THE ADAPTIVE RESPONSE OF MAIZE CROPS TO THE INTERACTION OF BIOTIC AND ABIOTIC FACTORS UNDER CLIMATIC CONDITIONS OF 2025

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INTRODUCTION

Heat and water stress associated with climate change reduce maize photosynthesis and biomass, and increase vulnerability to *Fusarium spp*. and *Ostrinia nubilalis*. The larvae of the European corn borer bore tunnels that weaken the plants and allow pathogens to develop rapidly, amplifying kernel deterioration and the risk of mycotoxin occurrence. Tolerant hybrids and irrigation support crop performance during the growing season and help maintain yield gains, even if physiological processes do not fully return to normal.

MATERIAL and METHODS

The analysis of the temperature and precipitation regime for the period October 2024 – September 2025 allowed the identification of drought periods during both the winter and the maize growing season, as well as thermal deviations from the multiannual average. The weather conditions in 2025 were characterized by high temperatures and low atmospheric humidity, generating soil moisture deficits and influencing hybrid responses depending on the irrigation regime. For the experimental assessments, the same set of ten hybrids was used (nine domestic and promising hybrids and one check hybrid), analyzed under both biotic and abiotic stress conditions. Biotic stress tolerance was evaluated immediately after the analysis of weather conditions, using the same set of hybrids in two complementary experiments:

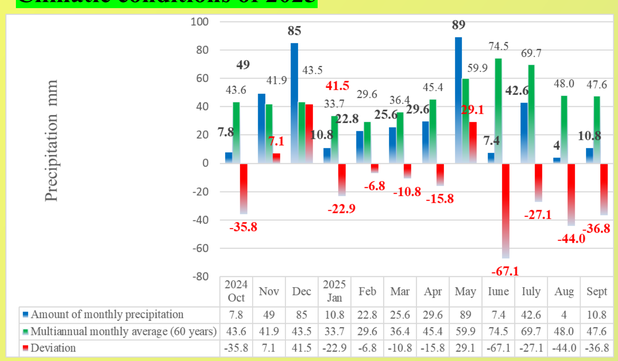
Fusarium experiment: The objective was to evaluate hybrid tolerance to artificial infection with *Fusarium spp*. Inoculation was performed in the silk channel of the main ear using 5 ml/ear of a *Fusarium verticillioides* spore suspension (10^6 conidia/ml), prepared from naturally infected ears, isolated and purified on specific media, and incubated at 25°C for 15 days. The inoculum was applied 10 days after silk emergence, using self-refilling syringes. At harvest, each ear was individually analyzed and classified according to the level of infection to determine hybrid tolerance. The inoculum was supplied by the Plant Protection Laboratory, NARDI Fundulea.

Ostrinia experiment: The objective was to evaluate tolerance to artificial infestation with *Ostrinia nubilalis*. Infestation was performed by placing 10 clutches of *O. nubilalis**/plant on 10 plants for each row and genotype, before tassel emergence. The attack level was determined by longitudinally splitting the infested plants, between advanced vegetation and physiological maturity, and measuring the total length of larval galleries for each hybrid and experimental repetition.

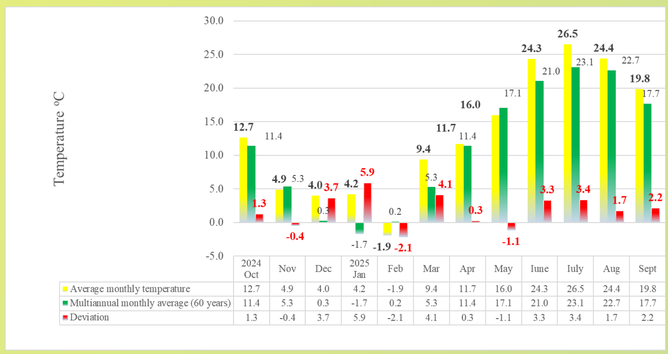
Adaptability to heat and water stress was evaluated in two field experiments, with irrigated and non-irrigated variants, conducted at a plant population/density of 70,000 plants/ha. Drip irrigation was initiated at the 8-leaf stage and applied on average 4 hours/day, with an application rate of 1.3 l/m²/hour. Evaluation parameters included yield and harvest moisture.

