

Formation of maize grain oil content depending on technological elements and variable agro-climatic conditions

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ABSTRACT

To study the influence of plant density and foliar applications of micronutrients on the oil content in the grains of DEKALB maize hybrids from different FAO maturity groups under the conditions of the Northern Steppe of Ukraine in 2022–2024, a three-factor field experiment was conducted. Factor A – maize hybrids: DKC 4098, DKC 4109, DKC 4391, DKC 4598, DKC 4712, DKC 5075, DKC 5206. Factor B – plant density: 55, 60, 65, 70, 75, 80, 90, and 110 thousand plants/ha. Factor C – foliar applications: control (water treatment); Amino Ultra Maize; Micro-Mineralis Maize. It was established that the oil content in the grains ranged from 3.80% to 4.00%. A decrease in the indicator was observed in 2023, followed by an increase in 2024, which was attributed to weather conditions, particularly water deficit, which increased oiliness while decreasing grain protein content. The highest oil content in the grains was consistently formed by hybrids DKC 4712, DKC 5206, and DKC 4391. The oil content depended on plant density, decreasing from 4.00% (55 thousand plants/ha) to 3.78% (80 thousand plants/ha), with a subsequent increase when planting density was raised to 110 thousand plants/ha (3.94%). Foliar applications slightly reduced the oil content. The lowest value was provided by the micronutrient Amino Ultra Maize. The micronutrient Micro-Mineralis Maize proved to be more effective in terms of grain oiliness across all years of research. The highest average oil content over the three years was obtained from growing hybrids DKC 4712, DKC 5206, and DKC 4391 at densities of 55–70 thousand plants/ha without foliar fertilization. At the same time, the calculated oil yield per hectare ranged from 0.26 to 0.37 t/ha and tended to increase with the use of microfertilizers due to higher grain yields, despite a slight decrease in percentage oil content. The highest calculated oil yield (0.36–0.37 t/ha) was achieved by growing high-yield hybrids at a plant density of 55–70 thousand plants/ha with Amino Ultra Maize application. The results of the research confirm that optimizing plant density and nutrient background allows for realizing the genetic potential of corn hybrids regarding oiliness and increasing oil yield per unit area.

Keywords: maize, hybrid, plant density, foliar fertilization, microfertilizer, oil.

INTRODUCTION

Under current climate change conditions and the growing demand for high-quality raw materials for the food, feed, and bioenergy industries, improving maize grain quality has become particularly relevant. One of the main approaches to addressing this challenge is enhancing technological elements, in particular selecting high-yielding hybrids, rationally regulating plant density, and creating an optimal nutritional background.

Maize hybrids differ significantly in their potential to accumulate protein, starch, oil, and other grain components, which necessitates their

targeted evaluation. For example, in the U.S. Maize Belt during 2020–2021, eighteen trials were conducted, each evaluating 40 maize hybrids with an average growing period of 103 days. These hybrids had been commercially developed between 1980 and 2020 by Bayer Crop Science. The results showed that grain protein content declined from 9.2% to 7.7% by 2008 (a genetic decline of approximately 0.05% per year), starch content increased from 71% to 73% by 2000 and then stabilized, while oil content remained almost unchanged. At the same time, due to yield increases, the conditional protein yield per hectare rose substantially [King et al., 2024].

One of the important directions for improving grain quality is the introduction of Quality Protein Maize (QPM) into production – hybrids with increased levels of lysine and tryptophan. QPM grain contains approximately twice as much of these amino acids, and the biological value of its protein reaches ~80% compared to ~45% in standard grain, significantly enhancing the food and feed value of maize [Maqbool et al., 2021]. For example, the cultivation of QPM hybrids such as TZEEQI 468 × TZEEQI 321 results in a consistently high level of maize grain yield with excellent quality indicators, even under conditions of insufficient nitrogen supply or infestation by the parasitic weed *Striga hermonthica* (Del.) Benth [Okunlola et al., 2023]. Other researchers also report on the high protein-energy value of grain with a balanced amino acid composition from QPM hybrids [Mebratu et al., 2024; Ying et al., 2021].

