RESEARCH ON SELECTION OF SEVERAL MAIZE HYBRIDS DEVELOPED BY THE NARDI FUNDULEA FOR PRODUCTIVITY, WATER AND NUTRIENT USE EFFICIENCY, IN DIFFERENT ENVIRONMENTS

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INTRODUCTION

- Water and nutrient use efficiency in maize refers to the plant's ability to convert available resources into biomass and, ultimately, into grain yield. These efficiencies vary depending on genetic (hybrid), agronomic (water availability, planting density, cultivation practices), and environmental factors;
- Maize has high water requirements, particularly during certain phenological stages such as anthesis, grain formation, and grain filling. Nutrient use efficiency especially nitrogen use efficiency is essential for maximizing productivity and reducing environmental impact. It is influenced by genetic factors, soil fertility, the type and timing of fertilizer application, and crop management practices;
- This study aimed to evaluate a set of maize hybrids under different ecological and technological conditions during the 2024–2025 period, focusing on yield level and stability, to select maize hybrids with superior adaptability and high efficiency in water and nutrient use;

MATERIAL AND METHODS

- The biological material consisted of 20 maize hybrids, 19 of which were developed at INCDA Fundulea, while one served as a competitive control. The hybrids were tested under nitrogen fertilization, both in non-irrigated and irrigated conditions across five locations with different pedoclimatic conditions: at NARDI Fundulea, ARDS Brăila, and ARDS Valu lui Traian (under both non-irrigated and irrigated conditions), and at ARDS Lovrin and ARDS Livada (under non-irrigated conditions);
- The experiment was carried out at normal plants population (62,112 pl./ha, under non-irrigated conditions) and high plant population (71,429 pl./ha, irrigated conditions); average grain yield was expressed in kg/ha at 15.5% moisture content;
- The fertilizers applied were moderate, differentiated according to the available water (60-90 kg N/ha);
- The irrigation of the experiments at NARDI Fundulea was carried out using the drip irrigation system, while at ARDS Brăila and ARDS Valu lui Traian it was irrigated by sprinkling;
- The *grain moisture* content at *harvest* time was measured in laboratory by the humidity meter - DICKEY JOHN GAC 2000 (Grain Analysis Computer) and the protein, starch and oil content analyzes of the grains were performed with the Analyzer NIR DA 7250-NARDI Fundulea;

RESULTS AND DISCUSSION

Figure 1. Rainfalls registered at NARDI Fundulea during 2024-2025

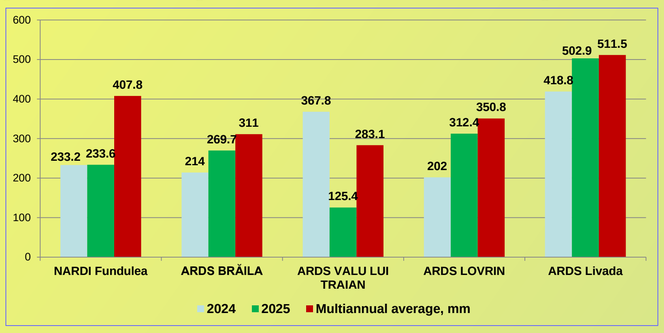


Figure 2. Monthly average temperature registered at NARDI Fundulea during 2024-2025

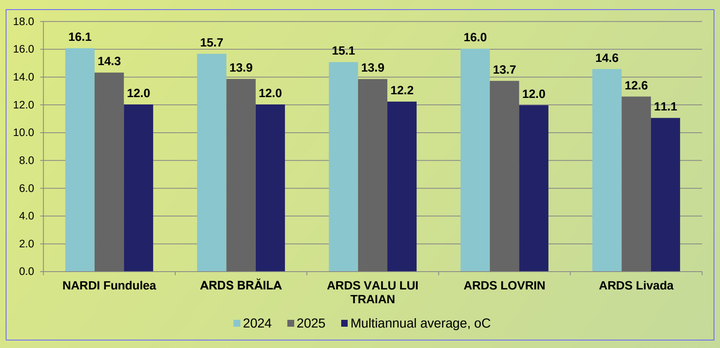


Table 1 . Grain yield with 15.5% moisture (kg/ha) of maize hybrids tested in under nitrogen fertilization, in non-irrigated conditions, during 2024-2025

