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PRODUCTIVITY OF MAIZE HYBRIDS DEPENDING ON PLANTING DENSITY

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This study presents the results of research on the effect of planting density on the growth, development, and productivity of maize hybrids of different maturity groups under the conditions of the Right-Bank Forest-Steppe of Ukraine. The primary objective was to determine the relationship between maize hybrid productivity and planting density, as well as to identify optimal plant spacing schemes that ensure the maximum realization of their genetic yield potential.

The field experiments were conducted in 2024–2025 at the experimental field of the department of crop production and horticulture of Vinnytsia national agrarian university, within the farming enterprise LLC «Organik-D». The study involved maize hybrids representing various maturity groups: Anovie KS (FAO 220), ES Sirius (FAO 200), ES Perspektiv (FAO 240), DKC 3609 (FAO 260), DKC 3939 (FAO 320), and Harmonium (FAO 380). Planting densities ranged from 50,000 to 90,000 plants per hectare.

The results revealed that plant height and ear attachment height were significantly influenced by the genetic characteristics of the hybrid, weather conditions, and planting density. Favorable hydrothermal conditions in 2025 contributed to an increase in average plant height to 268.0 cm, compared to 252.9 cm in 2024. The tallest plants were observed in mid-maturity hybrids – DKC 3939 (283.0 cm) and Harmonium (284.1 cm) – under an optimal density of 60,000–80,000 plants/ha.

Yield analysis demonstrated that a longer vegetation period was associated with higher productivity. The average yield across two years ranged from 7.96 to 10.08 t/ha, depending on the hybrid. The highest yields (10.06–10.08 t/ha) were recorded for DKC 3939 (FAO 320) and Harmonium (FAO 380) at a planting density of 80,000 plants/ha. For early-maturing hybrids, the optimal density was 90,000 plants/ha. Excessive or insufficient plant density resulted in yield reduction. The findings highlight that adjusting plant density according to the hybrid's maturity group is an effective agronomic strategy for optimizing maize cultivation and achieving stable yields under the conditions of the Forest-Steppe zone of Ukraine. Further research is recommended to refine hybrid-specific density parameters.

Keywords*: maize, hybrid, planting density, grain yield, ear height, plant height, yield structure, Forest-Steppe zone.*

Table 2. Lit. 17.

Introduction. Maize is an important grain and forage crop that significantly influences not only the development of the livestock industry but also the overall state of grain production. Its cultivation plays a crucial role in the food, processing, medical, and microbiological industries. Moreover, maize is of particular interest to the fuel and energy sector, as it serves as a valuable raw material for the production of bioethanol and other types of fuel [1].

In global grain production, maize ranks third after wheat and rice. Therefore, ensuring consistently high maize yields is essential for the development of Ukraine's agricultural sector [2]. The use of intensive cultivation technologies allows for increased productivity and higher profitability. Today, Ukraine is among the top five global exporters of maize grain, which has led to an expansion of maize cultivation areas across the country [3].

The rising cost of synthetic fertilizers, crop protection products, and, potentially, seed material necessitates the optimization of production costs for agricultural crops. This is especially relevant for maize, which accounts for over 30% of the sown area in most Ukrainian farms [3]. Studies assessing the economic potential of maize hybrids under various environmental gradients indicate that, with scientifically grounded selection of hybrid material and the application of adaptive cultivation technologies, it is possible to achieve consistently high yields of commercial grain and seed that meet quality standards and exhibit typical varietal traits [4].

Optimization of hybrid-specific agrotechnical practices is one of the priority directions in modern crop production. Such an approach aims to ensure that plants receive adequate nutrients and growth conditions, thus enabling the full realization of the genetic potential of hybrids. Accordingly, conducting research under the natural and climatic conditions of the Right-Bank Forest-Steppe of Ukraine is of particular scientific and practical relevance.

Review of scientific literature. One of the key factors in improving maize productivity in Ukraine is the enhancement of technological elements of its cultivation. Achieving targeted productivity indicators is possible only through a comprehensive consideration of soil fertility, climatic conditions, and available material and technical resources. The yield level of any agricultural crop, including maize, is determined by the intensity of physiological and biochemical nutrition processes, moisture regime, fertilizer application rates, planting density, weather conditions, and a combination of other ecological and agronomic factors [5].