The density of plant stands determines the conditions of nutrition, light regime, and the formation of the assimilation surface, which directly affects the synthesis of organic substances in the grain. Increasing planting density promotes better photosynthetic activity; however, beyond optimal values, it can lead to intraspecific competition and a decrease in individual plant productivity [Ciampitti and Vyn, 2011]. To achieve maximum productivity of the agroecosystem, it is essential to find a balance between fully utilizing resources and preventing the negative consequences of competition. Optimal plant density allows for maximizing the overall productivity of the crop through more efficient resource use [Djaman et al., 2022; Sibonginkosi et al., 2019]. Research conducted in the northeastern region of China indicates that reducing plant density from 80,000 to 50,000 plants per hectare significantly increased the weight of 1,000 grains and the protein content in maize grain [Zhang et al., 2020]. Reducing plant density from 90,000 to 60,000 plants per hectare when growing the high-yielding maize hybrid Zhengdan 958 in China resulted in a 0.7% increase in protein content and a 0.3% increase in oil content [Jiang et al., 2023]. Excessive crowding of maize crops leads to a decrease in protein and oil content in the grain by 4–11%, an increase in starch content by 0.65–2.00%, and an increase in soluble sugars by 39–69% [Wang et al., 2023]. Therefore, optimizing plant density not only increases yield levels but also improves the quality indicators of maize grain. For comprehensive grain

quality management, in addition to regulating planting density, creating an optimal nutritional background is equally important. This includes conducting foliar fertilization with micronutrients that regulate metabolic processes and directly influence the synthesis and accumulation of nutrients [Sary and El-Aziz, 2025].

Foliar fertilization of maize crops with micronutrients (zinc, iron, selenium, and nitrogen) under the soil and climatic conditions of China increased the concentration of these elements in the grain without reducing yield levels. For instance, the content of Zn increased from 13.8 to 22.1 mg/kg, Fe from 17.2 to 22.1 mg/kg, Se from 21.4 to 413.5 µg/kg, and N from 13.8 to 14.7 g/kg. At the same time, the content of phytic acid (PA) and the PA/Fe and PA/Zn ratios decreased, indicating an increase in the bioavailability of Zn and Fe in the grain [Xue et al., 2023].

Research conducted at the Podkarpackie Agricultural Extension Center in Boguchwała (Poland) found that foliar application of zinc, boron, and copper significantly improved the chemical composition of maize grain: it increased the content of protein, starch, fiber, as well as the concentration of micronutrients and antioxidant activity. Zn stimulated the accumulation of carotenoids, while Fe and Mo enhanced antioxidant properties and the level of bioactive compounds [Jarecki et al., 2025].

An analytical review of scientific publications from the Web of Science database, conducted by Hungarian researchers, confirmed that foliar fertilization with micronutrients during critical growth and development phases positively affects the content of proteins, carbohydrates, lipids, and mineral compounds in maize grain, increases kernel size, and enhances plant resistance to stressful conditions throughout the growing season [Ssemugenze et al., 2025].

Thus, a comprehensive study of the interaction between hybrid characteristics, plant density, and foliar applications of micronutrients is extremely relevant for developing effective maize cultivation technologies that will ensure not only stable yield levels but also high grain quality in accordance with modern production needs.

The aim of our research was to study the effect of plant density and foliar applications of micronutrients on the oil content in the grain of DEKALB maize hybrids from different FAO groups under the soil and climatic conditions of the Northern Steppe of Ukraine.

RESEARCH METHODOLOGY

Field studies were conducted from 2022 to 2024 at the research field of LLC Agricultural Firm “Agrotechnology-Plus” in the Kropyvnytskyi district of Kirovohrad region (48°24'54" N, 32°01'02" E), which is located in the subzone of the Northern Steppe of Ukraine.

