EXPERIMENTAL RESULTS OBTAINED AT PERSPECTIVE MAIZE HYBRIDS AT ARDS SIMNIC

Ioana-Claudia DUNĂREANU[1], Dorina BONEA[2]

[1]Agricultural Research and Development Station Şimnic, 54 Bălceşti Street, Craiova, Dolj County, Romania, author email: claudia.borleanu@yahoo.com
[2]University of Craiova, Faculty of Agronomy, 19 Libertății Street, Craiova, Romania, author email: dorina.bonea@edu.ucv.ro

Corresponding author email: dorina.bonea@edu.ucv.ro.

Abstract

Because maize is a crop sensitive to extreme weather events, maize production is expected to decline in the future, especially in arid and semi-arid areas. Therefore, the development of productive and drought-tolerant maize hybrids is a major objective of breeding programs worldwide. This study presents aspects regarding the performance of perspective maize hybrids developed at INCDA (NARDI) Fundulea, in order to meet market demands in the context of climate change. For this purpose, fifteen maize hybrids were evaluated in comparative trials carried out under the pedoclimatic conditions of SCDA (ARDS) Şimnic, Dolj County. The testing lasted two years. As a result of this study, the perspective maize hybrids HSF1033-17, HSF 1214-17 and HSF1128-14 were selected for high yield and adaptability, as well as for tolerance to Fusarium spp. attack. These selected hybrids can be advanced for testing in the ISTIS network (SIVTR/State Institute for Variety Testing and Registration).

Key words**: **maize, test weight, 1000-grain weight, yield

INTRODUCTION

Maize (*Zea mays* L.) is a staple crop worldwide, providing essential nutrients for billions of people (Batiru et al., 2025). Drought, an increasingly widespread climatic phenomenon in recent years, is a sinister force that wreaks havoc on agricultural systems. Among the crops affected by this phenomenon, maize stands out as one of the most vulnerable, with considerable economic consequences (Makuya et al., 2024).

Maize (*Zea mays*) is a C4 crop, but its sensitivity to drought during the reproductive stage makes it a key crop in climate vulnerability research (Wang et al., 2025).

Previous research has shown that the combined stress of drought and high temperatures during this stage can lead to a 40%–60% reduction in maize yield (Dunăreanu and Bonea, 2022b; Hu et al., 2023).

The Oltenia area is known for its semi-arid climate with frequent hydroclimatic phenomena, such as droughts and heat (Grecu et al., 2010; Băducă et al., 2011;; Colă et al., 2022; Dunăreanu and Bonea, 2022a; Bălan, 2023; Bălan, 2024; Constantinescu et al., 2024; Vlăduț et al. 2017). Here, these phenomena intermittently lead to low yields.

The reduction in maize yield not only affects the economy of this area, but also threatens food security at the national level. From a food point of view, maize is appreciated for its protein, fiber and carbohydrate content, but also for approximately 400 products with various uses (Medelete and Pânzaru, 2023).

Therefore, breeding programs pay increased attention to studying the effects of these climatic factors on the maize crop.
According to Haș et al (2021), selecting semi-early genotypes that show better tolerance to heat and drought, especially during the grain-filling period, can contribute to the ability of new hybrids to counteract the effect of climate change.
For the development of maize hybrids characterized by drought tolerance, selection pressure must be carried out through early testing of genotypes (Voica, 2012).
Determining the degree of expression of improved traits is done by experimenting with genotypes in comparative trials under different agro-climatic conditions (Horhocea et al., 2020). In this paper, we aimed to highlight the effect of agro-climatic conditions on the performance of some perspective maize hybrids in the Oltenia area (ARDS Șimnic).

MATERIALS AND METHODS

The biological material studied consisted of 15 maize genotypes: a commercial hybrid used as a control – F423, and 14 perspective hybrids obtained at INCDA (NARDI) Fundulea, Romania.
The experiment was carried out at ARDS Şimnic under non-irrigated conditions. The experiments were set up according to the completely randomized block method for two years (2021-2022).
During the growing period, the following observations were made: date of emergence (when 75% of the plants had emerged); date of physiological maturity (when 50% of the plants had completely yellowed panicles); plant height (measured from the ground to the top of the panicle).
At harvest, notes were made on the total number of plants harvested/plot; weight of grains/plot to determine yield/ha (kg/ha); 1000-grain weight (TGW), test weight (TW), grain moisture at harvest for yield correction to the standard moisture of 15.5%.
The degree of attack of the fungus *Fusarium spp*. on the ear was assessed with notes in the FAO scale (1 = sensitive and 9 = tolerant).
The experimental results regarding grain yield were statistically processed by ANOVA (Ceapoiu, 1968).