RESULTS

Climatic conditions of 2025



	2024 Oct	Nov	Dec	2025 Jan	Feb	Mar	Apr	May	Iune	Iuly	Aug	Sept
Amount of monthly precipitation	7.8	49	85	10.8	22.8	25.6	29.6	89	7.4	42.6	4	10.8
Multiannual monthly average (60 years)	43.6	41.9	43.5	33.7	29.6	36.4	45.4	59.9	74.5	69.7	48.0	47.6
Deviation	-35.8	7.1	41.5	-22.9	-6.8	-10.8	-15.8	29.1	-67.1	-27.1	-44.0	-36.8



	2024 Oct	Nov	Dec	2025 Jan	Feb	Mar	Apr	May	Iune	Iuly	Aug	Sept
Average monthly temperature	12.7	4.9	4.0	4.2	-1.9	9.4	11.7	16.0	24.3	26.5	24.4	19.8
Multiannual monthly average (60 years)	11.4	5.3	0.3	-1.7	0.2	5.3	11.4	17.1	21.0	23.1	22.7	17.7
Deviation	1.3	-0.4	3.7	5.9	-2.1	4.1	0.3	-1.1	3.3	3.4	1.7	2.2

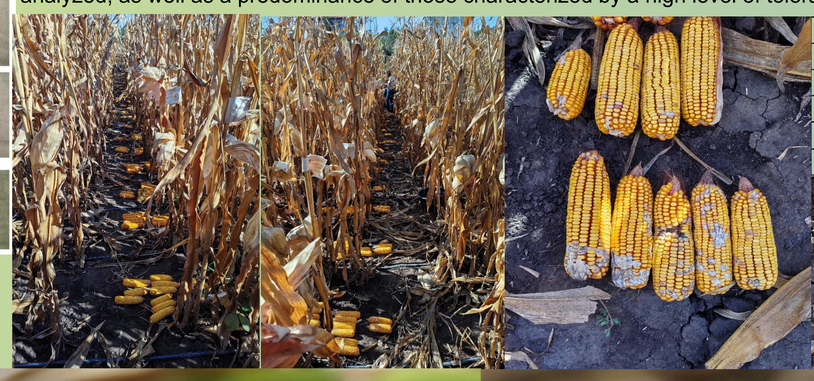
Based on the data in the graphs, it can be observed that precipitation was insufficient throughout the entire maize growing season (except for May), and during the summer months (June–August) temperatures were above the multiannual average. The water deficit combined with heat stress negatively affects the flowering and silking phenophases: pollen becomes less viable and the fertilization process is incomplete, significantly reducing yield. This explains the increase in the percentage of sterile plants. In addition, water and heat stress weaken the plant, making it more susceptible to pathogen attack, such as *Fusarium spp*., which promotes the occurrence of ear fusariosis and reduces grain quality.

Fusarium Scores and Tolerance Classes of Maize Hybrids (2025, Artificial Inoculation)