The climate of the research region is continental with moderate aridity, sharply expressed seasonality of temperatures and precipitation, a prolonged warm period, and periodic manifestations of moisture deficiency.

During the years of the study, a clear trend of increasing thermal provision was observed. The sum of effective temperatures (above 5 °C) gradually increased from 2426.1 °C in 2022 to 2715.4 °C in 2023 and reached 3106.6 °C in 2024 (Figure 1). A similar dynamic was observed for the sum of active temperatures (above 10 °C), which rose from 3226.1 °C in 2022 to 3479.0 °C in 2023 and 4176.6 °C in 2024, indicating an extension of the active growing season and an increase in the thermal potential of the climate in the area where the research was conducted.

The dynamics of the hydrothermal coefficient (HTC) according to G.T. Selianinov indicate a significant deterioration in moisture supply conditions. In 2022, the HTC was 0.936, which indicated an optimal or near-optimal level of moisture (for Steppe conditions), but by 2023, its value dropped to 0.585, and in 2024, it further decreased to 0.471. Such a decline in the HTC to values below 0.7 indicates a gradual transition of climatic conditions

towards pronounced aridity and insufficient moisture during the active growing season.

The soil of the experimental plot is ordinary low-humus deep black soil with an average level of provision of mobile forms of essential macrolelements. The granulometric composition is medium loam, and there is no differentiation by genetic horizons. The distribution of humus in the soil profile of the experimental plots is characterized by a gradual decrease with depth of the genetic horizons. Thus, while the humus content in the humus-accumulative horizon (H) is 3.6%, it decreases to 0.7% in the carbonate horizon (PK). The distribution of the main macronutrients throughout the soil profile also shows a decreasing trend with depth. This pattern applies to both total nitrogen (determined according to DSTU ISO 11261–2001) and available phosphorus (according to the method of V.I. Machigin, DSTU 4114–2002) (Figure 2).

The study is a three-factor experiment. Factor A – maize hybrids of the DEKALB brand: DKC 4098 (FAO 310), DKC 4109 (FAO 320), DKC 4391 (FAO 350), DKC 4598 (FAO 360), DKC 4712 (FAO 370), DKC 5075 (FAO 410), DKC 5206 (FAO 420). Factor B – plant density: 55, 60, 65, 70, 75, 80, 90, and 110 thousand/ha. Factor C – foliar fertilization: control (water treatment); Amino Ultra Maize (0.75 kg/ha); Micro-Mineralis Maize (1.5 l/ha). Foliar fertilizations were carried out twice – during the phases of 3–5 and 7–9 leaves.

Amino Ultra Maize from the Polish company INTERMAG is an organo-mineral microfertilizer

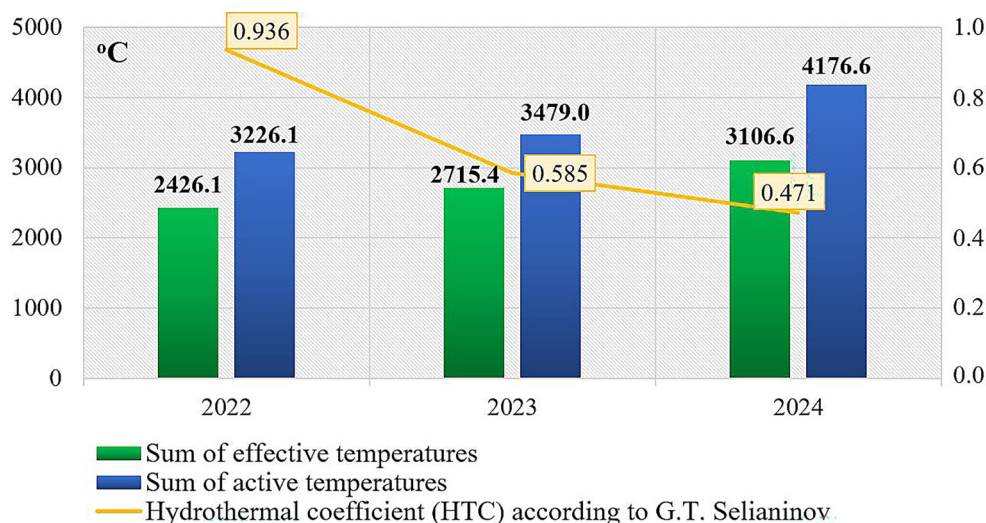


Figure 1. Agro-climatic indicators during the years of the study (according to the Kirovohrad Regional Center for Hydrometeorology)