RESULTS AND DISCUSSIONS

Climatically, 2021 was a hot and very dry year, with drought periods occurring in April, July, August and September, the months in which sowing, grain formation and filling, as well as physiological maturity, take place. Also, the drought in June and July 2022 had negative influences on flowering and grain formation (Figure 1).
Table 1 presents the grain yields obtained in 2021 and 2022, as well as the average over the two years of study (2021-2022).
The ANOVA results regarding grain yield for each year and as an average for the two years of experimentation indicated significant differences between the tested hybrids.
In 2021, a year characterized by severe drought during critical phases of the maize crop, the yields achieved ranged between 1084 kg/ha (HSF 3425-16) and 2261 kg/ha (HSF 1370-17), and compared to the yield recorded by the control variant (hybrid F423 - 2210 kg/ha), no statistically significant yield increases were recorded.
In 2022, wich was somewhat more favorable year for maize crop, the yields obtained ranged between 2773 kg/ha (HSF 10865-19) and 3846 kg/ha (HSF 1214-17). Compared to the yield recorded by the control variant (hybrid F423 - 2775 kg/ha), statistically very significant yield increases were recorded for the hybrids HSF 1214-17 (+1071 kg/ha), HSF 10901-19 (+965 kg/ha) and HSF 1033-17 (+923 kg/ha).
Also, distinctly significant yield increases were recorded in the HSF 3425-16 (+495 kg/ha) and HSF 10879-19 (+469 kg/ha) hybrids, and significant increases in the HSF 1128-14 (+562 kg/ha), HSF 1142-17 (+443 kg/ha), HSF 11717-19 (+424 kg/ha) and HSF 1370-17 (+387 kg/ha) hybrids.
On average over the two years of experimentation, the HSF 1033-17 (2752

kg/ha), HSF 1214-17 (2740 kg/ha) and HSF 1128-14 (2736 kg/ha) hybrids achieved significant yield increases compared to the control variant.