Year	Experiment	Number of repetitions	Variant	Number of infested plants	Silking date	Inoculation date	Maize hybrid	Number of Class 1 cobs	Class 1 score	Number of Class 2 cobs	Class 2 score	Number of Class 3 cobs	Class 3 score	Number of Class 4 cobs	Class 4 score	Number of analyzed cobs	Weighted average	Fusarium disease score (artificial inoculation)	Significance / tolerance class
2025	PN	1	1	13	27.06	8.07	Check hybrid	5	7	5	8	2	9	0	0	12	7.8	7.8	T
2025	PN	1	2	13	26.06	4.07	F423	2	7	6	8	1	9	0	0	9	7.9	7.9	T
2025	PN	1	3	13	27.06	8.07	Felix	5	7	3	8	2	9	0	0	10	7.7	7.7	T
2025	PN	1	4	13	25.06	4.07	Magnus	3	7	6	8	1	9	0	0	10	7.8	7.8	T
2025	PN	1	5	13	24.06	4.07	Amurg	3	5	7	7	1	8	0	0	11	6.5	6.5	MT
2025	PN	1	6	13	26.06	4.07	Miraj	4	4	5	5	1	6	0	0	10	4.7	4.7	MT
2025	PN	1	7	13	25.06	4.07	FDL Ovidiu	4	4	6	5	3	6	0	0	13	4.9	4.9	MT
2025	PN	1	8	13	26.06	4.07	FDLDonaris	2	6	4	7	4	8	0	0	10	7.2	7.2	T
2025	PN	1	9	13	24.06	4.07	HSF7395-18	2	7	6	8	1	9	0	0	9	7.9	7.9	T
2025	PN	1	10	13	25.06	4.07	FDLGruia	2	7	5	8	3	9	0	0	10	8.1	8.1	T

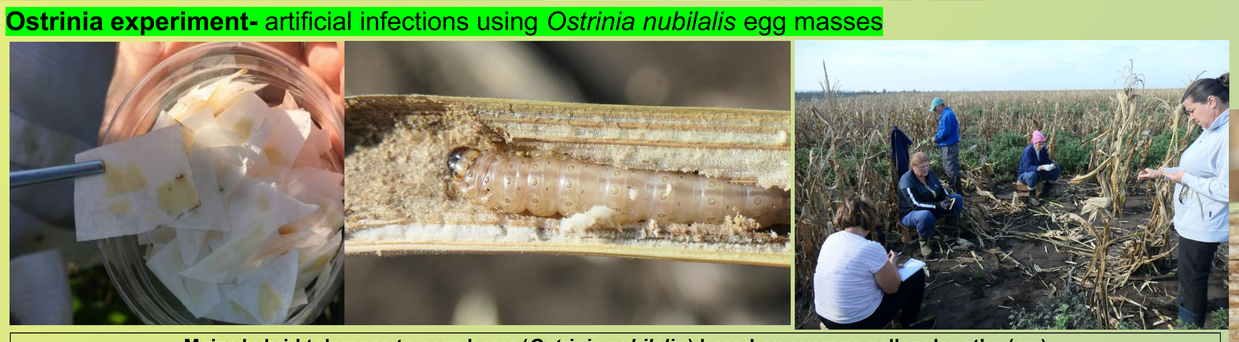
Fusarium experiment- Field inoculation using *Fusarium* inoculum (Syringe-based inoculation)

In the experiment conducted in 2025 (PN), ten maize hybrids were tested for tolerance to *Fusarium* under artificial inoculation conditions. The evaluation was based on four infection classes: Class 1 – highly susceptible, Class 2 – susceptible, Class 3 – moderately tolerant, Class 4 – tolerant with class values/score from 1 to 9. The results show that most hybrids exhibited good tolerance to the pathogen. Hybrids classified as T (tolerant) – External check, F423, Felix, Magnus, FDL Donaris, HSF7395-18, and FDL Gruia – received scores between 7.2 and 8.1, indicating high tolerance to the pathogen. The best-performing hybrid was FDL Gruia (8.1), followed by F423 and HSF7395-18 (7.9). Hybrids classified as MT (moderately tolerant) – Amurg, Miraj, and FDL Ovidiu – recorded scores between 4.7 and 6.5, indicating a moderate level of tolerance to artificial *Fusarium spp*. inoculation. Overall, the results obtained in the 2025 experiment highlight significant genetic variability among the hybrids analyzed, as well as a predominance of those characterized by a high level of tolerance to the pathogen.