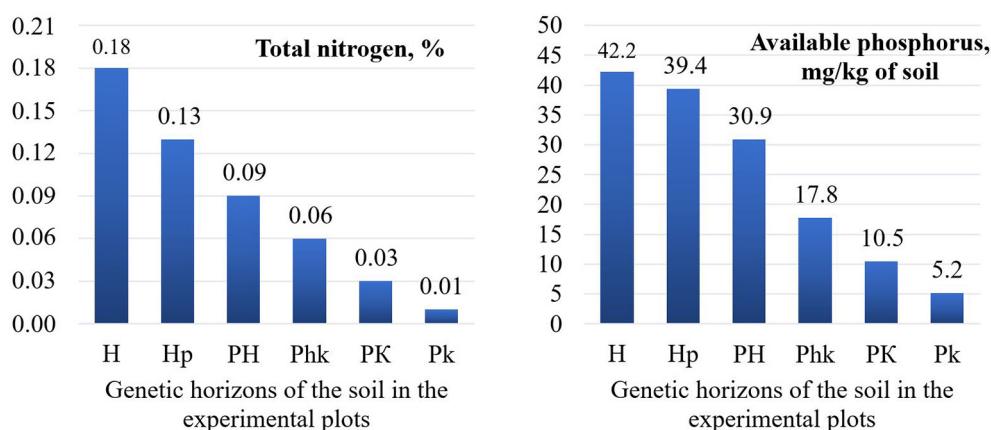


Figure 2. Content of total nitrogen and available phosphorus by genetic horizons of the soil in the experimental plots

for foliar feeding of maize, containing microelements in chelated form, g/kg: Fe – 68, Zn – 60, Mn – 57, B – 16, Cu – 8, Mo – 0.8. These elements are combined with the amino acid glycine using GCAA technology, which ensures quick and efficient absorption of nutrients by the plant. Glycine, as the most mobile amino acid, facilitates the rapid transport of microelements within the plant. The amino acids in the microfertilizer are a source of nitrogen (N – 40 g/kg, glycine content – 30–35%). The microfertilizer also contains 22 g/kg of magnesium oxide (MgO).

Micro-Mineralis Maize from LLC “Mineralis Ukraine” is a specially formulated complex of macro- and microelements in a liquid solution for foliar feeding. The composition of the microfertilizer includes ammonium-carboxylate complexes, %: N – 4.0, Zn – 3.1, Mg – 2.5, Fe – 2.0, Mn – 1.78, Cu – 0.75, B – 0.5. The oil content was measured by extraction in a Soxhlet apparatus using the method of S.V. Rushkovsky (State Standard of Ukraine 13496.15–97 – Feeds, compound feeds, feed raw materials. Methods for determining crude fat content). The statistical analysis of the field experiment results was performed using variance analysis according to V.O. Ushkarenko’s methodology, utilizing the “Agrostat” computer program [Ushkarenko et al., 2008].

Maize in the experiment was grown according to zonal technology, except for the studied factors. For the main soil cultivation, a nitrogen-phosphorus fertilizer was applied at a rate of $N_{60}P_{30}$. Ammonium nitrate (N – 34%) was used as the nitrogen source, and granulated superphosphate (P_2O_5 – 20%) as the phosphorus source. Before sowing, $N_{30}P_{30}K_{30}$ was applied in the form of nitroamophoska at a rate of 200 kg/ha.

