

## THE BEHAVIOR OF SOME MAIZE HYBRIDS CREATED AT ARDS TURDA IN TWO ECOLOGICAL CONDITIONS: TURDA AND LOVRIN

Roxana-Elena CĂLUGĂR<sup>1</sup>, Andrei VARGA<sup>1,\*</sup>, Alina Laura AGAPIE<sup>2</sup>, Loredana Ancuța CECLAN<sup>1</sup>,  
Carmen Daniela VANA<sup>1</sup>, Felicia CHEȚAN<sup>1</sup>, Nicolae TRITEAN<sup>1</sup>

<sup>1</sup>Agricultural Research and Development Station Turda, Turda, 401100, Romania

<sup>2</sup>Agricultural Research and Development Station Lovrin, Lovrin, 307250, Romania

\*Corresponding author: [andrei\\_varga06@yahoo.com](mailto:andrei_varga06@yahoo.com)

**Abstract.** Maize is one of the main crop plants worldwide and nationally, so the improvement of this plant and the creation of new superior productive and adaptive hybrids is an activity of particular importance. In order to promote a hybrid to be registered, it must be tested in several ecological conditions, precisely for this reason, the hybrids created at ARDS Turda are also tested in other locations, one of them being the ARDS Lovrin experimental fields. 24 maize hybrids were tested in the two research stations regarding the yield, thousand kernel weight (TKW) and two vegetative traits of agronomic interest, the plant and ear height. Differences were reported between the two locations, but they were statistically insignificant. Based on the data obtained, 4 maize hybrids were noted, that will be further analyzed regarding several traits, so that one or two will be proposed for registration. These hybrids obtained average yields of over 9,000 kg/ha in both locations, being also noted for their high TKW and uniformity of plant and ear height.

**Keywords:** maize, hybrids, yield.

### INTRODUCTION

Maize (*Zea mays* L.) is one of the main crops in the world. The areas cultivated with maize worldwide are impressive, around 202 million hectares in recent years, thus occupying the second place from this point of view (after wheat). In terms of total productions obtained, however, maize is ahead of wheat. In our country, it is the plant cultivated on the most extensive area, and at the level of the European Union, Romania occupies the largest area cultivated with maize, while on the European continent, in recent years, more extensive areas were cultivated only in Ukraine (FAOSTAT, 2023). The same sources indicate that in the last 60 years the areas cultivated with maize have doubled, and it is expected that in the future it will become the plant cultivated on the most extensive areas.

In maize all factors are important, namely the applied technology (Imbrea, 2011; Onat.,2017; Dhaliwal., 2019, Krishnendu, 2019), factors climatic conditions (Muneeb et al.,2017), soil fertility, but the most important is the seed used. Over time, maize germplasm has improved considerably (Suba,2021).

The expansion of the areas is due to several causes, among which are the introduction of hybrids, genotypes with a higher yield capacity than the varieties or local populations used in the past, the improvement of crop technology, as well as due to the adaptive heterosis of hybrids, which respond better to some stress factors, as well as the use of fertilizers (Has, 2004).

The importance of this crop emerges not only from the cultivated areas, but also from its multiple uses: human food, animal feed, industry. In human food it can be used in the form of polenta, flakes or canned. Maize is a plant of particular importance from an agrophytotechnical point of view, being a weedy plant that leaves the land clean of weeds. It is also a plant that allows intercropping with other species (beans, pumpkin) (Ayilara et al., 2023) and can also be cultivated after early predecessors, as a successional crop, both for green mass and for grains, in favorable areas.

The hybrids created at ARDS Turda in the first decades of its activity are part of the extra-early or early maturity group, but after the year 2000, due to the increase in temperatures in the Transylvania area, the share of semi-early hybrids increased significantly (Varga, 2022). These hybrids are characterized by superior production capacity and increased adaptability to environmental factors.

Prior to the proposal for testing in order to register a hybrid in the Official catalog of cultivated plants in Romania, it must stand out through certain characteristics of productivity and adaptability to various environmental and cultural conditions. The hybrids that stood out for production characteristics, some vegetative characteristics, tolerance to various stress factors encountered in the area where they were created, are then tested in several crop conditions. In the case of the maize hybrids created at ARDS Turda, and which stood out in the breeding fields, their testing is also done at other stations belonging to the Academy of Agricultural and Forestry Sciences, and special attention is paid to the results obtained at ARDS Lovrin.