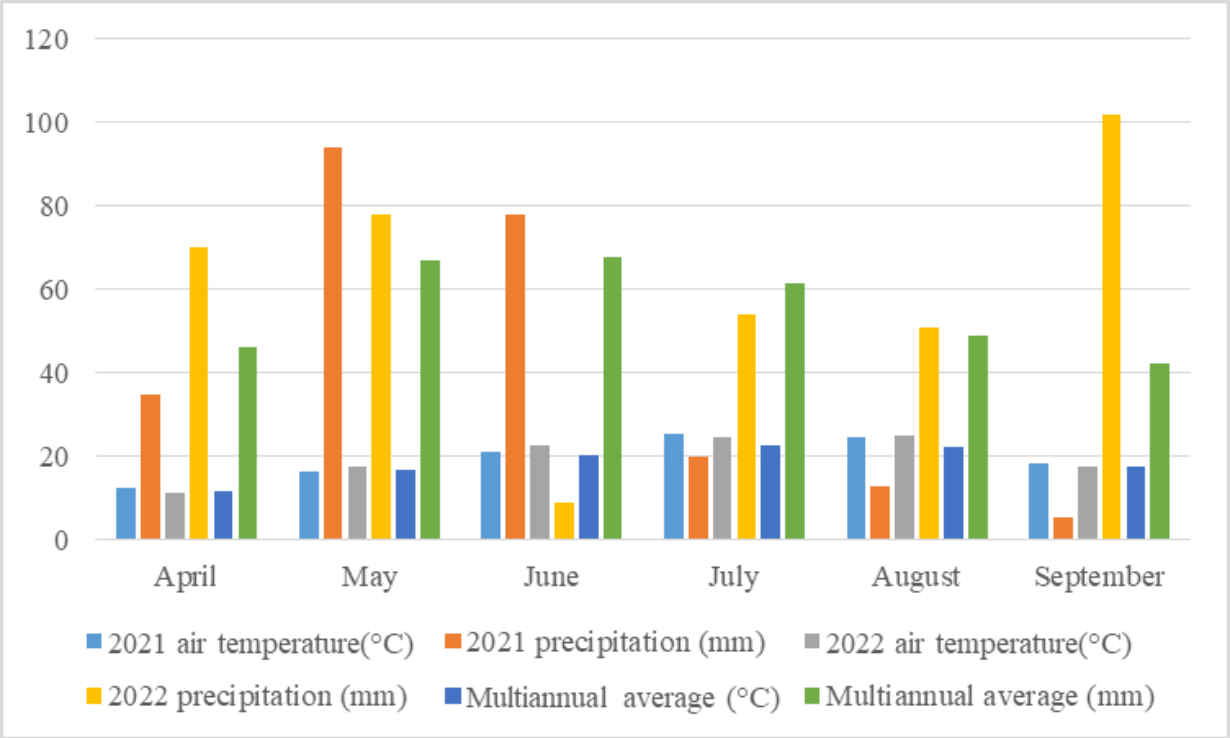

Figure 1. Climatic conditions (precipitation and temperature) for the study period at ARDS Simnic

Table 1. Grain yield for maize genotypes experimented at ARDS Simnic

Genotypes	Yield (Kg/ha)					
	2021	Difference to control	2022	Difference to control	Average (2021-2022)	Difference to control
F423 (Control)	2210	-	2775	-	2493	-
HSF 1128-14	2086	-124ns	3387	562*	2736	243*
HSF 3425-16	1084	-1126^{000}	3270	495**	2177	-316^{0}
HSF 1033-17	1805	-405^{00}	3698	923***	2752	259*
HSF 1142-17	1197	-1013^{000}	3218	443*	2208	-285^{0}
HSF 1214-17	1633	-577^{000}	3846	1071***	2740	247*
HSF 1370-17	2261	51ns	3162	387*	2712	219ns
HSF 7375-18	1349	-861^{000}	2976	201ns	2163	-330^{00}
HSF 10799-19	1813	-397^{00}	3072	297ns	2443	-50ns
HSF 10913-19	2232	22ns	2895	120ns	2564	71ns
HSF 10865-19	1523	-687^{000}	2773	2ns	2148	-345^{00}
HSF 10879-19	1478	-732^{000}	3244	469**	2361	-132ns
HSF 10901-19	1149	-1061^{000}	3740	965***	2445	-48ns
HSF 11717-19	1820	-390^{00}	3199	424*	2510	17ns
HSF11955-19	1635	-575^{000}	3107	332ns	2371	-122ns
LSD 5%	277		341		238	
LSD 1%	374		459		321	
LSD 0.1%	496		609		427	

*** - very significant; **- distinctly significant; *- significant

Regarding the vegetation period (days from emergence to physiological maturity), it was observed that due to increased temperatures, the vegetation period was

shortened in both years.Thus, in 2021, the vegetation period ranged between 97 and 107 days, and in 2023 from 95 to 104 days. Analyzing the average vegetation periods for the two years of study, it was found that the shortest vegetation period was recorded for the perspective hybrids HSF 3425-16 and HSF 1142-17 (97 days), and the longest vegetation period for the hybrid HSF 10901-19 (104 days) – Table 2.

Plant height was also influenced by the climatic conditions in the years of study. Thus, in 2021, the largest height was recorded in the perspective hybrids HSF 1033-17 and HSF 11717-19 (200 cm), and in 2022 in the hybrid HSF 11717-19 (217 cm). Analysis of the data on the average for the two years of experimentation showed that the plant height of the plants varied from 175 cm for HSF 11955-19 to 209 cm for HSF 11717-19 – Table 2.

Table 2. Vegetation period and plant height for maize genotypes experimented at ARDS Simnic

Genotypes	Vegetation period (days)			Plant height (cm)		
	2021	2022	Average (2021-2022)	2021	2022	Average (2021-2022)
F423	97	96	97	168	198	183
HSF 1128-14	105	98	102	175	196	186
HSF 3425-16	98	95	97	165	198	182
HSF 1033-17	102	103	103	200	190	195
HSF 1142-17	99	95	97	180	205	193
HSF 1214-17	97	98	98	175	184	180
HSF 1370-17	99	97	98	170	192	181
HSF 7375-18	100	95	98	174	189	182
HSF 10799-19	107	98	103	180	210	195
HSF 10913-19	106	98	102	190	200	195
HSF 10865-19	107	97	102	167	191	179
HSF 10879-19	103	100	102	155	203	179
HSF 10901-19	107	100	104	160	203	182
HSF 11717-19	103	95	99	200	217	209
HSF11955-19	107	96	102	150	199	175
Average	102	97	100	174	198	186