Fusarium Tolerance: Class & Score (2025)			
Class	Class values		Tolerance class
1	1.0	2.9	**HS**-Highly susceptible
2	3.0	4.9	**S**-Susceptible
3	5.0	6.9	**MT**-Moderately tolerant
4	7.0	9.0	**T**-tolerant

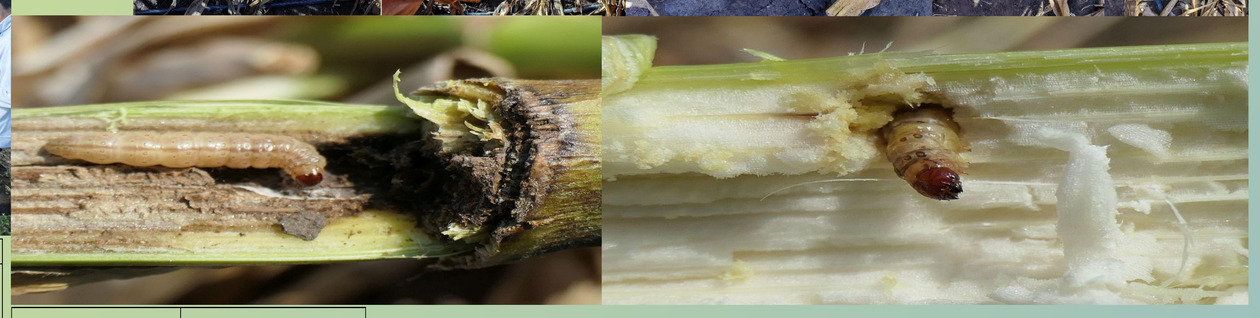
Ostrinia experiment- artificial infections using *Ostrinia nubilalis* egg masses



Maize hybrid tolerance to corn borer (*Ostrinia nubilalis*) based on average gallery lengths (cm)

Year	Experiment	Number of repetitions	Variant	Maize hybrid	Average gallery length (cm)	Maximum gallery length (cm)	Total gallery length (cm)	Significance of results	Number of infested plants	Infestation date	Scoring date
2025	PN	1	1	Check hybrid	5.30	24	53	**HS**	10	**23.06**	**15.09.**
2025	PN	1	2	F423	0	0	0	**T**	10	**23.06**	**15.09.**
2025	PN	1	3	Felix	0	0	0	**T**	10	**23.06**	**15.09.**
2025	PN	1	4	Magnus	0.40	3	4	**MT**	10	**23.06**	**15.09.**
2025	PN	1	5	Amurg	0	0	0	**T**	10	**23.06**	**15.09.**
2025	PN	1	6	Miraj	0.57	7	10	**MT**	10	**23.06**	**15.09.**
2025	PN	1	7	FDL Ovidiu	0.25	2	2	**T**	10	**23.06**	**15.09.**
2025	PN	1	8	FDL Donaris	0	0	0	**T**	10	**23.06**	**15.09.**
2025	PN	1	9	HSF7395-18	0	0	0	**T**	10	**23.06**	**15.09.**
2025	PN	1	10	FDL Gruia	0.60	15	15	**MT**	10	**23.06**	**15.09.**

Tolerance class	Class values	
T-tolerant	0	0.30
MT-Moderately tolerant	0.31	0.61
ST-Slightly tolerant	0.62	1.22
S-Susceptible	1.23	3.26
HS-Highly susceptible	3.27	5.30

