ANALYSIS OF QUALITY OF POINT SOWING FINOLA VARIETY HEMP SEEDS WITH PRECISION SEEDER

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Abstract. The aim of the study was to assess the quality of sowing hemp seeds of the Finola variety using a precision seeder with a pneumatic sowing system from Gaspardo. During the study, the influence of selected operating parameters of the tested prototype (aggregate) for cultivation and sowing on the quality of its work (sowing uniformity) was assessed. The implementation of the assumed objective and scope of the study required field tests, which were carried out in Adamów near Zamość. Evaluation of the quality of sowing hemp seeds using a pneumatic precision seeder included in the sowing unit was carried out based on the methodology of testing precision seeders and guidelines included in the literature. During the seeder study, the influence of the arrangement of plants after emergence in a row on a section of 5 m was examined in five repetitions at the following unit speeds: 5, 6, 7 and 10 km·h^{-1}. It was found that with the increase of the working speed of the seeder and the rotational speed of the sowing disc, the quality of seed sowing deteriorated. The conducted scientific research related to the improvement of precision sowing techniques, including their in-depth theoretical analysis and experimental studies, will allow for further extension of this research topic. Analysis of the variance of independent variables, i.e. the working speed of the seeder and the sowing disc, showed their influence on the shares of single, double and pass sowings at the given parameters. The interaction of these variables is also important. As a result of the research work carried out, guidelines for practice were developed regarding the appropriate operating settings of the bleaching unit of the tested precision seeder in relation to sowing the selected seed species.

Keywords: precision sowing, hemp seeds, working speed, sowing quality.

Introduction

Precision sowing is one of the key agricultural technologies that allows for optimal seed distribution, increased yields and minimized losses [1; 2]. Correctly conducted precision sowing allows for obtaining uniform spacing between seeds in rows, while maintaining the set width between rows and the depth of seed placement in the soil, which affects the proper growth and development of plants. It also allows for reducing the amount of seed material used, which contributes to reducing the production costs of the cultivated plant [3]. So far, research has mainly been conducted on the quality of precision sowing of maize seeds [4; 5], to a less extent, vegetable seeds [3; 6; 7].

There is, however, very little literature devoted to the precise sowing of energy crop seeds and the use of their yields in the energy industry, for example biodiesel [8-10], wood pellets [8; 11-13] and other agri-food waste [14]. The research carried out in this area is of a random nature and does not include the impact of various factors on the quality of sowing. Seed preparation is important [15-17] and in this area the following works can be cited [18-19]. A number of discrepancies in the methodological approach also create difficulties in comparing the obtained results.

In recent years, there has been growing interest in the cultivation of hemp, both fiber and medical. In Poland, as in the world, the development of this technology [1; 20] is closely linked to legal regulations, market requirements and progress in material sciences [21], mechanization and automation of agriculture [22-24] and technical service of agricultural machinery [25; 26]. The importance of precision sowing for various seeds, its impact on crop quality and the latest trends and technologies used have a significant impact on the quality of the crop. As well as the optimization of cultivation conditions, adaptation of machines to the specificity of hemp seeds, significantly affects the sowing quality of this plant [27; 28]. Farmers are increasingly looking for alternative cultivation technologies [29; 30], which would successfully replace energy-intensive plough cultivation. One of the solutions is strip tillage, i.e. strip-till [31].

Soil cultivation in this system consists in deep loosening of narrow strips of soil, in which seeds are subsequently sown [32]. As a result, two separate zones are created on the soil surface: strips of loosened soil and uncultivated space between them [33; 34]. The name “strip-till” was formulated by the Conservation Technology Information Centre (CTIC) and defined as a modification of the conservation soil cultivation technique [35; 36]. The purpose of this method is to reduce soil spraying and achieve financial savings [37; 38]. The soil cultivation system using this method is relatively little used in Poland, it is already used to a limited extent mainly for sowing winter rape and maize [39].

There is a need to develop a new technology for sowing small hemp seeds with a precision seeder, taking into account its regulation and adjustment of operating parameters. Therefore, the motive for choosing the topic of the scientific research problem was to attempt to solve the possibility of improving the quality of sowing hemp seeds of the Finola variety in relation to improving the economics of cultivation.

Materials and methods

The research was carried out in 2024 on a farm located in Adamów near Zamość. A pneumatic precision seeder, which was the subject of the research, was used to sow industrial hemp seeds. The aim of the research was to assess the quality of hemp seed sowing with a precision seeder with a pneumatic sowing system. The research assessed the impact of selected operating parameters of the tested cultivation and sowing prototype (uniformity of sowing). Achieving the assumed goal and scope of work required field tests to determine the suitability of the tested machine, which was used for sowing Finola hemp.