Drought and heat during the period of grain formation and filling, negatively influenced especially the 1000-grain weight (TGW).
Thus, in the climatic conditions of 2021 the average value of the TGW was 149 g, the highest value being recorded in the hybrid HSF 10913-19 (176 g) followed by HSF 11955-19 (174 g) and the lowest value – in HSF 3425-16 (122 g). In 2022, a year with a slightly better water supply during the grain-filling period, the average value of the TGW was 170 g, the highest value being recorded for the HSF 1214-17 hybrid (190 g), and the lowest value for HSF 7375-18 (152 g). Analysis of the averages of the two years of experimentation showed that the highest value for TGW was recorded for the HSF 10913-19 hybrid (178 g), and the lowest value for the HSF 3425-16 hybrid (146 g) - Table 3.
Regarding test weight (TW), the values ranged between 63 kg/hl (HSF 3425-16) and 72 kg/hl (HSF 10799-19 and HSF 10865-19) in 2021, and between 63 kg/hl (HSF10913-19) and 73 kg/hl (HSF 10865-19) in 2022. As an average for the two years of experimentation, the hybrid HSF 10865-19 (73 kg/hl), followed by HSF 10901-19 (72 kg/hl), recorded the highest values for TW - Table 3.

Table 3. 1000-grain weight (TGW) and test weight (TW) for the maize genotypes experimented at ARDS Simnic

Genotypes	TGW (g)			TW (kg/hl)		
	2021	2022	Average	2021	2022	average
F423	148	172	160	67	68	68
HSF 1128-14	151	178	165	67	68	68
HSF 3425-16	122	170	146	63	66	65
HSF 1033-17	134	163	149	71	66	69
HSF 1142-17	155	165	160	64	64	64
HSF 1214-17	130	190	160	66	65	66
HSF 1370-17	138	170	154	64	67	66
HSF 7375-18	142	152	147	65	67	66
HSF 10799-19	142	178	160	72	70	71
HSF 10913-19	176	180	178	70	63	67
HSF 10865-19	162	168	165	72	73	73
HSF 10879-19	158	172	165	71	67	69
HSF 10901-19	146	165	156	72	71	72
HSF 11717-19	158	164	161	65	66	66
HSF11955-19	174	160	167	71	68	70
Average	149	170	160	68	67	68

The presence of *Fusarium* diseases leads to a reduction in the quality of maize yields due to the accumulation, on grains and cobs, of mycelial masses of fungi of the genus *Fusarium* (about 85%), as well as through contamination with specific mycotoxins (Nagy et al., 2009).

In this study, it was found that all the genotypes tested showed good and very good tolerance to *Fusarium ssp.*, the notes awarded in both years being between 7 and 9 (Table 4).

Table 4. Tolerance of maize genotypes to attack by the pathogen *Fusarium spp*.

Genotypes	Notes		
	2021	2022	average
F423	8	8	8
HSF 1128-14	8	8	8
HSF 3425-16	7	8	8
HSF 1033-17	7	8	8
HSF 1142-17	8	8	8
HSF 1214-17	8	9	9
HSF 1370-17	8	7	8
HSF 7375-18	8	8	8
HSF 10799-19	8	8	8
HSF 10913-19	8	8	8
HSF 10865-19	8	8	8
HSF 10879-19	7	8	8
HSF 10901-19	9	9	9
HSF 11717-19	8	8	8
HSF11955-19	8	7	8

CONCLUSIONS

Extreme climatic conditions (frequent droughts or high temperatures during the grain formation and filling phases) manifested in the ARDS Șimnic area negatively influence maize yields.

In the two years of experimentation, the average yields of the 15 experimental maize genotypes varied significantly, ranging between 2148 kg/ha (HSF 10865-19) and 2752 kg/ha (HSF 1033-17).

Compared to the control hybrid (F423), significant yield increases were recorded by the perspective hybrids HSF 1033-17 (2752 kg/ha), HSF 1214-17 (2740 kg/ha) and HSF 1128-14 (2736 kg/ha), suggesting their better adaptability to the agro-climatic conditions in central part of Oltenia. Therefore, these perspective hybrids will be advanced for testing in the ISTIS network (State Institute for Variety Testing and Registration) in order to obtain competitive maize hybrids on the market.

The vegetation period was shorter and different depending on the climatic conditions during the grain filing - maturity period.

The plant height of the plants was influenced by the climatic conditions in the years of experimentation, the highest height was found in 2022.

The climatic factors during the period of grain formation and filling influenced the TGW, with higher values being recorded in 2022 (170 g).

The average test weight recorded similar values in both years of experimentation (68 kg/hl in 2021 and 67 kg/hl in 2022).

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