RESEARCH ON THE INFLUENCE OF UREA FERTILIZATION ON THE QUALITY OF MAIZE PRODUCTION IN THE CENTRAL AREA OF OLTENIA

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Abstract

A bifactorial experiment involving maize hybrids fertilized with different doses of urea was conducted in 2025 on chernozem soil in Caracal. The maize hybrids used were P9944, P0260, and P0450. The tested urea doses were 50 kg/ha, 100 kg/ha, and 150 kg/ha. The obtained yield was analyzed based on five quality indices: protein content, fat content, sugar content, starch content, and fiber content. The average protein content was 4.7%, while the fat content averaged 2.7%. Under the pedoclimatic conditions of Caracal, the quality of maize production was influenced by nitrogen fertilization.

***Key words**: maize, urea, production quality, protein, fat*

INTRODUCTION

From Central America to South America and then to Europe, maize has a long and fascinating history. The earliest evidence dates back to around 5000 BC in Mexico, where maize was considered a staple food. At that time, it was even believed that the first human was made from maize kernels. During his voyage to the "New World" in 1492, Columbus discovered maize and brought it to Spain. Less than half a century later, along with sweet potatoes and peanuts, maize reached Asia, where it was called "the bread of the poor," being regarded as the most important source of protein and energy for low-income populations.

Especially in rural areas, the inhabitants relied heavily on cereal consumption, and maize soon became a basic dietary component. The crop spread rapidly across the world, reaching China by 1555. By the 17th century, maize was already cultivated in Central Europe, where it quickly replaced the traditionally grown cereals.

Today, maize continues to attract considerable interest, making it one of the most popular foods among both children and adults. In 1989, the U.S. state of Wisconsin designated maize as its official grain, drawing attention to its importance and to its many applications, which include animal feed, ethanol fuel, sweeteners, and biodegradable plastics.

Maize contributes to food security by being a staple crop that provides essential energy, protein, and micronutrients. Progress in genomics is ensuring food security by improving crop resilience, increasing yields, and enhancing nutritional value (De Souza and Bonciu, 2022 a,b). Maize contains a moderate amount of protein—approximately 3.4 to 9.4 grams per 100 grams—and a relatively low-fat content of 1.5 to 4.7 grams per 100 grams of maize.

Excessive fertilizer use in recent years has led to a range of agronomic and environmental problems (Paunescu et al., 2021, 2023; Rosculete et al., 2021). While fertilization can significantly enhance maize yield, improper practices—such as over-application and nutrient imbalances in nitrogen (N), phosphorus (P), and potassium (K)—have markedly diminished the yield response and now pose significant constraints to further yield gains (Ren et al., 2021a; Ren et al., 2021b).

Field trials across different genotypes and environments have reported that phosphorus (P) application does not significantly affect fatty acid composition or tocopherol content in maize kernels (Lux et al., 2021). In contrast, potassium (K) application was found to reduce protein content while increasing oil concentration in soybean seeds (Anthony et al., 2012).

Although numerous studies have explored the relationship between fertilization and maize yield and quality in Northeast China, most of these are based on individual field experiments, which tend to reflect only localized patterns and findings (Shi et al., 2024; Young et al., 2021). Given the vast expanse of the primary maize production areas in Northeast China—spanning from east to west and north to south—there exists considerable variability in natural conditions. As such, results from single-location trials are insufficient to generalize fertilization effects at the regional scale, and comprehensive studies addressing the overall relationship between fertilization, yield, and quality in this region remain limited. Meta-analysis is a quantitative statistical method that integrates and synthesizes results from multiple independent but comparable studies and has been widely applied in agricultural research (Makowski et al., 2019; Borenstein et al., 2021). Numerous meta-analyses on fertilization have been conducted. For instance, Guo et al. (2022) demonstrated that nitrogen application has a positive effect on crop yield and global warming potential, while increasing greenhouse gas emissions. Zhang et al. (2024) reported that a nitrogen input of 215 kg ha−1 was most effective in enhancing both yield and water use efficiency. However, few studies have systematically evaluated the synergistic effects of fertilization—namely, the simultaneous improvement of both maize yield and grain quality—across diverse environmental and management contexts (Gao et al., 2024).