A major advantage of maize over other cultivated plants in the context of global climate change lies in its ability to use solar energy more efficiently due to its specific CO_2 fixation mechanism, which involves the formation of an intermediate compound with four carbon atoms [6]. This characteristic classifies maize as a C_4-type photosynthetic plant [7]. Such a mechanism ensures a very low light compensation point, allowing photosynthesis to continue even under limited solar radiation. The initiation of photoperiodic reactions occurs under the influence of thermal energy formed by specific wavelengths of solar radiation [7].

Achieving high yields is possible only if plants develop an optimal leaf area with sufficient duration of functional activity. The efficiency of solar radiation utilization depends on the spatial orientation of leaves as an optical system, their chlorophyll content, the intensity of photosynthesis, and the productivity of biosynthetic processes [4].

An increase in maize planting density from 60,000 to 90,000 plants per hectare results in a 9.0–17.3 % rise in the coefficient of absorption of photosynthetically active radiation (PAR). At the same time, the coefficient of PAR utilization decreases: in early-maturing hybrids – from 0.31 to 0.14; in medium-early – from 0.24 to 0.09; and in medium-late and late hybrids – from 0.21 to 0.06 [8]. The leaf area index (LAI) of maize stands increases significantly with higher planting density, which reduces PAR penetration to the lower canopy layers [9].

To ensure optimal plant density, taking into account field germination, and to minimize losses caused by pests, diseases, and plant mortality during cultivation, several researchers recommend increasing the seeding rate by 35–40% compared to the calculated rate required to achieve the target density [10].

In the early stages of vegetation, maize exhibits slow growth, a low water consumption coefficient, and a weakly developed root system, which makes the plants relatively insensitive to changes in stand density. However, in later growth stages, planting density significantly affects plant growth and development, as well as the overall productivity of the crop [10].

Under current agricultural conditions, determining differentiated planting densities for new maize hybrids, taking into account specific soil and climatic conditions, has become especially relevant. The rational selection of planting density can increase grain yield by 20–30% [11]. Maize yield largely depends on the optimal number of productive plants per hectare and their uniform distribution within rows, which ensures conditions for intensive photosynthesis and the most efficient use of soil resources, moisture, and applied fertilizers [12].

A rational selection of planting density according to the soil type and specific hybrid makes it possible to achieve maximum yield while minimizing the risk of competition between plants. In areas with insufficient moisture, the recommended densities range from 45–65 thousand plants per hectare; in areas with sufficient moisture – from 75–95 thousand plants per hectare; and in areas with unstable moisture – from 60–80 thousand plants per hectare [10].

Planting density determines not only the plants' access to water and nutrients but also the level of light exposure for individual plants, which is critical for effective photosynthesis. The optimal density includes the number of plants per unit area recommended by breeders and their uniform distribution within rows. This approach ensures the formation of the maximum number of well-grained ears, thereby increasing grain yield and enhancing the energy value of silage. It is worth noting that errors made during sowing cannot be compensated for by other agronomic practices [3, 7].

The optimal range of planting density for maize largely depends on weather conditions. Maize is characterized by relatively efficient water use: to produce 1 kg of dry biomass, it consumes about 250 L of water – significantly less than most other crops. For instance, spring wheat requires approximately 432 L of water to form 1 kg of dry matter. At the same time, the high productivity of maize results in considerable total water consumption per unit area, which can reach up to 16 million l/ha [9].

Taking into account the periodic droughts that occur annually highlights the importance of reducing maize plant density per unit area when necessary. Considering the variable response of the crop to different seeding rates makes it possible to increase maize yield, as this crop is particularly sensitive to deviations from the optimal planting density [3].

For maize intended for grain, silage, or green fodder, the optimal planting density is determined based on the crop's intended use and growing conditions. It should be emphasized that different hybrids reach their maximum yield at different planting densities, since the size of the leaf area and the duration of its activity are largely determined by the genetic potential of each specific hybrid [13]. When determining the optimal planting density, it is necessary to consider soil and climatic factors such as moisture availability, soil type and structure, and terrain. The level of plant nutrition and the chosen cultivation technology also play an important role [3]. Uneven plant distribution in the field can lead to yield losses of up to 20% [9, 12].