RESULTS

Based on the research results, the variability of oil content in maize grain was determined, depending on plant density (factor B) and foliar fertilization with microfertilizers (factor C), as well as the hybrid (factor A) and weather conditions during the years of the study. On average, from 2022 to 2024, the oil content in the grain ranged from 3.80% for hybrid DKC 4598 (FAO 360) to 4.00% for hybrid DKC 4391 (FAO 350) (Table 1).

A clear trend was observed towards a decrease in fat content in the grain of all studied hybrids in 2023 compared to 2022, followed by a significant increase in fat content in 2024, indicating a substantial impact of agroclimatic conditions during the growing year on maize metabolism, particularly on lipid synthesis in the grain. In 2024, a small amount of precipitation fell, which negatively affected protein formation in the grain; however, the maximum amount of oil accumulated, reflecting a trend towards an inverse relationship between these two components in maize grain under stress conditions of water deficit. The negative correlation between protein and oil content is also confirmed by the results of other researchers [Ray et al., 2019].

Despite the overall annual dynamics, the relative ranking of hybrids by oil content is relatively stable. The maximum oil content in the grain of the experiment was provided by hybrids DKC 4712 (FAO 370), DKC 5206 (FAO 420), and DKC 4391 (FAO 350) – averaging 3.95–4.00% over the three years of research. The oil content in maize grain depended on plant density, confirming the regularity of decreasing oil content with increasing density from 55 to 80 thousand/ha. Thus, on average from

Table 1. Oil content in the grain of maize hybrids of different FAO groups on average for factors B and C, %

Hybrid (factor A)	Year of research			Average for 2022–2024
	2022	2023	2024	
DKC 4098 (FAO 310)	3.85	3.72	4.14	3.90
DKC 4109 (FAO 320)	3.88	3.74	4.17	3.93
DKC 4391 (FAO 350)	3.95	3.81	4.24	4.00
DKC 4598 (FAO 360)	3.76	3.61	4.04	3.80
DKC 4712 (FAO 370)	3.90	3.76	4.19	3.95
DKC 5075 (FAO 410)	3.83	3.70	4.11	3.88
DKC 5206 (FAO 420)	3.92	3.78	4.22	3.97

2022 to 2024, oil content decreased from 4.00% at a density of 55 thousand/ha to 3.78% at a density of 80 thousand/ha (Table 2).

Thickening of the crops above 80 thousand/ha increased the oil content of the grain, which at the maximum plant density (110 thousand/ha) averaged 3.94% over the three years of research. This can be explained by the activation of compensatory mechanisms that influence the chemical composition of the grain. The pattern regarding oil accumulation in maize grain depending on plant density was observed in all years of the study; however, the absolute values of this quality indicator varied. The maximum oil content in the grain for all planting densities was recorded in 2024 (4.02–4.23%), while the minimum was in 2023 (3.60–3.81%), which substantiates the significant impact of agro-climatic conditions during the growing year on the realization of the genetic potential of hybrids for oil accumulation in the grain.

The application of foliar fertilization with microfertilizers Amino Ultra Maize and Micro-Mineralis Maize in all years of the study slightly reduced the oil content in the grain compared to the control variant. On average, from 2022 to 2024, two applications of the microfertilizer

Amino Ultra Maize resulted in the lowest oil content in the grain – 3.87%, which is 0.09% lower than that of the control (Figure 3). Foliar fertilization with Micro-Mineralis Maize also led to a slight decrease in oil content to 3.93%, which is 0.03% lower than the control values.

The microfertilizer Micro-Mineralis Maize proved to be more effective in influencing the oil content in maize grain compared to the microfertilizer Amino Ultra Maize, as observed in all years of the study. For example, in 2022, the oil content in the grain for the treatments with foliar applications of the microfertilizer Micro-Mineralis Maize was 3.87%, while for the treatments using the microfertilizer Amino Ultra Maize, it was 3.80%.

