COMPARATIVE ANALYSIS OF MAIZE HYBRID PERFORMANCE AND YIELD COMPONENTS IN THE BURNAS PLAIN UNDER DIFFERENTIAL FERTILIZATION

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Abstract

A two-factor field experiment was carried out in 2024 on Chernozem soil in the Burnas Plain, under irrigated conditions, to evaluate several maize hybrids subjected to differential fertilization. The study included the hybrids MAS DM5332, GIRO, P450, P710, DKC 5810, and DKC 5709. The fertilization factor (Factor B) consisted of five treatments: b1 – unfertilized control (M); b2 – 40 t/ha poultry manure (O); b3 – 20 t/ha cattle manure combined with 111 kg/ha NPK 20:20:0 (O+NPK); b4 – 222 kg/ha NPK 20:20:0 (NPK); and b5 – 310 kg/ha urea (U). The parameters assessed were grain yield, 1000-kernel weight, number of kernels per ear, and harvest index. The results indicated that all fertilized treatments produced higher yields than the unfertilized control; however, only three of these increases were statistically significant. Moreover, fertilization resulted in a highly significant improvement in 1000-kernel weight, demonstrating the positive influence of nutrient management on maize productivity components.

***Key words**: maize hybrids, differential fertilization, grain yield, yield components, Burnas Plain*

INTRODUCTION

Maize (Zea mays L.) remains one of the world's most important cereal crops, cultivated over a wide range of agroecological conditions and contributing significantly to global food security (FAO, 2023). In Romania, maize occupies one of the leading positions among cereal crops, covering nearly half of the total arable area and contributing significantly to the country's overall agricultural output (Dragomir et al., 2022). Maize represents the primary cereal crop cultivated in Romania, accounting for more than half of national grain production and playing a crucial role in ensuring food security and agro-industrial stability (Petre, 2022).

Nutrient management remains a key determinant of maize productivity, influencing physiological processes, grain filling, and overall yield (Hawkesford et al., 2022). According to Liu et al. (2021), balanced fertilization combining organic and mineral sources contributes to improved soil fertility and higher nutrient-use efficiency. Similar conclusions were drawn by Lal (2020), who emphasized that integrating organic amendments enhances soil structure and long-term productivity.

Numerous studies demonstrated the positive effects of nitrogen fertilization on maize growth and yield formation (Ciampitti & Vyn, 2014; Dobermann, 2007). However, excessive nitrogen application can reduce efficiency and increase environmental risks, such as nitrate leaching and greenhouse gas emissions (Snyder et al., 2014). Consequently, differential fertilization strategies that integrate organic, organo-mineral, and mineral nutrient sources are increasingly investigated to enhance nutrient-use efficiency and maintain yield stability. Recent studies demonstrated that "the increase in crop yields due to the adoption of Integrated Nutrient Management (INM) over conventional nutrient management was as high as 66.5% across the major cropping systems" (Timsina et al., 2023), and that "integrated nutrient management provided the highest dry biomass and grain yield of maize and was found to be economically feasible" (Gezahegn, 2021).

At the physiological level, fertilization not only affects grain yield but also key components such as 1000-kernel weight and harvest index (Blanco-Canqui & Lal, 2007). According to Amanullah and Khan (2015), nitrogen availability promotes kernel filling and improves grain density, while phosphorus supports early root development and energy transfer. Organic amendments further stimulate microbial activity, which enhances nutrient cycling and crop resilience (García et al., 2018).

Given the increasing pressure for sustainable agricultural systems, integrated fertilization and hybrid improvement represent essential tools for maximizing maize productivity while conserving soil resources (Tilman et al., 2020). Therefore, the current research focuses on evaluating the combined effects of genotype and fertilization in the Burnas Plain, aiming to identify efficient technological solutions for enhancing yield and yield components under irrigated conditions.

MATERIALS AND METHODS

The commune of Sfințești, where the MILAGRO ANG S.R.L. experimental farm is located, lies in the south-central part of the Romanian Plain, within Teleorman County, an area characterized by favorable agro-ecological conditions for field crops.

A two-factor field experiment was established in 2024. Factor A (hybrid) included six levels: a1 = MAS DM5332, a2 = GIRO, a3 = P0450, a4 = P0710, a5 = DKC 5810, and a6 = DKC 5709.