Hybrid	*Non- irrigated , 2024-2025*										*Average*	
	NARDI Fundulea		*ARDS Braila*		*ARDS Valu lui Traian*		*ARDS Lovrin*		*ARDS Livada*			
	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	kg/ha	%
Competitor hybrid	11951	123	7158	103	8946	137	6305	109	8113	98	**8494**	**114**
Amurg	10738	110	7455	107	7117	109	6219	108	8176	99	**7941**	**107**
Magnus	10205	105	7088	102	7356	113	5259	91	9367	113	**7855**	**105**
HSF1089-17	10613	109	6855	99	7909	121	6453	112	7444	90	**7855**	**105**
HSF1142-17	11046	114	6802	98	8065	124	6761	117	9477	114	**8430**	**113**
HSF10901-19	9900	102	6182	89	7323	112	5414	94	7627	92	**7289**	**98**
HSF10935-19	9269	95	7530	108	6587	101	6757	117	8758	106	**7780**	**104**
HSF10941-19	10220	105	6386	92	8680	133	6583	114	8316	100	**8037**	**108**
HSF11397-19	10565	109	6767	97	8680	133	6579	114	7338	89	**7986**	**107**
HSF11467-19	10190	105	8306	119	5841	90	7520	131	7940	96	**7959**	**107**
HSF11513-19	9585	98	6947	100	7509	115	6755	117	9084	110	**7976**	**107**
HSF11936-19	7523	77	6260	90	4744	73	3111	54	6253	75	**5578**	**75**
HSF2015-22	9346	96	6107	88	4114	63	6041	105	9092	110	**6940**	**93**
HSF2016-22	8450	87	8735	126	5258	81	6830	119	9978	120	**7850**	**105**
HSF2019-22	10494	108	7616	109	5850	90	6124	106	9104	110	**7837**	**105**
HSF2021-22	7915	81	6467	93	4764	73	5277	92	8050	97	**6494**	**87**
HSF2141-22	9312	96	5936	85	5026	77	4571	79	7127	86	**6395**	**86**
HSF2209-22	7532	77	5348	77	5065	78	3293	57	7472	90	**5742**	**77**
HSF2211-22	8942	92	6986	100	4904	75	3966	69	7772	94	**6514**	**87**
HSF2213-22	10837	111	8212	118	6458	99	5421	94	9332	113	**8052**	**108**
AVERAGE	**9732**	**100**	**6957**	**100**	**6510**	**100**	**5762**	**100**	**8291**	**100**	**7450**	**100**

Figure 3. Relationship between mean grain yield in the LWS conditions and mean grain yield in the HWS conditions, 2024-2025