The oil content in maize grain is the result of a complex interaction between hybrid characteristics (factor A), plant density (factor B), and foliar applications of microfertilizers (factor C). The highest average oil content in maize grain over the three years of research was achieved by growing hybrids DKC 4712 (FAO 370), DKC 5206 (FAO 420), and DKC 4391 (FAO 350) at a plant density of 55–70 thousand/ha without foliar applications of microfertilizers (Table 3). This combination of cultivation elements provides the most favorable

Table 2. Effect of plant density on the oil content in maize grain, average across factors A and C, %

Plant density, thousand plants/ha (factor B)	Year of research			Average for 2022–2024
	2022	2023	2024	
55	3.95	3.81	4.23	4.00
60	3.94	3.80	4.22	3.99
65	3.93	3.79	4.21	3.98
70	3.91	3.77	4.20	3.96
75	3.78	3.64	4.07	3.83
80	3.73	3.60	4.02	3.78
90	3.83	3.70	4.13	3.89
110	3.89	3.74	4.18	3.94

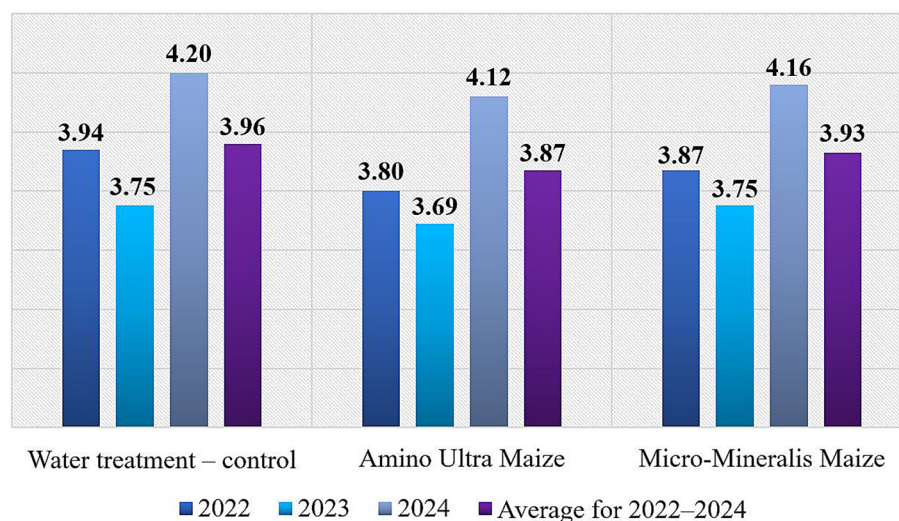


Figure 3. Effect of foliar application of micronutrient fertilizers on the oil content in maize grain, average across factors A and B, %

Table 3. Oil content in maize grain of hybrids from different FAO maturity groups depending on the studied factors (average for 2022–2024), %

