivation requires a scientific basis in the management of plant growth and development. It is necessary to consider the favorable environmental conditions, soil type, length of daylight hours, temperature and water regimes. Important importance in this aspect is given to technological factors, in particular the use of mineral fertilizers, sowing dates, including seeding rates. Important importance should be given to the biological object, ie the variety of hemp, which is the main factor in technology. Modern varieties of hemp grown are quite different in terms of ensuring the maximum amount of final products, including commercial seeds and fiber. They react differently to technological factors. Most tests in the past have been limited to studies aimed at producing fibrous products.

The aim of the research was to establish the dependence of commercial hemp seed yield on technical factor A, namely seeding rates based on their differentiation, as well as biological factor B, ie monocotyledonous hemp variety in the organisation of agrophytocenosis by wide sowing method in western forest-steppe of Ukraine.

LITERATURE REVIEW

As a rule, the main purpose of growing any crop is to increase both quantitative and qualitative indicators of the resulting products. Breeding and seed production play a leading role in solving this problem. A characteristic feature of hemp is that they are grown for two important products – fiber and seeds, which, in turn, complicates the selection for simultaneous increase in yield and fiber and seeds (Mygal, 2015).

The main factor in increasing seed productivity is the increase in plant size, especially inflorescences. This is achieved through the use of sparse sowing, i.e. reducing the seeding rate (Mygal *et al.,* 2017).

Some scientists believe that the yield of straw (stems), fiber, seeds and the quality of technical hemp largely depend on many technological factors, in particular, seeding rates and sowing methods (Dmitriev *et al.,* 2001; Mediavilla, 2001; Keller *et al.,* 2001).

As a result of research by Kabanets & Kabanets (2016), it is noted the increase in sowing rates of hemp seeds contributes to the cultivation technology to improve the final results in terms of yield and fiber quality, but under such conditions the number of seeds per unit area becomes smaller. Conversely, it is noted that underestimation of sowing rates cause diametrically opposite results. In particular, the seed yield increases, but the yield per unit area of fibrous products naturally decreases. The authors emphasises that this pattern draws attention to the relevance of research on seeding rates, which would satisfy the farmer to receive in the technology of growing products of bilateral use. Particular attention is paid to this area of technology with the use of new varieties (Kabanets & Kabanets, 106; Labanets & Kabanets, 2018).

P.A. Holoborodko & G.V. Dyshleva (1985) noted that when growing hemp for seed sowing should be carried out with a row spacing for varieties of Central Russian hemp 45 cm, southern – 60-70 cm and with a sowing rate of 1.5-2.0 million similar seeds (25-35 kg) per hectare.

Many studies have focused on the impact of fertilizer application rates, crop density on growth and yield of different types of hemp fibers (Tang *et al.,* 2017; Papastylianou *et al.,* 2018; Deng *et al.,* 2019). Appropriate sowing density allows efficient use of available resources such as light, moisture and nutrients by culture, significantly increasing the yield of hemp fibers (Tang *et al.,* 2017; Schafer & Honermeier, 2006).

The seeding rate depends, first of all, on the purposes of use of the grown production of technical hemp. When grown on seeds, crops are made sparse, because the plants need some space for their branching and the formation of full-fledged inflorescences (Tang *et al.,* 2017; Adesina *et al.,* 2020). However, information on the optimal sowing rate for the production of commercial hemp seeds is very limited and needs to be studied. The scientific knowledge about cannabis should be studied in more detail and updated to understand and recommend the best methods of plant productivity management.

MATERIALS AND METHODS

The research was performed during 2018-2020 at the Podolsk State University Higher Education Institution in the Western Forest-Steppe of Ukraine.