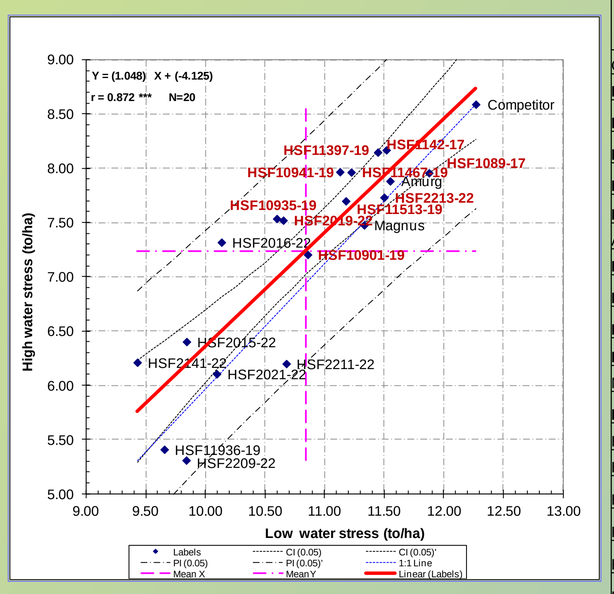


Table 4. Drought tolerance index, DRIND

Hybrids	Average yield (to/ha) LWS	Average yield (to/ha) HWS	Drought tolerance index DRIND
Competitor	12.27	8.59	17.57
HSF1142-17	**11.52**	**8.17**	**17.00**
HSF11397-19	**11.45**	**8.15**	**16.97**
HSF10941-19	**11.13**	**7.97**	**16.72**
HSF11467-19	**11.22**	**7.96**	**16.72**
HSF1089-17	**11.88**	**7.96**	**16.69**
Amurg	11.55	7.88	16.59
HSF2213-22	**11.50**	**7.73**	**16.38**
HSF11513-19	**11.18**	**7.70**	**16.34**
HSF10935-19	**10.60**	**7.54**	**16.13**
HSF2019-22	**10.65**	**7.52**	**16.11**
Magnus	11.33	7.48	16.02
HSF10901-19	**10.86**	**7.20**	**15.65**
HSF2016-22	10.13	7.32	15.84
HSF2015-22	9.84	6.40	14.55
HSF2141-22	9.43	6.21	14.30
HSF2211-22	10.68	6.20	14.24
HSF2021-22	10.09	6.11	14.13
HSF11936-19	9.66	5.41	13.16
HSF2209-22	9.84	5.31	13.01

Figure 4. Dynamics of grain water loss

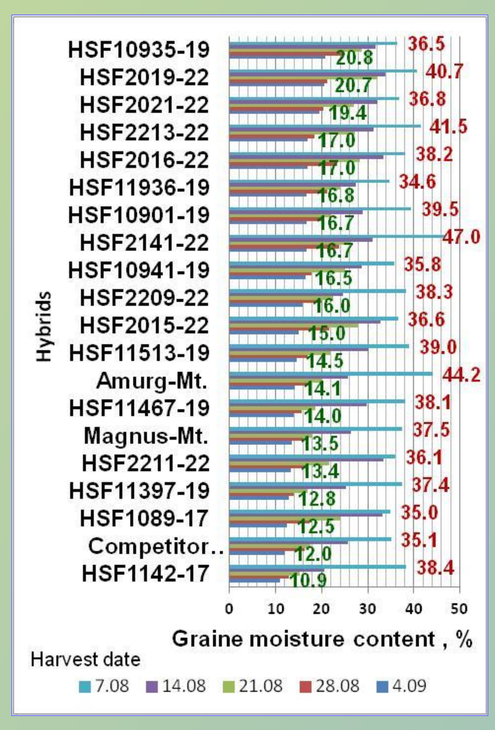


Figure 5. Rate of water loss from grain

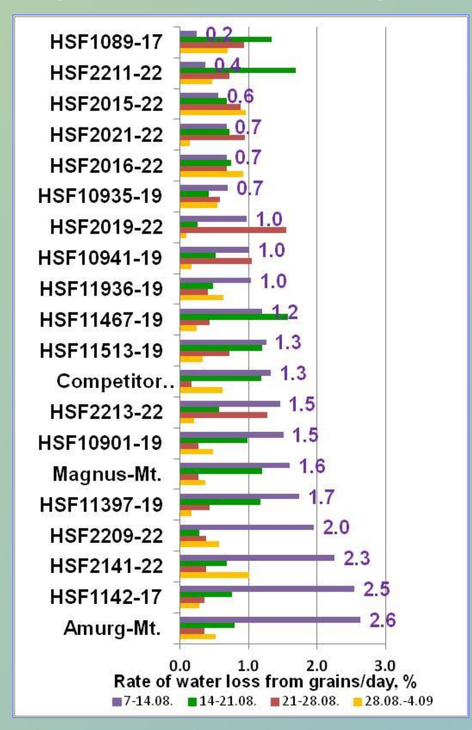


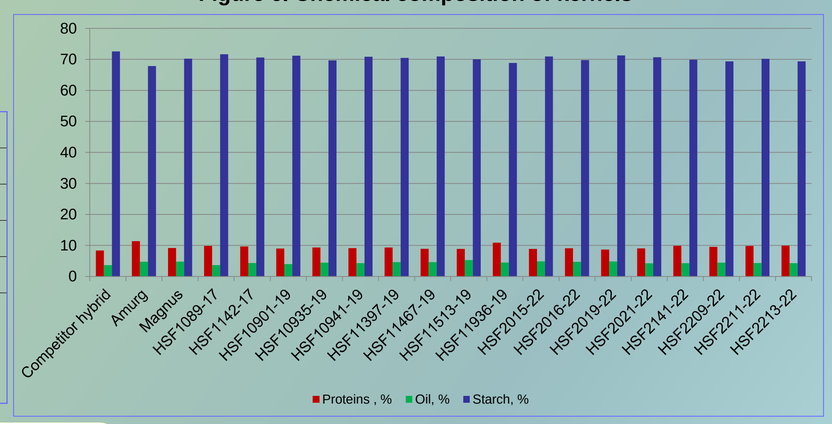
Table 2 . Grain yield with 15.5% moisture (kg/ha) of maize hybrids tested in under nitrogen fertilization, in irrigated conditions, during 2024-2025