The fertilization factor (Factor B) comprised five treatments: b1 = unfertilized control (M); b2 = organic fertilizers – 40 t/ha poultry manure; b3 = organic fertilizers – 20 t/ha poultry manure + 111 kg/ha NPK 20:20:0; b4 = mineral fertilization – 222 kg/ha NPK 20:20:0; and b5 = urea – 310 kg/ha.

MAS DM5332 (FAO 470) is a semi-late hybrid with medium plant height and dent-type kernels, typically forming 18–20 kernel rows per ear.

The GIRO KWS hybrid (FAO 430), part of the ClimaControl3 range, is highly productive and adaptable to soils with low fertility, achieving yields of up to 13.8 t/ha under experimental conditions.

P0450 (FAO 450) is a semi-late hybrid distinguished by excellent tolerance to drought and heat stress, making it suitable for the southern and western regions of Romania.

P0710 (FAO 450), from the Pioneer AQUAmax series, is known for its exceptional drought resistance and high grain yield potential.

DKC5810 (FAO 570) is recognized for its very high yield potential, reaching 10–13 t/ha under intensive management practices.

The experimental soil is classified as a leached (argic) Chernozem, typical of the Romanian Plain, with a medium texture, slightly acidic reaction, low available phosphorus, adequate potassium content, and moderate nitrogen fertility.

Although climatic conditions in 2024 were unfavorable for maize cultivation, the experiment was conducted under irrigated conditions, ensuring optimal crop growth and reliable yield assessment.

RESULTS AND DISCUSSIONS

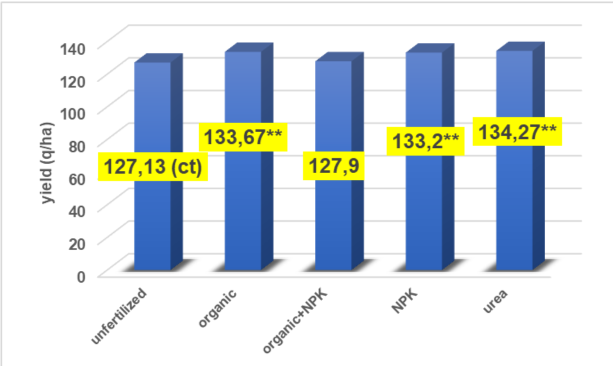
The six tested maize hybrids recorded grain yields ranging from 113.09 q/ha for the hybrid MAS DM5332 to 152.23 q/ha for DKC5810, with an overall mean yield of 131.25 q/ha. While the first two hybrids (MAS DM5332 and GIRO) showed highly significant yield reductions, the hybrids DKC5810 and DKC5709 exhibited highly significant and significant yield increases, respectively, compared with the average of all tested hybrids (Table 1).

The coefficient of variation (CV) calculated from the yield data series of each hybrid—based on all levels of the fertilization factor (Factor B) and two replications—indicated that the hybrids GIRO, P450, and DKC5810 were stable in terms of productivity (CV below 10%), with values of 5.3% and 8.8% for the latter two. The hybrids MAS DM5332 and P710 showed medium stability (CV between 10% and 20%), with values of 14.7% and 14.9%, respectively. In contrast, the hybrid DKC5709 was unstable, having a coefficient of variation above 20% (25.2%), indicating a high degree of yield variability across treatments.

Table 1. Influence of Maize Hybrid on Grain Yield of the Tested Hybrids in the Burnas Plain Under Irrigated Conditions – 2024

Hybrid	**Grain yield (q/ha)**	**Difference from the mean (q/ha)**	**Significance**
MAS DM5332	113.09	-18.16	ooo
GIRO	115.78	-15.47	ooo
P450	130.43	-0.82	
P710	132.81	1.56	
DKC5810	152.23	20.98	***
DKC5709	143.15	11.9	**
Control mean	**131.25**		
DL 5%	**5.05 q/ha**		
DL 1%	**7.92 q/ha**		
DL 0.1%	**13.47 q/ha**		

As shown in Figure 1, the grain yield obtained from the fertilized treatments was higher compared to the unfertilized control, but the yield increase was statistically significant only in three variants—namely, organic fertilization, mineral fertilization with NPK, and urea application. Although the combined treatment (organic + NPK) resulted in a yield increase, this difference was not statistically significant compared with the control.