Agrochemical characteristics of soil of research sites. Soil type – chernozem podzolic gley medium loam, in terms of physical and agrochemical properties is characterised as favorable for growing crops. The humus content is 3.2%, the supply of nutrients is as follows: alkaline nitrogen – 100 mg per 1 kg of soil, mobile phosphorus P_2O_5 – 176 mg per 1 kg of soil, exchangeable potassium K_2O_5 – 160 mg per 1 kg of soil. The reaction of the soil solution is close to neutral or neutral – pH of the salt extract 6.8-7.0 mg-eq./100 g of soil, low hydrolytic acidity 0.56-0.62 mg-eq./100 g of soil, the amount of absorbed bases 32-36 mg-eq./100 g of soil.

The humus content was determined by the method of Turin, alkaline hydrolyzed nitrogen – by the method of Cornfield, mobile phosphorus and exchangeable potassium – by the method of Chirikov, the amount of absorbed bases – by the method of Kappen-Gilkovitz, the reaction of soil solution pH.

Meteorological conditions during the research were favorable for the cultivation of technical hemp. The average monthly air temperature during the growing season in 2018, 2019 and 2020 was 17.1 in May, respectively; 14.3; 11.4°C, in June – 18.6; 21.2; 19.2°C, in July – 19.6; 18.8; 19.4°C and in August – 20.8; 20.1; 20.1°C. The amount of precipitation in 2018, 2019 and 2020,

respectively, was 22.1 in May; 155.3; 101.3 mm, in June – 128.7; 81.3; 148.3 mm, in July – 87.1; 59.9; 53.9 mm, in August – 26.5; 39.8; 14.1 mm.

The experiment is organised under the condition of formation of crops between rows 45 cm wide.

Technological factor A is included in the experiment – seed sowing rate 0.6; 0.9; 1.2; 1.5; 1.8 million units/ha.

In conducting field research as a biological object (factor B) involved monoecious varieties of hemp technical selection of the Institute of Bast Cultures NAAS of Ukraine – YUSO-31, Glyana and Glesia, which fully meet modern requirements for drug-free and productivity. In all studied varieties, the THC content corresponded to the norm established by law, which according to the "List of narcotic drugs, psychotropic substances and precursors" (Cabeinet of Ministers of Ukraine, 2000), approved by the Cabinet of Ministers of Ukraine from 05/06/2000 No. 770 with the following changes, is 0.08%.

The YUSO-31 variety is a shining example of international recognition of the achievements of the Hemp Breeding Institute, which was included in the State Register of Plant Varieties of Ukraine in 1987, and in the registers of varieties of the European Union, Canada, Republic of Kazakhstan and other countries. The variety has been in international production for more than 30 years. Vegetation period – 110-115 days. Yield of straw – 6.5-8.0 t/ha, fiber – 2.0-2.4 t/ha, seeds – 1.2-1.4 t/ha. Fiber content – 28-30%, planes – 0.01%, THC – 0.03-0.05%.

The Glyana variety was created using the YUSO-31 variety as a source material based on multiple family-group selection in the selection process using the method of halves. The task was aimed at stabilising the sex in the cannabis population, increasing productivity potential and reducing cannabinoid content (Kabanets & Kabanets, 2018). The characteristics of the variety also indicate: the duration of the growing season – 115-120 days, the yield of stems – 7.5-8.0 t/ha, seeds – 1.0-1.2 t/ha, plant height parameters – 2.5-3.0 m. Year of registration – 2007.

Gler variety was used as a starting material for the cultivation of Glacier variety in order to improve seed productivity (Kabanets & Kabanets, 2018). At the end of the vegetative development of plants, the height of the variety reaches 2.5-3.0 m. The duration of the growing season is 115-120 days, the yield of stems – 7.5-8.0 t/ha, seeds – 1.5-2.0 t/ha. Year of registration – 2016.

Placement of technical hemp plots is systematised in tiers. Number of repetitions – four times. The total area of the plot is 60 m^2, the accounting area is 50 m^2.

The application rate of mineral fertilizers is $N_{90}P_{45}K_{45}$. Phosphorus and potassium fertilizers have been applied since autumn under the main tillage, nitrogen – in pre-sowing cultivation.

Accounting for the yield of marketable seeds of technical hemp varieties was carried out by the method of continuous threshing.