Hybrid (factor A)	Plant density, thousand plants/ha (factor B)							
	55	60	65	70	75	80	90	110
Water treatment – control (factor C)								
DKC 4098 (FAO 310)	4.03	4.00	3.99	4.00	3.88	3.82	3.90	3.95
DKC 4109 (FAO 320)	4.04	4.06	4.02	4.02	3.88	3.83	3.92	3.97
DKC 4391 (FAO 350)	4.12	4.09	4.08	4.08	3.95	3.91	4.00	4.06
DKC 4598 (FAO 360)	3.91	3.91	3.89	3.90	3.75	3.74	3.80	3.86
DKC 4712 (FAO 370)	4.06	4.08	4.06	4.01	3.89	3.85	3.95	4.03
DKC 5075 (FAO 410)	3.99	3.98	3.98	3.95	3.83	3.80	3.89	3.96
DKC 5206 (FAO 420)	4.09	4.07	4.08	4.07	3.94	3.88	4.00	4.04
Amino Ultra Maize (factor C)								
DKC 4098 (FAO 310)	3.95	3.89	3.91	3.87	3.77	3.70	3.82	3.87
DKC 4109 (FAO 320)	3.97	3.94	3.94	3.92	3.81	3.71	3.85	3.90
DKC 4391 (FAO 350)	4.03	4.02	4.02	3.98	3.85	3.80	3.92	3.95
DKC 4598 (FAO 360)	3.81	3.81	3.82	3.77	3.69	3.67	3.72	3.77
DKC 4712 (FAO 370)	3.97	3.97	3.97	3.92	3.81	3.77	3.88	3.91
DKC 5075 (FAO 410)	3.89	3.90	3.90	3.87	3.72	3.71	3.80	3.85
DKC 5206 (FAO 420)	4.00	3.98	3.96	3.96	3.83	3.77	3.86	3.93
Micro-Mineralis Maize (factor C)								
DKC 4098 (FAO 310)	3.99	3.98	3.97	3.96	3.81	3.77	3.88	3.92
DKC 4109 (FAO 320)	4.01	4.01	3.99	3.99	3.85	3.79	3.90	3.94
DKC 4391 (FAO 350)	4.11	4.10	4.08	4.04	3.92	3.85	3.99	4.02
DKC 4598 (FAO 360)	3.88	3.87	3.86	3.86	3.69	3.69	3.80	3.83
DKC 4712 (FAO 370)	4.05	4.02	4.03	3.99	3.88	3.80	3.93	3.98
DKC 5075 (FAO 410)	3.96	3.93	3.93	3.94	3.80	3.77	3.83	3.89
DKC 5206 (FAO 420)	4.09	4.06	4.03	4.03	3.90	3.84	3.95	4.01
LSD ₀₅ , %								
2022: A – 0.07; B – 0.04; C – 0.08; AB – 0.12; AC – 0.11; BC – 0.13; ABC – 0.28.								
2023: A – 0.05; B – 0.03; C – 0.06; AB – 0.09; AC – 0.08; BC – 0.09; ABC – 0.19.								
2024: A – 0.07; B – 0.05; C – 0.09; AB – 0.13; AC – 0.14; BC – 0.15; ABC – 0.32.								

Table 4. Conditional yield of oil per hectare of hybrid maize crops of different FAO groups depending on the studied factors (average for 2022–2024), t/ha

Hybrid (factor A)	Plant density, thousand plants/ha (factor B)							
	55	60	65	70	75	80	90	110
Water treatment – control (factor C)								
DKC 4098 (FAO 310)	0.31	0.31	0.30	0.32	0.31	0.30	0.29	0.29
DKC 4109 (FAO 320)	0.30	0.32	0.32	0.32	0.31	0.29	0.30	0.30
DKC 4391 (FAO 350)	0.32	0.32	0.33	0.33	0.31	0.30	0.29	0.29
DKC 4598 (FAO 360)	0.30	0.30	0.30	0.29	0.28	0.28	0.27	0.26
DKC 4712 (FAO 370)	0.32	0.33	0.33	0.31	0.31	0.29	0.29	0.28
DKC 5075 (FAO 410)	0.31	0.30	0.31	0.31	0.30	0.30	0.29	0.29
DKC 5206 (FAO 420)	0.32	0.33	0.33	0.31	0.30	0.29	0.30	0.29
Amino Ultra Maize (factor C)								
DKC 4098 (FAO 310)	0.36	0.35	0.34	0.36	0.35	0.33	0.33	0.34
DKC 4109 (FAO 320)	0.34	0.36	0.36	0.36	0.35	0.33	0.33	0.33
DKC 4391 (FAO 350)	0.37	0.37	0.37	0.37	0.35	0.33	0.33	0.34
DKC 4598 (FAO 360)	0.34	0.34	0.34	0.32	0.32	0.31	0.29	0.33
DKC 4712 (FAO 370)	0.36	0.37	0.37	0.36	0.36	0.33	0.33	0.34
DKC 5075 (FAO 410)	0.35	0.35	0.36	0.35	0.34	0.33	0.33	0.34
DKC 5206 (FAO 420)	0.37	0.37	0.37	0.36	0.34	0.33	0.33	0.35
Micro-Mineralis Maize (factor C)								
DKC 4098 (FAO 310)	0.35	0.34	0.34	0.36	0.34	0.32	0.33	0.33
DKC 4109 (FAO 320)	0.34	0.36	0.36	0.36	0.34	0.33	0.33	0.33
DKC 4391 (FAO 350)	0.37	0.37	0.37	0.36	0.35	0.32	0.33	0.34
DKC 4598 (FAO 360)	0.34	0.33	0.33	0.32	0.31	0.30	0.29	0.33
DKC 4712 (FAO 370)	0.36	0.36	0.37	0.35	0.35	0.32	0.32	0.34
DKC 5075 (FAO 410)	0.34	0.34	0.35	0.35	0.33	0.32	0.32	0.33
DKC 5206 (FAO 420)	0.37	0.37	0.37	0.35	0.34	0.32	0.32	0.35