DL 5%	**4.05 q/ha**
DL 1%	**5.50 q/ha**
DL 0.1%	**7.37 q/ha**

Figure 1. Influence of Fertilization on the Grain Yield of Maize Hybrids Tested in the Burnas Plain – 2024

The interaction between the studied factors had a clear influence on grain yield. The later-maturing DKC hybrids responded very well, showing highly significant yield increases under urea fertilization. Although the combination of organic and mineral fertilization, considered as a single factor, did not result in a statistically significant yield increase overall, the results suggest that hybrid DKC5810 was the only one that fully exploited this fertilization type, recording a highly significant yield increase of 20.8 q/ha (Table 2).

Table 2. Influence of the Hybrid × Fertilization Interaction on the Grain Yield of Maize Hybrids Tested in the Burnas Plain Under Irrigated Conditions – 2024

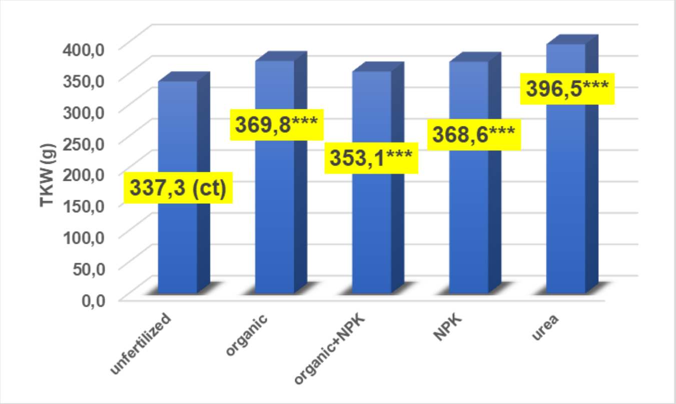
Hybrid	Fertilization type	Grain yield (q/ha)	Difference from the mean (q/ha)	Significance
MAS DM5332	Ct	114.63	ct	
	O	117.92	3.29	
	O+NPK	105.33	-9.3	
	NPK	118.62	3.99	
	U	108.95	-5.68	
GIRO	Ct	111.74	ct	
	O	117.15	5.41	
	O+NPK	115.84	4.1	
	NPK	118.71	6.97	
	U	115.45	3.71	
P450	Ct	128.82	ct	
	O	133.01	4.19	
	O+NPK	124.73	-4.09	
	NPK	130.49	1.67	
	U	135.09	6.27	
P710	Ct	130.41	ct	
	O	139.13	8.72	
	O+NPK	127.02	-3.39	
	NPK	131.07	0.66	
	U	136.40	5.99	
DKC5810	Ct	140.65	ct	
	O	150.08	9.43	*
	O+NPK	161.45	20.8	***
	NPK	146.57	5.92	
	U	162.40	21.75	***
DKC5709	Ct	136.55	ct	
	O	144.75	8.2	
	O+NPK	133.24	-3.31	
	NPK	153.84	17.29	***
	U	147.38	10.83	***

DL 5%	**8.9 q/ha**
DL 1%	**12.09 q/ha**
DL 0.1%	**16.19 q/ha**

Fertilization had a strong influence on the 1000-kernel weight. All fertilized treatments recorded highly significant increases, with urea application showing the greatest increase, of +59.5 g (Figure 2).

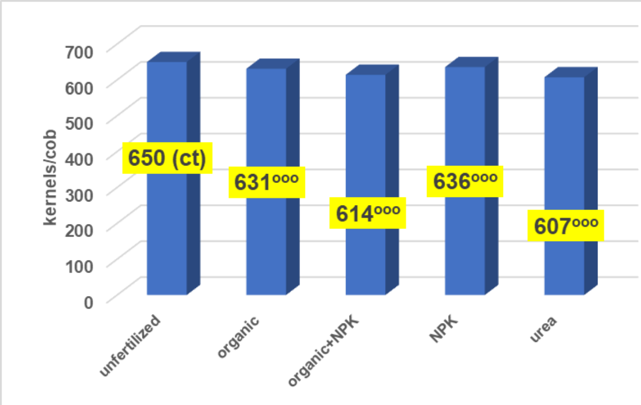
The number of kernels per ear was also affected by fertilization, but in a negative direction. This parameter showed a highly significant decrease across all levels of Factor B (fertilization). The results are consistent with the previous findings related to the 1000-kernel weight, indicating that a smaller number of kernels tends to develop more fully, resulting in greater individual kernel mass (Figure 3).

The harvest index, expressed as the ratio between grain weight and cob weight, was also influenced by the type of fertilization. In this case as well, all fertilization treatments produced statistically significant increases in harvest index values (Figure 4).