For the mathematical analysis of the obtained research results we used analysis of variance based on the multi-rank statistical criterion Duncan (Ermantraut *et al.,* 2017).

RESULTS AND DISCUSSION

V.H. Vyrovets et al. (2011) found that in the context of hemp seed yields, technical conditions are significantly influenced by growing conditions created by technological factors. These include seeding rates and row spacing. Many publications pay special attention to the fact that the potential of modern varieties of hemp in the cultivation of seeds are better realised in sparse crops. Reducing the seeding rate increases the yield of seeds and reduces the yield of fibrous products. The authors schematically characterise the dependence of seed and straw yields on seeding rates. Reveal patterns in changing the yield of one and the other type of hemp production from the seeding rate. This forces specialists to search for optimal sowing rates that would meet the requirements of production separately for seeds and separately for fibrous products, including for the bilateral use of both seed and fibrous products. As a result of the conducted researches which are directed on achievement of indicators of seed productivity of technical hemp, norms of sowing of seeds of 0.6 are involved; 0.9; 1.2; 1.5 and 1.8 million units/ha with a row spacing of 45 cm. Varieties of monoecious non-narcotic cannabis YUSO-31, Glyana and Glesia are included (Table 1). The maximum level of yield at the sowing rate of 0.6 million units/ha was provided by the variety Glesia – 1.737 t/ha.

***Table 1**. Yield of commercial hemp seed technical depending on the impact of sowing rates and varieties for row spacing 45 cm, t/ha (average for 2018-2020)*

Seed sowing rates, million units/ha (factor A)	Varieties (factor B)			Average factor A
	YUSO-31	Glyana	Glacier	
0.6	1.271	1.506	1.737	1.505
0.9	1.219	1.465	1.662	1.449
1.2	1.178	1.422	1.572	1.391
1.5	1.143	1.381	1.513	1.345
1.8	1.107	1.344	1.479	1.310
Average factor B	1.184	1.424	1.592	1.400

In the conditions of the North-Eastern Forest-Steppe of Ukraine according to similar researches, the author of which is V.M. Kabanets (2017), set at the included variants of sowing rates 0.5; 1.0; 1.5; 2.0; 2.5 million units/ha, which is characterised by the best seed yield of 1.0 million units/ha, where the figure is 1.7 t/ha.

Analysis of the data based on the analysis of variance by Duncan's test for the YUSO-31 variety shows that during all the years of research, each seed sowing rate had a significant impact on changes in seed yield. In 2018, the maximum level of yield was at the rate of sowing 0.6 million units/ha and amounted to 1.255 t/ha. The involved sowing rate of 0.9 million units/ha led to the formation of slightly lower productivity of crops, as a result of which the yield decreased significantly – by 60 kg (Table 2). Increasing the rate to 1.2 million units/ha again significantly reduced the seed yield in the variety YUSO-31, where the figure was 1.133 t/ha. A further increase in the seeding rate to 1.5 million units/ha did not provide an equivalent yield compared to the previous seeding rate, on the contrary, it caused a significant decrease. At the highest sowing rate of 1.8 million units/ha, the seed yield was the lowest and amounted to 1.067 t/ha.

***Table 2**. Dependence of yield of marketable hemp seeds of technical grade YUSO-31 on influence of sowing norms at width between rows of 45 cm by Duncan's criterion, t/ha*

Sowing rate, million units/ha	Year			Average for three years	Homogeneous groups				
	2018	2019	2020		1	2	3	4	5
0.6	1.255	1.192	1.365	1.271	****				
0.9	1.195	1.161	1.300	1.219		****			
1.2	1.133	1.127	1.275	1.178			****		
1.5	1.100	1.080	1.250	1.143				****	
1.8	1.067	1.048	1.207	1.107					****

In 2019, the patterns of seed yield of the YUSO-31 variety remain the same as in 2018. The maximum productivity of technical hemp crops corresponds to the lowest seeding rate. Accordingly, the rate of 0.6 million units/ha in the study contributed to a significantly higher yield of seeds of the variety YUSO-31 – 1.192 t/ha. Each subsequent increase in seeding rate led to a significant decrease in seed yield. According to the norms of sowing seeds 0.9; 1.2; 1.5; 1.8 million units/ha, yield levels were set at 1.161; 1.127; 1.080 Hours; 1.048 t/ha, where each norm provided a significant impact on the performance characteristic.