Hybrid	*Irrigated , 2024-2025*						*Average*	
	NARDI Fundulea		*ARDS Braila*		*ARDS Valu lui Traian*			
	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	Average grain yield (kg/ha)	% average	kg/ha	%
Competitor hybrid	13836	119	10666	108	12303	112	**12269**	**113**
Amurg	12978	111	10706	108	10963	100	**11549**	**107**
Magnus	12508	107	10054	102	11432	104	**11331**	**105**
HSF1089-17	13293	114	10982	111	11351	103	**11875**	**110**
HSF1142-17	13218	113	9757	99	11578	106	**11518**	**106**
HSF10901-19	11906	102	9944	101	10724	98	**10858**	**100**
HSF10935-19	10833	93	9858	100	11105	101	**10599**	**98**
HSF10941-19	11130	95	10376	105	11879	108	**11128**	**103**
HSF11397-19	11631	100	10978	111	11729	107	**11446**	**106**
HSF11467-19	11259	97	11775	119	10636	97	**11223**	**104**
HSF11513-19	11945	102	10078	102	11511	105	**11178**	**103**
HSF11936-19	10034	86	8557	87	10375	95	**9655**	**89**
HSF2015-22	10915	94	8631	87	9980	91	**9842**	**91**
HSF2016-22	10269	88	9533	96	10602	97	**10135**	**93**
HSF2019-22	12041	103	9833	99	10083	92	**10653**	**98**
HSF2021-22	10443	90	9020	91	10822	99	**10095**	**93**
HSF2141-22	10571	91	9307	94	8407	77	**9428**	**87**
HSF2209-22	10286	88	8479	86	10752	98	**9839**	**91**
HSF2211-22	11231	96	9690	98	11115	101	**10679**	**99**
HSF2213-22	12782	110	9589	97	12125	110	**11499**	**106**
AVERAGE	**11656**	**100**	**9891**	**100**	**10974**	**100**	**10840**	**100**

Table 3. The influence of water on maize yield

Conditions	2024				2025			
	Average yield		Difference		Average yield		Difference	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
Non-irrigated	8449	100	Ct.	-	7334	100	Ct.	-
Irrigated	11639	138	3190*	38	10638	145	3304***	45
LSD 5%			1891				369	
LSD 1%			4361				852	
LSD 0.1%			13886				2713	

Figure 6. Chemical composition of kernels



CONCLUSIONS

- Under non-irrigated conditions, the average yields of the experimental hybrids ranged from 5,578 kg/ha (HSF11936-19) to 8,430 kg/ha (HSF1142-17), with an experimental mean of 7,450 kg/ha.
- Under irrigated conditions, average yields ranged from 9,428 kg/ha (HSF2141-22) to 11,875 kg/ha (HSF1089-17), with an experimental mean of 10,840 kg/ha.
- The superior performance of the hybrids HSF11467-19, HSF10935-19, HSF2213-22, HSF 1142-17, and HSF 2016-22 was confirmed by their stability selection indices, which ranged from 13.61 to 13.02.

REFERENCES

•Horhocea, D., Ciocăzanu, I, Iordan, H., Ciontu, C. 2020. Experiment results obtained at commercial and perspective maize hybrids recently created at NARDI Fundulea. Anale INCDA Fundulea, vol. VOL. LXXXVIII, p: 35-47

• Huang, R., Birch C., George Doug., 2006- *Water use efficiency in maize production - the challenge and improvement strategies*. proceeding of 6th Triennial Conference, Maize Association of Australia.

•Mandache, V., 2013. Aspects of Maize Breeding for Drought Tolerance; contributions on drought tolerance testing and estimation in maize. Doctoral Thesis, University of Agronomic Sciences and Veterinary Medicine – Bucharest.

•Sarca T., 2004. Maize breeding, In: Maize - monographic study, Ed.Academiei Române, Bucureşti: 403-407

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