Maize genotypes exhibit varying sensitivity to crowding, which makes it possible to select forms capable of maintaining yield even when plant density increases to a certain level. Accordingly, research institutions have conducted trials of individual lines and hybrids under different density rates. Like other annual plants, maize has limited growth; that is, its linear height increase stops at the ripening stage, regardless of the combination of agronomic and meteorological conditions. The effect of density on maize growth, development, and productivity has been studied by numerous researchers. In particular, for hybrids of Krasnodar and Odesa breeding, plant height decreased as the density increased from 20 to 40 thousand plants per hectare [2].

In the early stages of vegetation, planting density has little effect on the linear growth of maize stems. However, in the second half of the growing season, when a large vegetative mass is formed and competition between plants intensifies, stem height increases proportionally to planting density [3].

Maximum maize yield is achieved under conditions of high individual productivity of each plant and an optimal stand density determined for specific soil and climatic conditions. Maize hybrids of different maturity groups exhibit varying sensitivity to changes in planting density, especially under conditions of unstable or, in some years, insufficient moisture [14]. Therefore, an accurate assessment of the productivity of such hybrids is possible only when using differentiated planting densities adapted to the specific agroecological conditions of each hybrid’s cultivation.

The aim of the study was to evaluate the productivity of maize hybrids of different maturity groups depending on variations in planting density.

Conditions and methods of research. The study was conducted in 2024–2025 at the experimental field of the department of crop production and horticulture of Vinnytsia national agrarian university, under the conditions of LLC «Organik-D». The research included field, laboratory-field, and laboratory experiments, as well as a set of observations and measurements, including phenological, biometric, and analytical studies.

The climatic conditions of the research area were generally favorable for maize growth and development, with the frost-free period lasting 175–181 days.

The experimental field was characterized by grey forest soils of light loam texture. In the arable layer, humus content was 2.8%, nitrogen – 98 mg/kg, available phosphorus and potassium – 106 and 115 mg/kg, respectively. The soil solution was slightly acidic (pH 5.8).

The maize cultivation technology corresponded to the commonly accepted agronomic practices of the Right-Bank Forest-Steppe zone. The experiments were carried out within a field crop rotation, with winter wheat as the preceding crop. Soil tillage included stubble disking to a depth of 10–12 cm using an LDP-3 disc harrow, plowing to

20–22 cm with an RABE Albatros 110 plow, spring harrowing with a BPSH-8 spring harrow, and pre-sowing and seedbed cultivation with a KPG-4 cultivator. Mineral fertilizers ($N_{60}P_{60}K_{60}$) were applied during the main tillage.

Sowing was performed when the upper soil layer (0-10 cm) warmed up to 8–10 °C using a SUPN-8 planter. The desired plant density was manually adjusted at the 3-5 leaf stage.

The experimental design included two factors: Factor A – maize hybrids: 1. *Early-maturing group:* Anovii KS (FAO 220) and ES Sirius (FAO 200); 2. *Medium-early group:* ES Perspectiv (FAO 240) and DKC 3609 (FAO 260); 3. *Medium-maturing group:* DKC 3939 (FAO 320) and Harmonium (FAO 380). Factor B – planting density: 1) 50 thousand plants/ha; 2) 60 thousand plants/ha; 3) 70 thousand plants/ha; 4) 80 thousand plants/ha; 5) 90 thousand plants/ha.

The area of the accounting plots was 25 m², with four replications. The establishment of experiments, data collection, and observations were carried out in accordance with generally accepted methodologies [15].

After the onset of the milk stage of grain maturity, the architectural traits of the plants (such as stem height and ear attachment height) were evaluated by measuring 10 typical plants in two non-adjacent replications of each experimental variant [16].

Harvesting and yield assessment were performed manually at the full grain maturity stage by weighing all ears from the accounting plot area. Grain yield, output, and moisture content were determined based on samples from 10 ears collected from each accounting plot. The yield results were recalculated to the standard grain moisture of 14% [16].

Research results. **Plant height and ear attachment height** are indicators determined both by the biological characteristics of maize hybrids and by the growing conditions. They are of great importance for ensuring the efficiency of mechanized technological processes during crop cultivation and harvesting. Insufficient soil moisture and elevated temperatures lead to a reduction in plant height and, consequently, in ear attachment height. Too low an ear position (30–50 cm) results in significant grain losses during mechanical harvesting (15–20% or more), while excessively high placement (over 130 cm) is also undesirable due to the increased risk of lodging [17].