In 2020, the yield was slightly higher, but the distribution of indicators depending on the seeding rate remains the same as in previous years. The maximum level of seed productivity is set at sowing rates of 0.6 million units/ha – 1.365 t/ha. Each increase in seeding rate in the order indicated in the table led to a significant decrease in the yield of hemp seeds variety YUSO-31. According to the sowing rates of 1.8 million units/ha, the yield was the lowest and amounted to 1.207 t/ha. The difference in data in yield levels between the highest and lowest seeding rates is 158 kg.

The analysis of data from the Duncan test for the Glan variety on the effect of sowing rates on the yield of technical hemp seeds does not differ from the pattern established for the YUSO-31 variety. In 2018, the maximum level of yield was also provided by the seed sowing rate of 0.6 million units/ha. The corresponding figure was 1.505 t/ha, which differs significantly from all other data obtained (Table 3). For each seeding rate 0.6; 0.9; 1.2; 1.5; 1.8 million units/ha according to the results of statistical calculations, the established seed yield indicators are allocated to separate statistical groups. This testifies to the regularity of the influence of each seed sowing rate with its increase on the development of significantly lower seed productivity of hemp crops of technical grade Glyana. The lowest value of seed yield was at the highest seeding rate. The range of changes in yields involved in sowing rates from 0.6 million units/ha to 1.8 million units/ha is in the range from 1.505 t/ha to 1.349 t/ha, respectively, the difference is 156 kg.

***Table 3**. Dependence of yield of marketable hemp seeds of technical grade Glyana on the influence of sowing rates at a row spacing of 45 cm according to the Duncan criterion, t/ha*

Sowing rate, million units/ha	Year			Average for three years	Homogeneous groups				
	2018	2019	2020		1	2	3	4	5
0.6	1.505	1.420	1.592	1.506	****				
0.9	1.475	1.380	1.540	1.465		****			
1.2	1.435	1.332	1.500	1.422			****		
1.5	1.400	1.288	1.455	1.381				****	
1.8	1.349	1.253	1.431	1.344					****

In 2019, seed seeding rates provided a similar impact as in 2018. The best level of yield of 1.420 t/ha was set at the sowing rate of 0.6 million units/ha, at the sowing rate of 0.9 million units/ha was significantly lower and amounted to 1.380 t/ha. Increasing the seeding rate to 1.2 million units/ha led to a further significant decrease in crop productivity, with a yield of 1.332 t/ha. The seeding rate of 1.5 million units/ha caused a decrease in the yield of Glyana hemp to 1.288 t/ha, and the rate of 1.8 million units/ha – to 1.253 t/ha.

In 2020, the regularity of the impact of seed seeding rates on the yield of Glyana variety was the same as in previous years. Each norm of sowing of seeds, as an effective sign corresponds to a certain value of the level of yield, which is allocated to a separate homogeneous group. According to the involved norms of sowing of seeds 0.6; 0.9; 1.2; 1.5; 1.8 million units/ha, the yield level of Glyana hemp was 1.592 > 1.540 > 1.500 > 1.455 > 1.431 t/ha.

Regarding the yield of Glesia hemp depending on the influence of seed sowing norms, no differences in the regularity of statistical distribution of data were found, it was similar to Glyana and YUSO-31 varieties (Table 4).