In order to reduce the costs of cultivation, combined machines constituting an aggregate were used in the research. The main advantages of such a solution are the reduction of the working time, energy savings and limited soil compaction. Therefore, simplifying the cultivation work, while simultaneously preparing the soil for sowing, increases the possibility of direct commencement of work related to sowing. The active harrow used in the aggregate, the operation of which is preceded by subsoilers, increases the possibility of optimal mixing of soil in the case of crop residues and stubble.

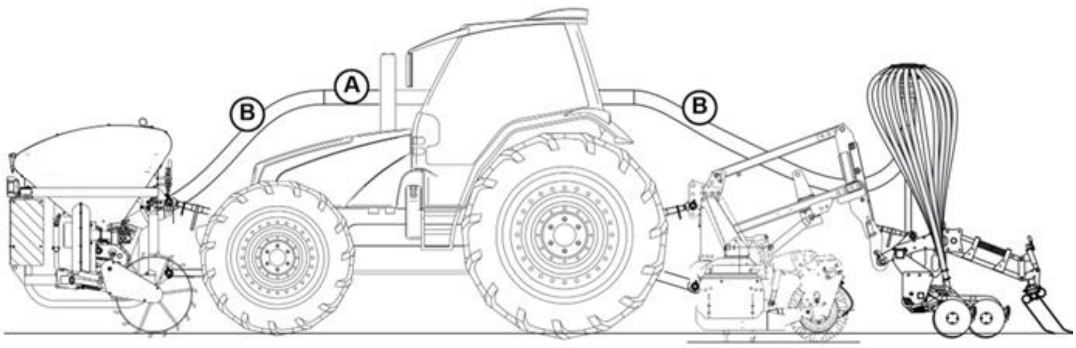

Fig. 1. **View of the tested object (negative pressure precision seeder):** A – rigid pipe with a circular cross-section; B – flexible pipes transporting the fertilizer to the distribution head

The tested unit consisted of a fertilizer spreader with pneumatic seed distribution, an active harrow and a pneumatic seeder connected to this technological line with the possibility of placing it on a bendable structure of a soil conditioning machine. The construction of the tested object (pneumatic seeder) and modular elements enable sowing hemp seeds in various variants and configurations. The sowing unit of this seeder, as well as many other pneumatic seeders, consists of a disc on the circumference of which there are holes with a diameter slightly smaller than the size of the sown seeds. When the disc is in the seed collection zone, there is negative pressure in its holes, causing the seeds to suck into them. When the disc continues to rotate and it enters the zone of the air stream blowing through the holes, the seeds fall under the influence of gravity into the furrow made by the coulter. The model of the tested machine allows for obtaining one, two or three sowing lines in one sowing device. In the tested case of the seeder, there was one sowing line. The increased body of the distributor device, in which there is a sowing disc with a diameter of 22 cm, requires a lower rotational speed of the disc itself at different seeder travel speeds, and this results in greater precision in applying seeds in the furrow previously made by the coulter. In the tested seeder, it is possible to manage different sowing depths with great versatility, obtaining the appropriate configuration depending on the cultivation conditions, including the type of soil. The machine had a fan driven by PTO at 540 rpm. The pressure and sowing depth were adjusted mechanically. Seeders of this type can work at different sowing depths. The minimum possible distance between rows for the section was 7 cm. The minimum distance between rows was 26 cm.

The evaluation of the quality of hemp seed sowing with a pneumatic precision seeder included in the cultivation unit was carried out based on the precision seeder testing methodology included in the ISO 7256/1-1984 (E) standard and guidelines included in the literature. During the tests, the distances between plants were measured after their emergence, in a row on a measuring section of 10 m, in five repetitions. The measurement sections were marked out using a measuring tape with a scale, and their beginning and end were marked with measuring posts. The measurements were taken for different sowing speeds of the unit: 5, 6, 7 and 10 km h^{-1}. The rotational speeds of the sowing discs of the tested seeder section were: 0.8; 1.0; 1.4 and 1.6 rpm, respectively. Then, the percentage of sowings was calculated: single, double and pass in five repetitions. The measurements were taken with an accuracy of 5 mm. Plants sown correctly were considered to be those which spacing was greater than a half of the average actual spacing and less than or equal to one and a half average actual spacings. Plants sown twice were considered to be those that grew at spacings less than or equal to one and a half average actual spacings. In turn, gaps greater than one and a half average actual spacings between plants were considered to be culverts. Then, the following was calculated.

- Share of single sowings, as the percentage ratio of the number of plants growing singly to the total number of plants in all measurement sections.
- Share of double sowings, as the percentage ratio of the number of these plants to the total number of plants in all measurement sections.
- Share of culverts, as the percentage ratio of the number of these distances to the total number of plants in all measurement sections.