Plant height in maize is significantly influenced by the level of mineral nutrition, meteorological factors throughout the growing season, plant density, and the morphobiological characteristics of the particular hybrid. The increase in the linear dimensions of maize plants usually correlates positively with higher FAO index values [3, 9].

Throughout the growing season, the growth and development of maize plants-depending on planting density and the hybrids' belonging to specific maturity groups-occur differentially, which results in variations in plant habit formation as well as in the development of generative organs, namely the tassel and the ear (Table 1).

Analyzing the characteristics of plant height expression in the studied maize hybrids across the years, it was found that in 2024 it averaged 252.9 cm across the experiment, while in 2025 it reached 268.0 cm.

Table 1

Plant height and ear height of maize hybrids, cm (2024-2025)

Maize hybrid	Planting density	Plant height			Ear height		
		2024	2025	avg. plant height	2024	2025	avg. ear height
Anovii KS (FAO 220)	50 thousand plants/ha	215.7	226.5	221.1	85.8	89.8	87.8
	60 thousand plants/ha	210.8	227.9	219.4	88.3	91.6	90.0
	70 thousand plants/ha	235.4	240.3	237.9	88.3	105.3	96.8
	80 thousand plants/ha	234.9	238.5	236.7	82.7	102.7	92.7
	90 thousand plants/ha	235.7	241.6	238.7	86.1	103.4	94.8
ES Sirius (FAO 200)	50 thousand plants/ha	200.3	213.9	207.1	68.3	76.5	72.4
	60 thousand plants/ha	212.1	224.7	218.4	76.1	85.7	80.9
	70 thousand plants/ha	215.6	228.4	222.0	82.7	91.2	87.0
	80 thousand plants/ha	223.5	235.8	229.7	76.1	96.3	86.2
	90 thousand plants/ha	223.7	238.9	231.3	77.2	97.9	87.6
ES Perspectiv (FAO 240)	50 thousand plants/ha	260.5	271.1	265.8	80.5	87.5	84.0
	60 thousand plants/ha	262.7	276.5	269.6	100.7	106.8	103.8
	70 thousand plants/ha	264.6	282.6	273.6	100.8	109.1	105.0
	80 thousand plants/ha	270.9	290.8	280.9	93.9	105.4	99.7
	90 thousand plants/ha	270.4	288.7	279.6	100.5	102.5	101.5
DKC 3609 (FAO 260)	50 thousand plants/ha	270.3	278.8	274.6	100.6	107.8	104.2
	60 thousand plants/ha	270.9	280.1	275.5	102.5	110.1	106.3
	70 thousand plants/ha	265.8	283.9	274.9	109.4	115.6	112.5
	80 thousand plants/ha	271.5	287.4	279.5	110.9	117.2	114.1
	90 thousand plants/ha	268.7	285.2	277.0	110.3	116.8	113.6
DKC 3939 (FAO 320)	50 thousand plants/ha	269.3	282.2	275.8	101.6	114.5	108.1
	60 thousand plants/ha	275.8	290.2	283.0	102.7	119.6	111.2
	70 thousand plants/ha	265.5	288.6	277.1	98.3	121.2	109.8
	80 thousand plants/ha	265.6	296.3	281.0	100.5	117.5	109.0
	90 thousand plants/ha	269.9	288.7	279.3	100.9	118.2	109.6
Harmonium (FAO 380)	50 thousand plants/ha	276.3	290.6	283.5	110.5	119.5	115.0
	60 thousand plants/ha	272.5	288.7	280.6	110.8	122.3	116.6
	70 thousand plants/ha	266.2	287.3	276.8	107.2	120.7	114.0
	80 thousand plants/ha	271.9	296.2	284.1	113.8	118.3	116.1
	90 thousand plants/ha	270.3	290.9	280.6	111.0	117.5	114.3
HIP_{05}, cm	Factor A Factor B Interaction AB	12.52 16.34 18.75	13.38 17.51 20.17	–	4.85 5.76 6.34	5.11 6.03 6.85	–

Source: compiled from the author's own research

This indicates that the climatic conditions during the maize growing season in 2025 were more favorable in terms of temperature indicators, as well as the total amount of precipitation and its distribution across the individual phases of the vegetation period. It was also found that the genetic characteristics of a specific hybrid had a significant influence on plant height formation. Thus, according to the average data of the two years of research, the plant height of the hybrid ES Sirius

(FAO 200) was 215.0 cm, while that of Anovi KS (FAO 220) was 226.5 cm, DKC 3609 (FAO 260) – 269.4 cm, ES Perspektiv (FAO 240) – 265.8 cm, DKC 3939 (FAO 320) – 269.2 cm, and Harmonium (FAO 380) – 271.4 cm.