***Table 4**. Dependence of yield of marketable hemp seeds of technical grade Glesia on the influence of sowing rates at a row spacing of 45 cm according to the Duncan criterion, t/ha*

Sowing rate, million units/ha	Year			Average for three years	Homogeneous groups				
	2018	2019	2020		1	2	3	4	5
0.6	1.698	1.733	1.779	1.737	****				
0.9	1.655	1.605	1.727	1.662		****			
1.2	1.560	1.473	1.683	1.572			****		
1.5	1.506	1.404	1.628	1.513				****	
1.8	1.480	1.370	1.586	1.479					****

In 2018, the maximum seed yield of 1.698 t/ha was at the sowing rate of 0.6 million units/ha. Significantly lower yields were obtained when sowing seeds of 0.9 million units/ha – 1.655 t/ha, but higher compared to all other sowing rates. At the sowing rate of 1.2 million units/ha, the yield of 1.560 t/ha was significantly lower compared to the sowing rates of 0.9 million units/ha, and the yield at the sowing rate of 1.5 million units/ha was significantly lower compared to the data obtained by sowing rates of 1.2 million units/ha. At the sowing rate of 1.8 million units/ha, the yield was the lowest and amounted to 1.480 t/ha.

In 2019, similarly, the highest yield was formed at the rate of 0.6 million units/ha – 1.733 t/ha. Significantly lower hemp yield was at a higher rate of 0.9 million units/ha and amounted to 1.605 t/ha. Increasing the seed sowing rate to 1.2 million units/ha led to a further decrease in the productivity of Glesia hemp crops, as a result of which the seed yield decreased to 1.473 t/ha, or 132 kg compared to 0.9 million units/ha. The reduction of the seed sowing rate to 1.5 million units/ha and 1.8 million units/ha similarly caused a significant decrease in yield results, which confirms the obtained figures of 1.404 t/ha and 1.370 t/ha.

The test results for 2020 are characterised by similar patterns that were established in previous years. The maximum yield was achieved at the sowing rate of 0.6 million units/ha – 1.779 t/ha. Increasing the sowing rate to 0.9 million units/ha resulted in a decrease in yield by 52 kg. With a sowing rate of 1.2 million units/ha, the yield was even lower – 1.683 t/ha. A further increase in seeding rate led to a decrease in seed yield. Respectively, according to the norms of 1.5 million units/ha and 1.8 million units/ha, the indicators obtained for the Glacia variety were 1.628 t/ha and 1.586 t/ha.

Thus, the regularity of the influence of seed sowing norms on the yield of Glesia hemp is characterized by a significant compliance with each of them by the seed productivity of crops at a given width between rows in crops of 45 cm.

Regarding the comparison of yields of varieties according to Tables 2, 3, 4 Glesia variety is characterised by higher productivity. Statistical calculations based on the Duncan criterion show the predominance of the Glacia variety over the YUSO-31 and Glyana varieties (Table 5).

***Table 5**. Dependence of yield of commercial hemp seed technical on the influence of the variety at a row spacing of 45 cm according to the Duncan criterion, t/ha*

Sowing rate, million units/ha	Year			Average for three years	Homogeneous groups		
	2018	2019	2020		1	2	3
Glacier	1.580	1.517	1.680	1.592	****		
Glyana	1.433	1.335	1.504	1.424		****	
YUSO-31	1.150	1.122	1.279	1.184			****

In 2018, the yield data of varieties according to the established indicators differ significantly compared to each other. The maximum productivity was provided by the variety Glesia, where the figure was 1.580 t/ha. Significantly lower seed yield was in the variety Glyana – 1.433 t/ha, the difference is 0.147 t/ha. Variety YUSO-31 is characterised by a yield of 1.150 t/ha, which is less than the data of the variety Glesia – by 0.430 t/ha.

A similar data distribution was in 2019. The maximum yield was formed by the cultivar Glesia – 1.517 t/ha, while in the cultivar Glyana the indicator was significantly lower, by 0.182 t/ha. YUSO-31 variety provided hemp seed yield at the level of 1.122 t/ha, which is 0.213 t/ha less than Glyan variety.

The same statistical distribution of data on the yield of varieties was in 2020. The highest yield of hemp seeds was shown by the variety Glesia, significantly inferior to the variety Glyana, and the variety YUSO-31 was inferior to the variety Glyana.