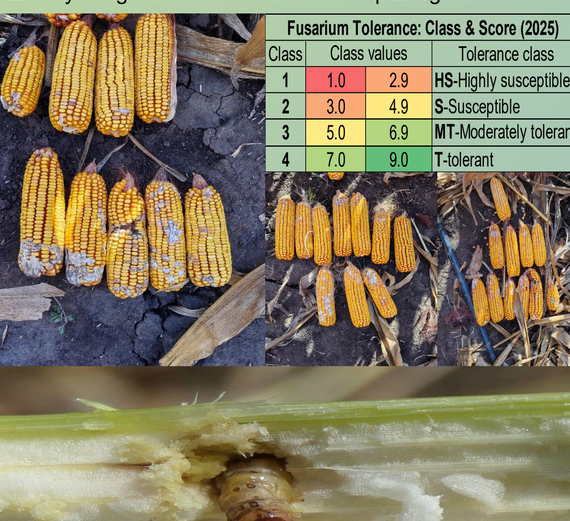


The data analysis revealed clear differences among maize hybrids in their tolerance to corn borer (*Ostrinia nubilalis*) attack. The external check was the most affected, with an average gallery length of 5.30 cm and a total of 53 cm, indicating low tolerance to the pest. In contrast, the hybrids F423, Felix, Amurg, FDL Donaris, and HSF7395-18 showed no galleries, being classified as highly tolerant. The hybrids Magnus, Miraj, and FDL Gruia exhibited moderate tolerance, with limited attack, while FDL Ovidiu showed minimal damage, confirming high tolerance. Overall, for the year 2025, the results highlight significant genetic variability in tolerance levels, identifying valuable genotypes for cultivation under high biotic pressure, while the external check can serve as a reference for comparative evaluation of the other hybrids.

MAIZE HYBRIDS (FAO 350–470) – AGRONOMIC PERFORMANCE-Irrigated vs. Rainfed - 2025

		RAINFED						IRRIGATED		
Variant	Maize hybrid	FAO maturity group	Density plants/ha	Average moisture at harvest (%)	Average test weight (kg/hl)	Yield kg/ha at 15.5% moisture		Average moisture at harvest (%)	Average test weight (kg/hl)	Yield kg/ha at 15.5% moisture
1	Amurg	350	70000	12.7	72.4	6301		17.2	74.5	14415
2	F423	470	70000	14.3	77.0	5469		17.3	74.8	14394
3	FDL Ovidiu	400	70000	13.0	70.3	4699		17.3	73.8	12831
4	Felix	460	70000	14.4	72.3	5549		16.7	79.4	14618
5	FDL Gruia	350	70000	14.3	76.0	5121		16.9	77.3	12834
6	FDL Donaris	370	70000	13.2	73.4	5173		16.6	74.1	13625
7	HSF7395-18	400	70000	15.3	72.8	4043		17.3	73.5	12017
8	Magnus	350	70000	13.0	76.6	5601		17.5	73.9	12934
9	Miraj	390	70000	14.2	68.4	5039		16.5	71.9	13705
10	Check hybrid	350-400	70000	13.1	71.9	4669		17.0	74.9	12039
Correlation of irrigated vs. non-irrigated yield						0.787				

The 2025 experiment analyzed the performance of maize hybrids from FAO groups 350–470, grown at 70,000 plants/ha, under non-irrigated and irrigated conditions. In the non-irrigated variant, harvest moisture ranged from 12.7–15.3%, and yields varied between 4,043–6,301 kg/ha. The hybrids Amurg, Magnus, and Felix showed the best results, highlighting good drought tolerance. Under irrigation, harvest moisture increased to 16.5–17.5%, and yields were significantly higher (12,017–14,618 kg/ha), with the highest values observed for Felix, Amurg, and F423. The hectoliter weight (71.9–79.4 kg/hl) indicated better grain filling. The correlation of 0.787 between yields in the two regimes shows a positive relationship between non-irrigated and irrigated performance, confirming the role of genetic potential. Irrigation generated yield increases of over 150–180%, improving both quality and stability of yield, and the hybrids Felix, Amurg, and F423 stood out for their superior adaptability to different moisture regimes.



Maize growth under contrasting water regimes, 2025

CONCLUSIONS

- The drought and high temperatures in 2025 negatively affected maize phenological stages, promoting sterile plants and *Fusarium spp*. infestation. However, most of the tested hybrids exhibited high pathogen tolerance.
- The genetic variability among the hybrids highlighted valuable genotypes capable of coping with both *Fusarium* and maize borer attacks, as well as drought conditions.
- Irrigation significantly increased yields and grain quality, with the Felix, Amurg, and F423 hybrids standing out for their adaptability and superior performance under varying moisture conditions.
- **The results are part of Nucleu Project PN 23 18 01 02.**