Planting density proved to be a decisive factor in shaping the linear parameters of the plants. Analysis of the average indicators over the two years of research showed that the tallest plants of the early-maturing hybrids were recorded at the density of 90 thousand plants/ha: ES Sirius (FAO 200) – 231.3 cm and Anovi KS (FAO 220) – 238.7 cm. In the medium-early hybrids, the maximum plant height was observed at the density of 80 thousand plants/ha: ES Perspektiv (FAO 240) – 280.9 cm and DKC 3609 (FAO 260) – 279.5 cm. For the medium-maturing hybrids, the optimal plant height was achieved at different densities: DKC 3939 (FAO 320) – 283.0 cm at 60 thousand plants/ha, and Harmonium (FAO 380) – 284.1 cm at 80 thousand plants/ha.

The ear attachment height was directly dependent on the plant height and was determined by the genetic characteristics of the hybrid, the climatic conditions of the growing year, and the planting density.

In terms of years, the ear attachment height in 2024 averaged 96.0 cm across the experiment, while in 2025, which was characterized by more favorable conditions in terms of temperature resources and precipitation, it increased by 11 cm and reached 107.0 cm.

According to the results of the study of maize hybrids, the average ear attachment height over the two years was: ES Sirius (FAO 200) – 82.8 cm, Anovi KS (FAO 220) – 92.4 cm, ES Perspektiv (FAO 240) – 98.8 cm, DKC 3609 (FAO 260) – 110.1 cm, DKC 3939 (FAO 320) – 109.5 cm, and Harmonium (FAO 380) – 115.2 cm. The maximum values of ear attachment height in the studied maize hybrids, depending on sowing density, were as follows: ES Sirius (FAO 200) – 87.6 cm and Anovi KS (FAO 220) – 96.8 cm at 70 thousand plants/ha; ES Perspektiv (FAO 240) – 105.0 cm at 70 thousand plants/ha; DKC 3609 (FAO 260) – 114.1 cm at 80 thousand plants/ha; DKC 3939 (FAO 320) – 111.2 cm at 60 thousand plants/ha; and Harmonium (FAO 380) – 116.6 cm at 60 thousand plants/ha.

Thus, the linear parameters of plants and the height of productive ear attachment in the investigated maize hybrids were determined by a combination of factors, including annual climatic conditions, the genetic characteristics of a particular hybrid, and plant density. The formation of maize grain productivity results from the combined effect of the main components of its yield structure – the number of ears per unit area, the number of kernels per ear, and the thousand-kernel weight. In the conducted studies, these structural yield indicators were formed under the influence of different plant densities.

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The level of success in agricultural production is directly determined by the yield indicators of crops. Through preliminary planning and economic calculations, it is possible to rationally choose a hybrid, determine optimal sowing rates, select appropriate soil cultivation methods, and develop an effective sowing schedule. At the same time, it should be taken into account that crop production is a sector highly dependent on external factors. Weather conditions and economic circumstances can significantly affect the final results of yield and the profitability of production.

In the field of crop production, two fundamental concepts are distinguished – yield and productivity are presented in Table 2.

Table 2

Effect of plant density on grain yield formation in maize hybrids, t/ha (2024-2025)