The Finola variety of oil hemp was used for the study. The seeds were characterized by high uniformity and shape, and all were similar. The measuring sections on which the seeder was tested were located on soils of different quality classes, i.e. IIIa, IIIb, IVa, IVb and Va. The number of seeds sown per hectare of the field area depended on the quality class of the soil, in connection with satellite maps of the yield potential. The sowing rate of 20 thousand seeds per hectare was planned for quality class IIIa. The weight of one thousand sown seeds of the Finola variety of hemp was 12.35 g according to the seed producer. Their germination power (vigor) was 77%.

Results and discussion

The results of the quality of hemp seed sowing with the tested seeder are presented in Table 1 and Figure 2.

Table 1

Results of testing the quality of sowing

Seeder operating speed (km·h^{-1})	Sowing disk peripheral speed (m·s^{-1})	Single plants (%)	Duplicated plants (%)	Skips (%)
5	0.8	83^a	11^a	6^a
6	1.0	72^b	16^b	12^b
7	1.4	64^c	5^c	31^c
10	1.6	48^d	3^c	49^d

Table 1 contains a one factor analysis of variance, different letters given in the superscripts of the indicators in Table 1 (a, b, c, d) mean that at the tested seeder working speeds there were significant differences between the shares of single, double and skips, at the level of $\alpha = 0.05$ at the tested ranges of the sowing speed and sowing disc.

Table 1 and the graph in Figure 2 show that the most favourable share of seeds in the tested distance classes in the row occurred at a seeder operating speed of 5 km·h^{-1}. At this speed, 83% of single sowings, 11% of double sowings and 6% of passes were observed. At higher seeder speeds, the share of single sowings decreased and the share of double sowings and passes increased. Statistical analysis of the obtained results showed significant differences between the shares of single sowings at the tested speeds. It can therefore be stated that the working speed of the seeder significantly influenced the quality of sowing of Finola hemp seeds.

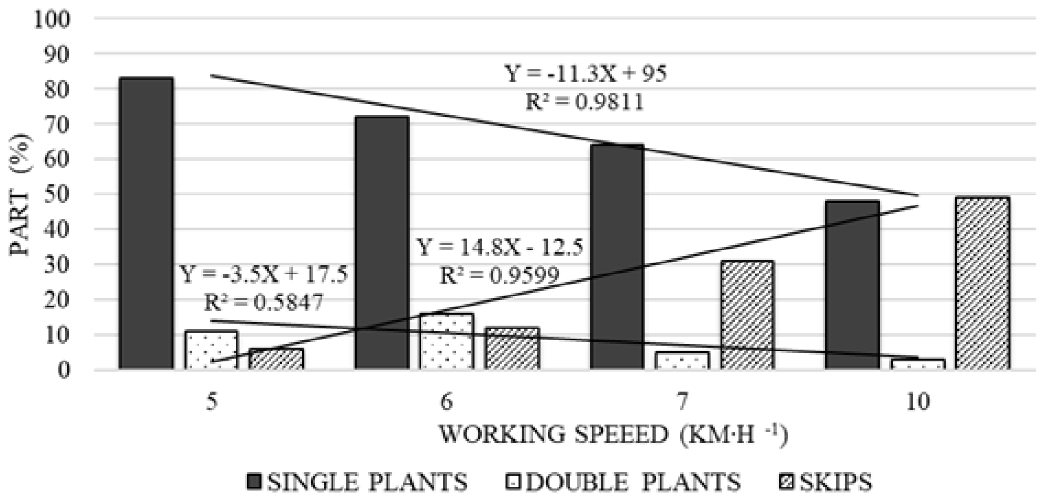

Fig. 2. **Influence of the working speed of the tested seeder on the percentage of single, double and pass sowings**

The issue of sowing quality has been present in literature for many years. The authors of research papers focus mainly on assessing the quality of seed drills using the national standard PN-91/R-55027. This standard differs from the ISO methodology, which significantly complicates comparisons of research results. Recently, the ISO 7256/1 standard has been used to assess the sowing quality. The following characteristics are taken into account in assessing the quality of a precision seed drill: accuracy of seed distribution in the row, sowing consistency, seed damage by the sowing unit, sowing depth, seed coverage, distribution of emerging plants in the row, deviation of plants from the row line. In the case of assessing the quality of seed drills, based on the condition of the plantation after plant emergence, the most important factor is the distribution of plants in the row, which is assessed on the basis of single sowings, double sowings and passes.

Conclusions

1. The study found a significant effect of the seeder working speed on the accuracy of Finola hemp plant row distribution, determined by the percentage of single, double and pass-through sowings.
2. The most favourable indicators of the plant row distribution were obtained at a seeder working speed of 5 km·h^{-1}.
3. At higher seeder working speeds, a significant deterioration in the precision of the plant row distribution was observed, which was expressed by a decrease in the share of single sowings and an increase in the share of pass-through sowings.

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