### MATERIAL AND METHODS

In the experimental year 2023, 24 maize hybrids were tested in order to select the best genotypes.

23 hybrids are ARDS Turda creations, two of them, registered hybrids, were used as experimental controls, and the rest are represented by hybrids under testing. One of the controls used is a hybrid registered by a private company.

The hybrids were tested in two locations: ARDS Turda and ARDS Lovrin, in a comparative crop established according to the randomized block method, in three repetitions. Each variant was sown in two rows with a length of 8.7 m, at a density of 70,000 plants/ha.

The first experimental location, the fields of the ARDS Turda maize breeding laboratory are located in the northwestern part of the city of Turda, Cluj county, on the upper terrace of the Aries river. The dominated soil is chernozem, with loam-clay texture, neutral pH (6.9) (Chețan et al., 2022, Călugăr et al., 2022). In the case of the research station from Lovrin, the soil conditions from the maize breeding fields are similar, chernozem type with neutral pH (6.7) (Agapie et al., 2023, Agapie et al., 2021).

The crop was sown on 26.04.2023 and harvested on 29.09.2023, at Turda, while at Lovrin, it was sown on 05/03/2023 and harvested on 09/14/2023.

The period of sowing and emergence of the crop, at Turda, was characterized by temperatures slightly below the multi-year average and from the pluviometric point of view, the months of April and May were very dry, so that the crop emerged with a slight delay. June was warm and excessively rainy, and July was a warm month with normal precipitation values, so favorable conditions for pollination were observed (Șimon, 2023). The months of August and September, months with influence in filling the grains and achieving the quality of the production, were warm and excessively rainy.

In Lovrin, in the first period of the vegetation period, the temperatures were close to the normal of the area, but starting with June, they exceeded the multi-year values. From the pluviometric point of view, during the sowing period the multi-annual averages were slightly exceeded, but in the summer months the precipitation had values close to normal or below its level. The extreme temperatures in June and July were associated with the presence of precipitation, but in August temperatures over 35 degrees were recorded, associated with the lack of precipitation.

Data were analyzed using ANOVA. The values obtained by each hybrid were compared with the experimental average, also paying special attention to the comparison with the three controls.

## RESULTS AND DISCUSSIONS

Following the analysis of the experimental data obtained in two locations, Turda and Lovrin, some hybrids were noted due to the yield higher than the experimental average, as well as due to other traits of agronomic interest. H14 had the highest average yield, 9.443 kg/ha, surpassing two of the three experimental controls. The hybrids H21, H5 and H4 were also noted, with average yield of over 9,000 kg/ha. The four hybrids were also noted for a TKW of over 300g and plant heights of over 260 cm. H4 was noted with the highest plant and ear height in the entire experimental system (table 1).

**Table 1. The influence of the "genotype" factor on some traits of interest in the studied maize hybrids**

Hybrid	Yield (kg/ha)		TKW		Plant height (cm)		Ear height (cm)	
	Hybrid average	±experimental average	Hybrid average	±experimental average	Hybrid average	±experimental average	Hybrid average	±experimental average
Experimental average	8,324	-	298	-	256	-	101	-
H1	8,539	215	292	-6	249	-7	96	-5
H2	6,302	-2,022 <sup>000</sup>	277	-21	265	9	112	11**
H3	8,203	-121	331	33**	257	1	100	-1
H4	9,131	807	319	21	287	31***	122	21***
H5	9,378	1,054	325	27*	262	6	101	0
H6	8,418	94	289	-9	256	0	100	-1
H7	8,453	129	280	-18	244	-12 <sup>0</sup>	93	-8 <sup>0</sup>
H8 control	8,956	632	325	27*	273	17**	108	7
H9	8,648	324	314	16	255	-1	103	2
H10	8,170	-154	300	2	240	-16 <sup>00</sup>	93	-8
H11	7,041	-1,283 <sup>0</sup>	275	-23	250	-6	97	-4
H12	7,987	-337	270	-28 <sup>0</sup>	264	8	107	6
H13	8,199	-125	260	-38 <sup>00</sup>	236	-20 <sup>00</sup>	95	-6
H14	9,443	1,119	306	8	261	5	97	-4
H15	8,224	-100	263	-35 <sup>00</sup>	254	-2	89	-12 <sup>00</sup>
H16 control	7,614	-710	296	-2	261	5	117	16***
H17	7,972	-352	291	-7	227	-29 <sup>000</sup>	80	-21 <sup>000</sup>
H18	7,371	-953	284	-14	237	-19 <sup>00</sup>	89	-12 <sup>000</sup>
H19	7,977	-347	306	8	248	-8	93	-8
H20	7,694	-630	296	-2	263	7	117	16***
H21	9,401	1,077	315	17	268	12*	106	5
H22	8,488	164	291	-7	266	10	105	4
H23	7,805	-519	319	21	247	-9	94	-7
H24 control	10,352	2,028***	331	33**	276	20***	102	7
	LSD 5%	1,158		23		11		8
	LSD 1%	1,532		31		15		11
	LSD 0.1%	1,979		40		20		14