MATERIALS AND METHODS

A bifactorial experiment involving maize hybrids fertilized with different doses of urea was conducted in 2025 on chernozem soil located in Caracal.

The maize hybrids used in the study were P9944, P0260, and P0450. The tested urea doses were 50 kg/ha, 100 kg/ha, and 150 kg/ha. The obtained yield was analyzed according to five quality indices: protein content, fat content, sugar content, starch content, and fiber content.

The soil presented a humus content of 3.04% in the Ap horizon and 1.78% in the Am horizon, decreasing to 1.24% in the B horizon. It was moderately supplied with total nitrogen (0.172% in Ap), very well supplied with available phosphorus (168 ppm in Ap), and well supplied with available potassium (248 ppm). The soil reaction across the profile ranged from slightly acidic to slightly alkaline. The sum of exchangeable bases was moderate (23.2 in Ap, 24.8 in Am), and the base saturation degree was 92.62%, increasing gradually towards the Cca horizon. The content of microelements was high for zinc (176 ppm in Ap) but extremely low in the B horizon (0.40 ppm).

The climatic conditions in 2025 were unfavourable for maize cultivation; however, the experiment was conducted under irrigated conditions.

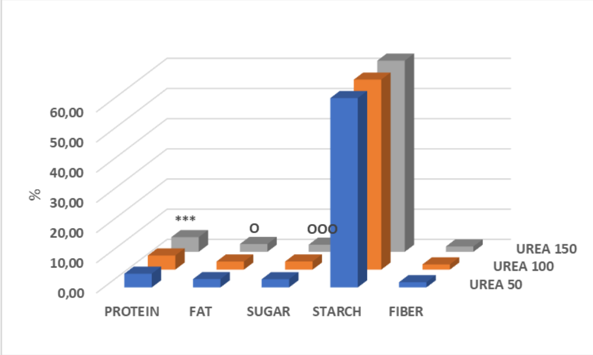
RESULTS AND DISCUSSIONS

The protein content ranged between 4.27% for hybrid P0450 fertilized with 50 kg a.i./ha of urea and 5.35% for hybrid P9944 at the dose of 150 kg a.i./ha.

The fat content varied between 2.34% in hybrid P9944 at 50 kg a.i./ha of urea and 3.22% in hybrid P0260 fertilized with 150 kg a.i./ha of urea (Figure 1).

Sugar content showed the greatest amplitude of variation. The lowest value (1.94%) was recorded in hybrid P9944 at the 150 kg a.i./ha dose, while the highest values (3.18–3.22%) were observed in hybrid P0260 at the first two urea doses (Figure 1).

Starch content exhibited only minor differences among hybrids and between doses within each hybrid. For hybrid P9944, the difference was below 1%. In hybrid P0260, starch content ranged between 62.25% and 63.59%, while in hybrid P0450, the difference was even smaller, also below 1% (Figure 1).



	PROTEIN%	FAT%	SUGAR%	STARCH%	FIBER%
UREA 50	4.55	2.75	2.71	62.73	1.71
UREA 100	4.68	2.68	2.69	62.95	1.72
UREA 150	4.86	2.59	2.35	63.33	1.77
LSD 5%	0.15	0.14	0.13	0.98	0.09
LSD 1%	0.21	0.2	0.18	1.38	0.12
LSD 0.1%	0.30	0.27	0.26	1.95	0.18

Figure 1. Influence of Urea Fertilization on Maize Production Quality – Caracal, 2025.

The fiber content ranged between 1.51% in hybrid P0450 fertilized with 150 kg a.i./ha of urea and 2.02% in hybrid P9944 at the same fertilization dose.

CONCLUSIONS

Maize contains a moderate level of protein, ranging between approximately 3.4 and 9.4 grams per 100 grams, and a low-fat content of 1.5 to 4.7 grams per 100 grams. In this study, the average protein content was 4.7%, while the average fat content was 2.7%.

Under the pedoclimatic conditions of Caracal, maize production quality was influenced by nitrogen fertilization. While higher urea doses resulted in increased protein content, the contents of fat and sugar decreased. Starch and fiber contents were not affected by urea fertilization, regardless of the applied dose.

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