CONCLUSIONS

Efficiency in management of productivity of crops of hemp technical on a level of productivity of commodity seeds on the basis of application of the technological factor – norms of sowing of seeds and a biological factor – a variety of monoecious non-narcotic hemp in the conditions of the Western Forest-Steppe of Ukraine is established.

Based on the data obtained as a result of statistical studies using the multi-rank Duncan criterion, it was found that the norms of sowing technical hemp seeds have a significant impact on the yield of commercial seeds of crops wide-row sowing for row spacing 45 cm. In accordance with seeding rates of 0.6; 0.9; 1.2; 1.5; 1.8 million units/ha on the average for years of researches on experiment the following indicators of productivity are established: 1.505 > 1.449 > 1.391 > 1.345 > 1.310 t/ha. With the increase in the seeding rate from 0.6 million units/ha to 0.9 million units/ha, the yield of commercial hemp seed decreased by 3.7%, at the seeding rate of 1.2 million units/ha compared to the previous sowing rates – by 4.0%, sowing rates of 1.5 million units/ha compared to the norm 1.2 million units/ha – by 3.3% and sowing rates of 1.8% compared to the norm 1.5 million units/ha – by 2.6%.

All varieties of monoecious technical hemp involved in the research provided the maximum realisation of biological potential in terms of marketability of marketable seeds in the development of crops at sowing rates of 0.6 million units/ha. Accordingly, according to this sowing rate, the varieties are characterized by the following yield indicators: Glesia – 1.737 t/ha, Glyana – 1.506 t/ha and YUSO-31 – 1.271 t/ha.

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Урожайність товарного насіння конопель технічних залежно від впливу норм висіву та сорту

Олександр Савич Гораш, Ріта Іванівна Климишена, Василь Миколайович Сучек

Подільський державний університет
32316, вул. Шевченка, 13, м. Кам'янець-Подільський, Україна

Анотація. На сучасному етапі забезпечення розвитку технології вирощування ненаркотичних конопель постійне завдання полягає у необхідності дослідження реакції нових сортів на умови формування агрофітоценозу за різних параметрів густоти рослин на одиниці площі посіву. Потенціал однодомних ненаркотичних сортів коноплі, виведених в Інституті луб'яних культур Національної академії аграрних наук, у технології вирощування на насіння в умовах західних зон землеробства України недостатньо досліджено. Мета досліджень полягає у встановленні залежності урожайності товарного насіння посівів конопель технічних від технологічного фактора А, а саме норм висіву на основі їхньої диференціації, а також біологічного фактора В, тобто сорту однодомних конопель при організації агрофітоценозу за широкорядного способу сівби в умовах західного Лісостепу України. Дані щодо вивчення однодомних ненаркотичних конопель сучасних сортів отримані на підставі організованого польового досліду в межах експериментальних одиниць за умови різних норм висіву насіння. Застосовані методи для узагальнення результатів досліджень: загальнонаукові, в основі яких є об'єктивність, доказовість, відтворення та математично-статистичний – для обробки експериментальних даних. Встановлено залежність урожайності насіння коноплі від сорту, де різниця даних становить у середньому по досліду до 25 %. Доведено, що норми висіву насіння за широкорядного способу сівби є результативним фактором у забезпеченні реалізації продуктивності сортів коноплі в посівах. Отримані результати дають підстави стверджувати, що диференціація фактора норми висіву насіння за кроком експерименту 0,3 млн шт./га забезпечує результативний розподіл отриманих даних на окремі статичні групи. Це дає можливість виділити кращі варіанти норм висіву насіння з метою рекомендації виробництву. Перспективи подальшого дослідження полягають у розширеному вивченні вирощування сорту Глесія коноплі технічної одночасно на урожайність товарного насіння та волокнистої продукції, тобто на двобічне використання безпосередньо в умовах західного Лісостепу України

Ключові слова: ширина міжрядь, продуктивність посівів, фактори, однодомні сорти конопель, ненаркотичні коноплі, закономірність впливу, ефективність