Following the analysis of the data regarding the yield obtained in other locations, one or two of the previously mentioned hybrids will be proposed for testing in order to be registered in the official catalog. Of course, in choosing the hybrids to be promoted, other particularly important aspects will be taken into account, such as the stability of production over several years and several testing conditions, the reaction to some stress factors (temperature, lack of water, diseases, pests), production quality, some vegetative traits etc.

In the case of all the hybrids studied, yield differences between the two locations were reported, but the differences were not statistically significant ( $LSD\ 5\% = 1,985$ ). 16 of the 24 tested hybrids had better yield at Lovrin, and for the other 8 the conditions from Turda were more favorable for the expression of production. Some hybrids with average yields of over 8,000 kg/ha, in both localities (H1, H14, H22) or even over 9,000 kg/ha (H4, H5) were noted (figure 1).

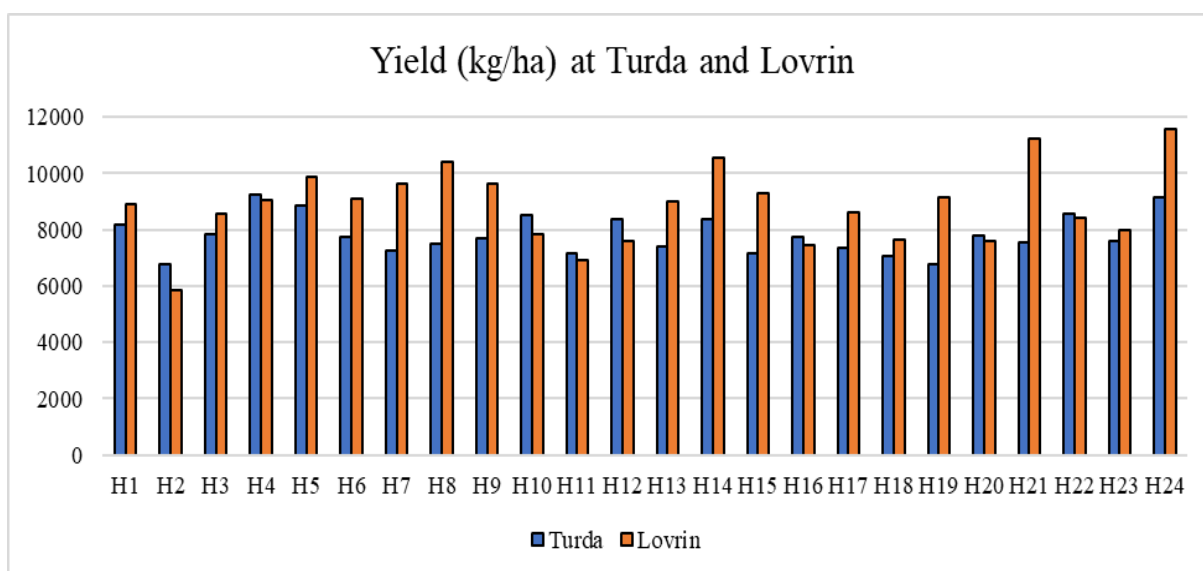


Figure 1. The yield of the studied maize hybrids at Turda and Lovrin, 2023

In the case of TKW, the same situation can be observed as in the case of yield: some hybrids behaved better at Turda, and others at Lovrin. The differences between the two locations, obtained in the case of TKW, were statistically insignificant ( $LSD\ 5\% = 32$ ), with one exception, H21, in which case a significant difference of 73 grams was noted ( $LSD\ 0.1\% = 55$ ) (figure 2).