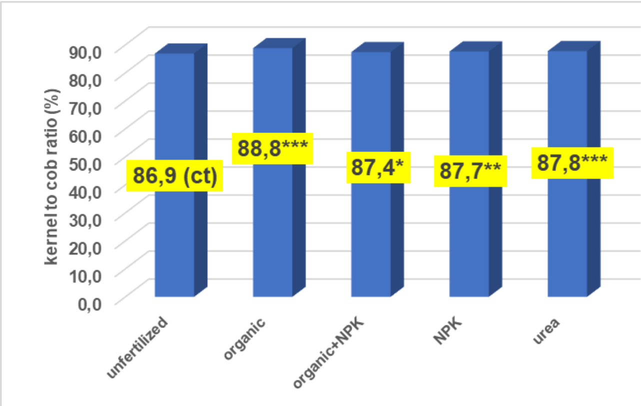
DL 5%	**5.1 g**
DL 1%	**6.9 g**
DL 0.1%	**9.3 g**

Figure 2. Influence of Fertilization on the 1000-Kernel Weight of Maize Hybrids Tested in the Burnas Plain – 2024



DL 5%	**5 g**
DL 1%	**7 g**
DL 0.1%	**9 g**

Figure 3. Influence of Fertilization on the Number of Kernels per Ear in Maize Hybrids Tested in the Burnas Plain – 2024



DL 5%	**0.5%**
DL 1%	**0.7%**
DL 0.1%	**0.9%**

Figure 4. Influence of Fertilization on the Harvest Index of Maize Hybrids Tested in the Burnas Plain – 2024

The hybrid × fertilization interaction had a strong influence on the harvest index. Values ranged from 82.8% for the unfertilized DKC5810 hybrid to 91.3% for the GIRO hybrid fertilized with NPK-type mineral fertilizers (Table 3).

The DKC5810 hybrid responded best to fertilization, showing highly significant increases in harvest index under all fertilization treatments. The tested hybrids responded differently to mineral fertilization: while GIRO, P450, and DKC5810 exhibited highly significant increases compared to the unfertilized control, the hybrids P710 and DKC5709 showed statistically significant decreases in harvest index values.

Table 3. Influence of the Hybrid × Fertilization Interaction on the Harvest Index of Maize Hybrids Tested in the Burnas Plain Under Irrigated Conditions – 2024

Hybrid	Fertilization type	Grain yield (q/ha)	Difference from the mean (q/ha)	Significance
MAS DM5332	Ct	**87.6**	0.0	
	O	**88.4**	0.8	
	O+NPK	**87.7**	0.1	
	NPK	**88.0**	0.4	
	U	**85.5**	-2.1	ooo
GIRO	Ct	**89.3**	0.0	
	O	**90.2**	0.9	
	O+NPK	**90.8**	1.5	**
	NPK	**91.3**	2.0	***
	U	**89.5**	0.2	
P450	Ct	**86.4**	0.0	
	O	**86.2**	-0.2	
	O+NPK	**85.4**	-1.0	
	NPK	**88.6**	2.2	***
	U	**88.2**	1.8	**
P710	Ct	**88.8**	0.0	
	O	**95.9**	7.1	***
	O+NPK	**87.9**	-0.9	
	NPK	**85.2**	-3.6	ooo
	U	**87.8**	-1.0	
DKC5810	Ct	**82.8**	0.0	
	O	**86.5**	3.7	***
	O+NPK	**87.0**	4.2	***
	NPK	**88.1**	5.3	***
	U	**89.8**	7.0	***
DKC5709	Ct	**86.5**	0.0	
	O	**85.8**	-0.7	
	O+NPK	**85.7**	-0.8	
	NPK	**84.8**	-1.7	oo
	U	**85.9**	-0.6	

DL 5%	**1.1%**
DL 1%	**1.5%**
DL 0.1%	**1.9%**

CONCLUSIONS

The types of fertilization, both as an individual factor and through their interaction with the hybrid factor, significantly influenced grain yield as well as the other analyzed traits: 1000-kernel weight, number of kernels per ear, and harvest index.

From a productivity standpoint, the DKC5810 and DKC5709 hybrids clearly stood out, achieving yields of 152.23 q/ha and 143.15 q/ha, respectively, compared with the mean yield of the tested hybrids, with the obtained increases being statistically significant.

Urea fertilization in the DKC hybrids resulted in very high grain yields compared with the unfertilized control, highlighting their strong response to nitrogen supply.

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