conditions for the synthesis and accumulation of oil in maize grain.

According to the calculations performed, it was determined that all studied factors had an impact on the conditional yield of oil per hectare of maize crops. This indicator varied from 0.26 to 0.37 t/ha on average over the three years of research (Table 4). The highest values were achieved by growing hybrids DKC 4391 (FAO 350), DKC 4712 (FAO 370), and DKC 5206 (FAO 420) at a plant density of 55–70 thousand/ha with foliar applications of the microfertilizer Amino Ultra Maize.

The most significant factor for increasing the conditional yield of oil per hectare of maize crops is the application of foliar microfertilizers. Compared to the control (water treatment), where the maximum oil yield in the most productive hybrids reached 0.33 t/ha, using microfertilizers in the cultivation technology increased this indicator to 0.36–0.37 t/ha. Thus, despite the decrease

in oil content in maize grain in treatments with two applications of microfertilizers, the conditional yield of oil increased due to a higher level of formed yield. This can be explained by the fact that microfertilizers contribute to the activation of overall metabolic processes in the plant, leading to an increase in its total biomass and grain quantity, which compensates for the slight decrease in the percentage oil content, ensuring a significant increase in the studied product per unit area.

CONCLUSIONS

The oil content in maize grain significantly depends on the genetic characteristics of the hybrid, agronomic practices, and the weather conditions of the growing year. On average, from 2022 to 2024, this quality indicator ranged from 3.80% to 4.00%. The highest oil content was accumulated by the hybrids DKC 4712 (FAO 370), DKC

5206 (FAO 420), and DKC 4391 (FAO 350). The fluctuations in oil content over the years were related to varying agro-climatic conditions. Stressful conditions of water deficit negatively affected the protein content in the grain; however, the oil content was maximized, indicating a negative correlation between protein and oil content.

The influence of plant density on the oil content in grain exhibited a stable pattern: a decrease in oil content was observed with increased planting density from 55 to 80 thousand plants per hectare (from 4.00% to 3.78%), followed by an increase at a density of 110 thousand plants per hectare (up to 3.94%).

Foliar applications of microfertilizers slightly reduced the percentage of oil compared to the control (3.96%), but they increased the yield level, positively affecting the conditional oil yield per hectare of crops. The least reduction in oil content was noted when using the microfertilizer Micro-Mineralis Maize (3.93%).

The highest conditional oil yield per hectare (0.36–0.37 t/ha) was achieved by growing the hybrids DKC 4712, DKC 5206, and DKC 4391 at a plant density of 55–70 thousand plants per hectare with foliar applications of the microfertilizer Amino Ultra Maize. To achieve a high level of oil content in grain, it is advisable to grow maize hybrids with high genetic potential at a density of 55–70 thousand plants per hectare without the use of microfertilizers. For maximum conditional oil yield per unit area, we recommend growing high-yield hybrids with optimal plant density and conducting foliar applications.

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