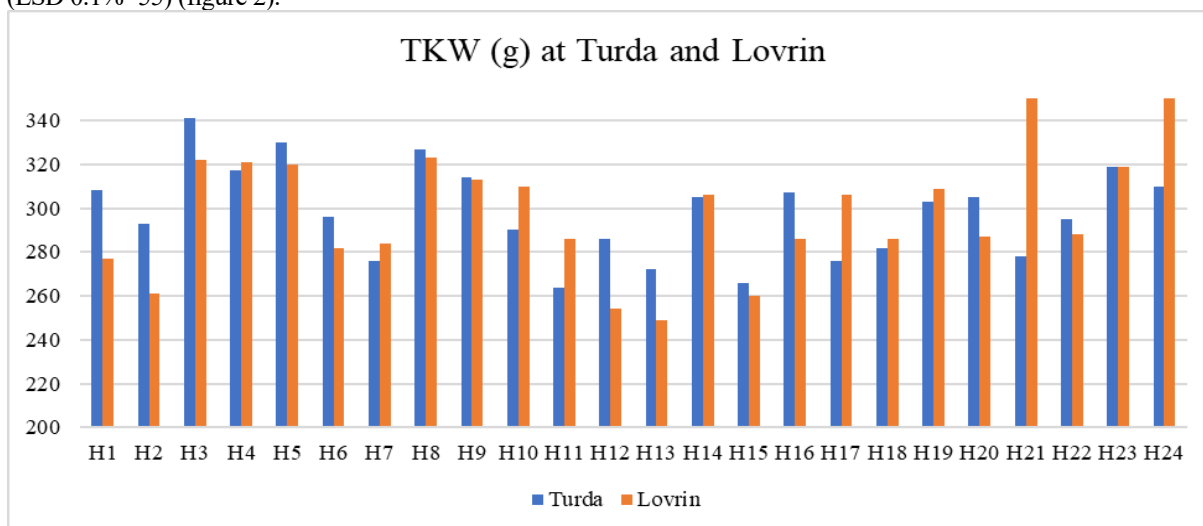


Figure 2. The TKW of the studied maize hybrids at Turda and Lovrin, 2023

The height of the plants was a trait with a high degree of uniformity, the differences between the Turda and Lovrin being very low and statistically insignificant. Some hybrids were distinguished by high plant heights in both localities (H4, H8, H12, H14, H20, H21, H22, H24), while others had reduced heights (H13, H17, H18) (figure 3).

