Summary

Effect of sowing method on maize yield

The main objective of the doctoral dissertation was to determine the impact of different methods of spatial seed distribution on the field surface using a precision seeder on maize grain yield and the yield of whole maize plants intended for use as fodder or as a substrate for biogas production.

An additional objective was to conduct operational tests of the new precision seeder Sipma S115 Plon II. The research aimed to identify the range of operating speeds at which the seeder achieves the lowest error in seed placement.

The study aimed to verify the hypothesis formulated as follows: it is possible to identify a maize sowing method that results in more favorable characteristics of the yield of whole plants, grain yield, and biometric features of yield components.

To achieve the research objective, it was necessary to carry out a series of research tasks, which included conducting operational tests of the Sipma S115 Plon II seeder to determine quantitative and qualitative performance indicators, analyzing the distribution of maize seeds in conventional (traditional) sowing, dense sowing, "magic triangle" sowing, and square sowing, determining the spatial arrangement and density of plants on the plantation for the four tested sowing methods, analyzing the crop structure and growth increments of maize plants during three vegetation periods for the four tested sowing methods, analyzing the fresh and dry mass of whole plants and their components depending on the maize sowing method, analyzing cob structure after harvest depending on the sowing method, and analyzing biometric traits of yield components, including determining the length of tassels, stems, leaves, and cobs of maize plants depending on the sowing method. The quality assessment of the 6-row pneumatic seeder during maize sowing was conducted in accordance with the quality evaluation standard for precision seeders ISO 7256/1.

The operational tests of the seeder used in the experiment showed that its performance and reliability meet the requirements for precision seeders for maize. The results of the seeder's quality tests formed the basis for selecting operational parameters for the experiment on the spatial arrangement of maize plants. Evaluating the uniformity of seed distribution within the row for sowing densities ranging from 10.40 to 15.59 cm and operating speeds between 3.7 and 8.3 $km \cdot h^{-1}$ received ratings from very good to satisfactory. The experiment adopted a theoretical seed spacing of 15.59 cm in the row and an operating speed of 6 $km \cdot h^{-1}$.

The study results showed that plant density determines the formation of the leaf assimilation area, which significantly affects the yield structure, especially the share of cobs in the total yield mass. The highest leaf mass was produced by plants provided with optimal living

space in uniform sowing (magic triangle). Compared to traditional sowing, this method resulted in a 56.2% increase in leaf mass.

Analyzing the spatial distribution of plants in the studied sowing methods showed that a larger area for nutrient uptake and root system development positively influences yield and its biometric traits. Plant height, stem diameter, average plant weight, total yield, average cob weight, and average grain weight per cob were higher in the magic triangle and square sowing methods. This confirms that spatially distributed sowing reduces competition for light, water, and nutrients, promoting better plant development and higher growth. It was also found that plant density and weather conditions, especially during the early growth period, significantly influenced the crop structure in the studied sowing variants.

In the area of biometric traits, the study revealed that the masses of tassels, leaves, stems, and cobs of maize plants differed statistically significantly depending on the sowing method. Dense sowing significantly reduced the weight of maize plant parts. The highest number of grains per cob was observed in the triangle and square sowing methods, while the lowest was in the dense sowing variant.

Assuming the use of maize yield as a substrate for biogas production, the triangle or square sowing method is most advantageous, as the fields sown with these methods were estimated to produce the highest amounts of biogas and methane per hectare. On the other hand, dense sowing, despite a lower average weight of individual plants, allows for a significant increase in fresh mass yield per unit area due to the doubled plant density. This has specific benefits for the production of maize silage.

The presented research findings on varied maize sowing techniques aimed at different row and plant spatial arrangements demonstrated that the sowing technique significantly affects the obtained yields. This positively verifies the research hypothesis and thus addresses the scientific problem of the dissertation.

Further research is needed on the technique of spatial seed/plant distribution in maize, particularly regarding strip sowing and the use of tools from the areas of precision and smart agriculture in sowing technology.

Keywords: maize, sowing technique, yield, biometric traits of plants

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