Hybrid (A)	Plant density (B), thousand plants/ha	Grain yield, t/ha		
		2024, t/ha	2025, t/ha	average 2024–2025, t/ha
Anovi KS (FAO 220)	50 thousand plants/ha	6.55	7.06	6.81
	60 thousand plants/ha	6.92	7.34	7.13
	70 thousand plants/ha	7.35	8.03	7.69
	80 thousand plants/ha	7.82	8.75	8.29
	90 thousand plants/ha	9.34	10.97	10.16
ES Sirius (FAO 200)	50 thousand plants/ha	6.09	6.88	6.49
	60 thousand plants/ha	6.85	7.27	7.06
	70 thousand plants/ha	7.28	9.05	8.17
	80 thousand plants/ha	7.31	9.96	8.64
	90 thousand plants/ha	8.89	10.05	9.47
ES Perspektyv (FAO 240)	50 thousand plants/ha	6.73	7.03	6.88
	60 thousand plants/ha	7.25	7.81	7.53
	70 thousand plants/ha	8.47	9.43	8.95
	80 thousand plants/ha	9.71	10.20	9.96
	90 thousand plants/ha	9.52	10.03	9.78
DKC 3609 (FAO 260)	50 thousand plants/ha	6.89	7.35	7.12
	60 thousand plants/ha	8.04	8.78	8.41
	70 thousand plants/ha	8.83	9.46	9.15
	80 thousand plants/ha	10.12	11.23	10.68
	90 thousand plants/ha	9.86	10.40	10.13
DKC 3939 (FAO 320)	50 thousand plants/ha	7.42	7.87	7.65
	60 thousand plants/ha	8.95	9.51	9.23
	70 thousand plants/ha	10.12	10.87	10.50
	80 thousand plants/ha	11.35	12.07	11.71
	90 thousand plants/ha	10.78	11.69	11.24
Harmonyum (FAO 380)	50 thousand plants/ha	7.67	7.94	7.81
	60 thousand plants/ha	9.16	9.39	9.28
	70 thousand plants/ha	9.35	10.12	9.74
	80 thousand plants/ha	11.78	12.22	12.00
	90 thousand plants/ha	11.07	12.09	11.58
HIP_{05}, т/ha	Factor A Factor B Interaction AB	0.24 0.17 0.35	0.32 0.21 0.42	–

Source: compiled from the author's own research

Yield refers to the total amount of products obtained from a particular crop or a group of similar crops (for example, cereals) from the entire sown area. Productivity, in turn, reflects the quantitative output of a crop per unit area, usually expressed in tonnes per hectare, and serves as a more specific indicator of the effectiveness of agronomic practices. The productivity indicators of the studied maize hybrids depending on plant densityThe highest average grain yield across the experiment for the studied maize hybrids was recorded in 2025, a year characterized by more favorable temperature conditions and moisture availability, with an even distribution throughout the growing season, including during critical periods.

During this year, the yield reached 9.36 t/ha, whereas in the less favorable 2024, due to weather conditions, it amounted to 8.58 t/ha.

Across the hybrids, the average two-year grain yield was as follows: Anovi KS (FAO 220) – 8.01 t/ha, ES Sirius (FAO 200) – 7.96 t/ha, ES Perspektiv (FAO 240) – 8.62 t/ha, DKC 3609 (FAO 260) – 9.03 t/ha, DKC 3939 (FAO 320) – 10.06 t/ha, and Harmonium (FAO 380) – 10.08 t/ha. Analysis of the obtained data indicates an increase in hybrid productivity with the extension of the growing season duration, with the highest yield values recorded for the medium-maturity hybrids DKC 3939 (FAO 320) and Harmonium (FAO 380) – 10.06–10.08 t/ha.

Regarding planting density, it should be noted that the maximum grain yield for the hybrids Anovi KS (FAO 220) – 10.16 t/ha and ES Sirius (FAO 200) – 9.47 t/ha was observed at a density of 90 thousand plants/ha. For the hybrids ES Perspektiv (FAO 240) – 9.96 t/ha, DKC 3609 (FAO 260) – 10.68 t/ha, DKC 3939 (FAO 320) – 11.71 t/ha, and Harmonium (FAO 380) – 12.00 t/ha, the optimal planting density was 80 thousand plants/ha.

Thus, a density of 90 thousand plants/ha was optimal for achieving high grain yield in the hybrids Anovi KS (FAO 220) and ES Sirius (FAO 200), while for ES Perspektiv (FAO 240), DKC 3609 (FAO 260), DKC 3939 (FAO 320), and Harmonium (FAO 380), the optimal density was 80 thousand plants/ha. At the same time, both excessive thickening and thinning of plant stands led to reduced yields of the studied maize hybrids.