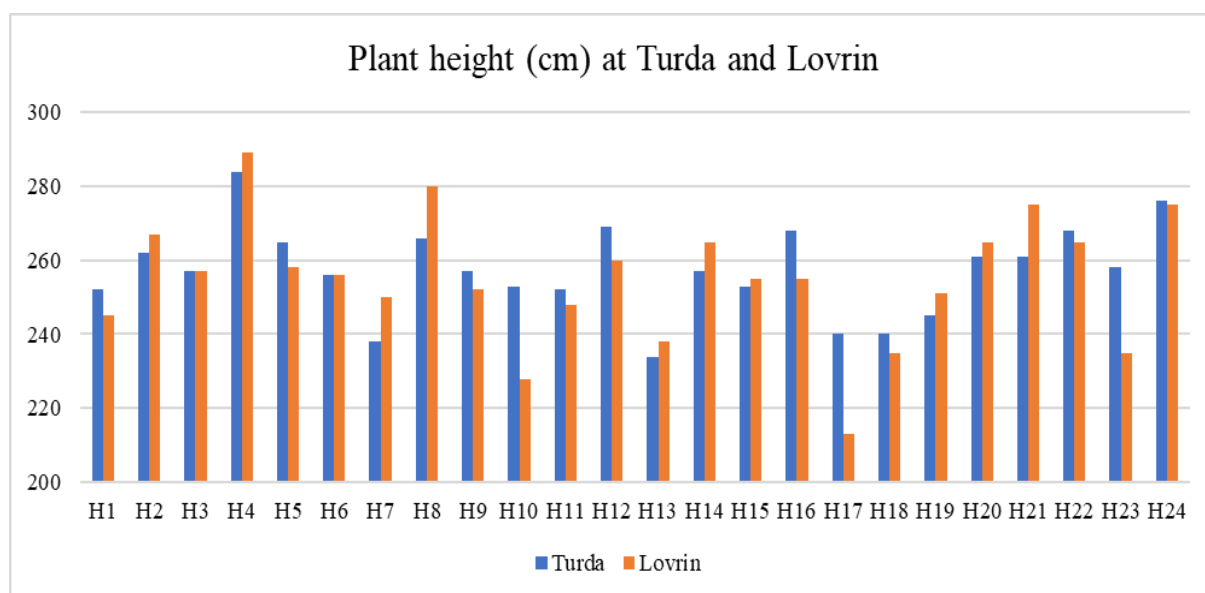


Figure 3. The plant height of the studied maize hybrids at Turda and Lovrin, 2023

The ear height is another trait that stood out through increased uniformity, the differences between locations having low, statistically insignificant values. The insertion height between 80 and 130 cm, as well as the increased uniformity of this trait, makes the hybrids suitable for mechanized harvesting (figure 4).

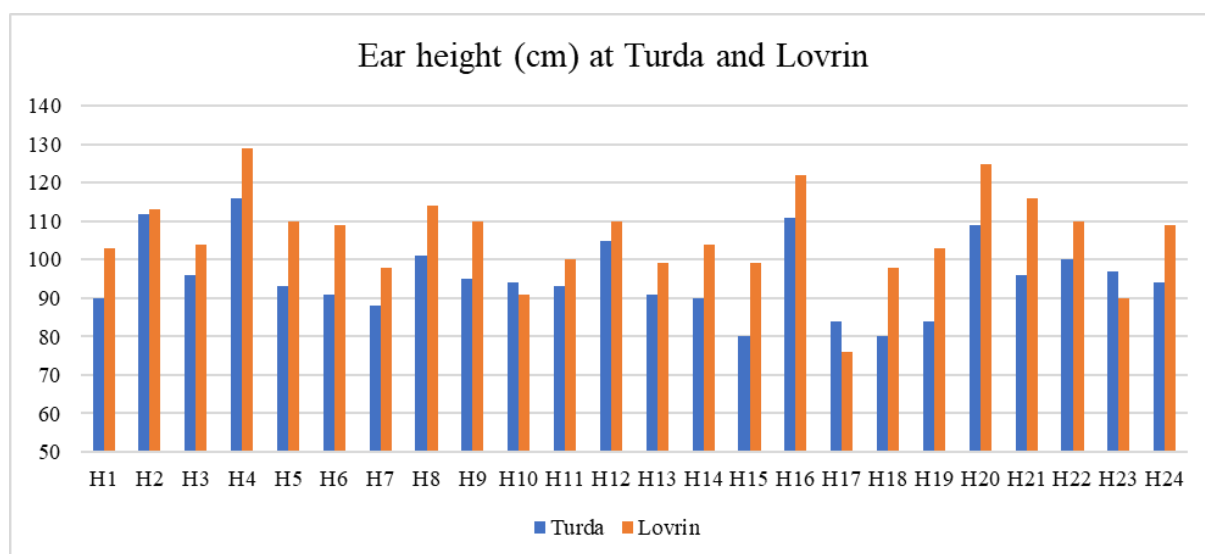


Figure 4. The ear height of the studied maize hybrids at Turda and Lovrin, 2023

## CONCLUSIONS

Following the analysis of the data obtained in 2023 at ARDS Turda and ARDS Lovrin, 4 hybrids (H14, H21, H5 and H4) were noted with average yield of over 9,000 kg/ha.

The four hybrids were also distinguished by a large TKW, in both localities. In the case of H21, the TKW difference between the values obtained at Turda and Lovrin was statistically significant. The H4 hybrid was also distinguished by the highest plant and ear height in the entire experimental system.

The results obtained by the four hybrids will be supplemented with data regarding their reaction in other locations as well, so that one or two hybrids can be proposed for registration.

## ACKNOWLEDGMENTS

The authors thank ARDS Turda and ARDS Lovrin for facilitating this study.

**REFERENCES**

1. Agapie A.L., Horablaga N.M., Bostan C., Popa L.D., Istrate-Schiller C.M., Rechițean D., Sala F - The Dynamics of Nitrogen Valorification in Wheat Crop Under the Influence of the Used Agrofound. *Romanian Agricultural Research*, 2023, 40: 1-13.
2. Agapie Alina Laura, Nicolae Marinela Horablaga, Cristian Bostan, Popa Diana - The efficiency of using nitrogen fertilizers in wheat crop, *Life science and sustainable development*, 2021, vol 2(1), pp. 1-6.
3. Ayilara M.S., M. Abberton, O.A. Oyatomi, O. Odeyemi, Olubukola O. Babalola - Nutritional Properties of Underutilized Legumes and Intercropped Maize. *Frontiers in Soil Science*, 2023, 3:1047847, doi:10.3389/fsoil.2023.1047847.
4. Calugar R.E., Muntean E., Varga A., Vana C.D., Has V.V., Tritean N., Ceclan, L.A. - Improving the Carotenoid Content in Maize by Using Isonuclear Lines. *Plants*, 2022, 11, 1632. <https://doi.org/10.3390/plants11131632>.
5. Chețan F., Rusu T., Călugăr R.E., Chețan C., Șimon A., Ceclan A., Bărdaș M., Mintăș O.S. - Research on the Interdependence Linkages between Soil Tillage Systems and Climate Factors on Maize Crop. *Land*, 2022, 11(10): 1731, doi:10.3390/land11101731.
6. Dhaliwal, Daljeet S., Martin M. Williams – Optimum plant density for crowding stress tolerant processing sweet corn, *Plos One*, 2019.
7. FAOSTAT. <https://www.fao.org/faostat/en/#data/QCL> (accessed on 5 nov 2023).
8. Haș I. - Heterozisul la porumb, în Cristea M., I. Căbulea, T. Sarca (edit.), *Porumbul - Studiu monografic*, Editura Academiei Române, București, 2004, pp. 311–362.
9. Imbrea Florin, Marinovic Branko, Tabara Valeriu, Pirsan Paul, David Gheorghe, Botos Lucian – Role of bio physics in maize cultivation technology. *Romanian Biotechnological Letters*, 2011, Issue: 16 S, 107 – 112.
10. Krishnendu Ray, Hirak Banerjee, Sudarshan Dutta, Alok Kumar Hazra, Kaushik Majumdar - Macronutrients influence yield and oil quality of hybrid maize (*Zea mays* L.), *PLoS One* 14(5): e0216939. Published online 2019 May 29.
11. Muneeb Khan, Kamran Khan, Sami Ullah Afzal, Nawab Ali, Muhammad Mehran Anjum, Hazrat Usman, Muhammad Owais Iqbal - Seed Yield Performance of Different Maize (*Zea mays* L.) Genotypes under Agro Climatic Conditions of Haripur. *Int J Environ Sci Nat Res*. 2017, 5(5), 555672.
12. Onat, B.; Bakal, H.; Gulluoglu, L.; Arioglu, H. - The effects of row spacing and plant density on yield and yield components of peanut grown as a double crop in Mediterranean environment in Turkey. *Turk. J. Field Crops*, 2017, 22, 71–80.
13. Șimon A. - Caracterizarea climatologică a perioadei octombrie 2022-iulie 2023, la Turda. *Agricultura Transilvană*, 2023, nr.39:9-13.
14. Varga A., Haș V., Tritean N., Vana C., Călugăr R., Mureșanu F., Șoptorean L. - Hibrid de nouă generație semitimpuriu Turda 380 adaptat schimbărilor climatice din zona de centru a țării. *Analele INCDA Fundulea*, 2022, 90:63-71. Electronic ISSN 2067–7758.
15. Suba Titus, Suba Dana, Negruț Georgiana - The behavior of some perspective corn hybrids created at ARDS Lovrin under the current climate change conditions. *Life science and sustainable development*, 2021, vol 2(1), pp. 96-103.