Conclusions. According to the research results, the climatic conditions of the study year significantly influence the formation of biometric indicators in the examined maize hybrids. In 2025, which was more favorable in terms of temperature and moisture availability, the average plant height reached 268.0 cm, exceeding the 2024 value (252.9 cm) by 15.1 cm. A similar trend was observed for ear attachment height, which increased from 96.0 to 107.0 cm.

The tallest plants were recorded in the medium-maturity hybrids − Harmonium (FAO 380) at 271.4 cm and DKC 3939 (FAO 320) at 269.2 cm, while the shortest were the early-maturity hybrids ES Sirius (FAO 200) at 215.0 cm and Anovi KS (FAO 220) at 226.5 cm. The ear attachment height was determined by the combined influence of plant height, the biological characteristics of the hybrid, weather conditions, and planting density. On average over two years, the highest ear placement was recorded in the hybrids Harmonium (115.2 cm) and DKC 3609

(110.1 cm), while the lowest values were observed in ES Sirius (82.8 cm).

Maize grain yield varied depending on the year of the study, the biological characteristics of the hybrid, and planting density. In the favorable year 2025, the average yield across the experiment reached 9.36 t/ha, which was 0.78 t/ha higher than in in 2024. On average over the two years, the highest yields were produced by the medium-maturity maize hybrids − DKC 3939 (10.06 t/ha) and Harmonium (10.08 t/ha), while the early-maturity hybrids (ES Sirius, Anovi KS) provided lower yields – 7.96–8.01 t/ha. Thus, excessive thickening or thinning of plant stands leads to decreased productivity in all studied maize hybrids, indicating the need for an individual selection of planting density, taking into account the genetic characteristics of each hybrid and the growing conditions.

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АНОТАЦІЯ
ПРОДУКТИВНІСТЬ ГІБРИДІВ КУКУРУДЗИ ЗАЛЕЖНО ВІД ГУСТОТИ ПОСІВУ

У статті наведено результати вивчення впливу густоти посіву на ріст, розвиток та продуктивність гібридів кукурудзи різних груп стиглості в умовах Лісостепу правобережного. Основною метою роботи було визначення залежності продуктивності гібридів кукурудзи від варіацій густоти посіву та встановлення оптимальних схем розміщення рослин, здатних забезпечити максимальну реалізацію їх генетичного потенціалу врожайності.

Дослідження проводили у 2024-2025 рр. на дослідному полі кафедри рослинництва та садівництва Вінницького національного аграрного університету в умовах господарства ТОВ «Органік-Д». Об'єктом вивчення були гібриди кукурудзи різних груп стиглості: Анові КС (ФАО 220), ЕС Сіріус (ФАО 200), ЕС Перспектив (ФАО 240), ДКС 3609 (ФАО 260), ДКС 3939 (ФАО 320) та Гармоніум (ФАО 380). У дослідах використовували густоти посіву 50-90 тис. рослин/га.

Встановлено, що висота рослин і рівень прикріплення качана істотно залежали від генетичних особливостей гібриду, погодних умов року та густоти посіву. Сприятливі гідротермічні умови 2025 року зумовили збільшення середньої висоти рослин до 268,0 см порівняно з 252,9 см у 2024 році. Найбільшу висоту рослин зафіксовано у гібридів середньостиглої групи – ДКС 3939 (283,0 см) і Гармоніум (284,1 см), що поєднувалося з оптимальною густотою 60-80 тис. рослин/га.

Аналіз урожайності показав, що подовження тривалості вегетаційного періоду супроводжувалося зростанням продуктивності. Середній рівень урожайності за два роки становив 7,96-10,08 т/га залежно від гібриду. Найвищі показники урожайності (10,06–10,08 т/га) – одержано у гібридів ДКС 3939 (ФАО 320) та Гармоніум (ФАО 380) за густоти 80 тис. рослин/га. Для ранньостиглих гібридів оптимальною виявилася густота 90 тис. рослин/га. Надмірне загущення або зрідження посівів призводило до зниження врожайності.

Отримані результати свідчать, що адаптація густоти стояння до групи стиглості є ефективним інструментом оптимізації сортової агротехніки кукурудзи та забезпечення *стабільного формування врожаю в умовах Лісостепу України і потребую проведення подальших досліджень.*

***Ключові слова**: зерно, кукурудза, гібрид, густота посіву, висота кріплення качанів, висота рослин, врожайність, структура врожаю.*

Табл. 2. Літ. 17.

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