RESEARCH REGARDING THE DEGREE OF SIMILARITY / DIVERSITY FOR SOME MAIZE HYBRIDS CREATED AT ARDS LOVRIN

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Abstract. *Maize (Zea mays L.) is cultivated all over the world (Bălan, 2017) due to its multiple uses in human nutrition, in the feeding of animals subjected to fattening (Cojocariu, 2005), in the starch, alcohol, oil, biofuel and some industries. cosmetics (Pîrvulescu et al., 2008, Ram Reddy and Jabeen, 2016). The expansion of maize cultivation in Europe is due not only to its nutritional qualities but also to its characteristics: high resistance to drought, fall, to some diseases and pests, a good use of fertilizers and water. The paper aims to assess the degree of similarity / diversity for a set of maize hybrids, obtained from inbred lines created at the Agricultural Research and Development Station Lovrin, regarding the production of stas / hectare kernels, under the given conditions, in order to select valuable hybrids, drought resistant. Twenty maize hybrids were analyzed as biological material, the experiment being arranged according to randomized blocks, with a density of 50,000 plants per ha^{-1}. The analyzed maize hybrids had a different behavior, in response to climatic factors specific to 2020, the maximum value being recorded for the hybrid C20-7020 (10731 kg.ha^{-1}). The mentioned hybrid differs significantly from the other ones, registering an increase of 37% compared to the experience average. The hybrid C18-7018 with a production of 9204 kg.ha^{-1} stas kernels is also approaching the maximum value. The results regarding the production of stas kernels per hectare for hybrids, classify the 20 maize hybrids studied on the basis of similarity in three classes. Maize breeding program, an applied and avant-garde science, has first-rate tasks in the future in order to create productive hybrids, adapted to the environmental conditions - respectively to the drought during the summer months specific to the studied area.*

Keywords*: Zea mays L., stas kernels production, drought resistance*

INTRODUCTION

The interest towards maize in Romania is also translated by the subsidies allocated to the culture through the National Rural Development Program 2014-2020 (https://www.madr.ro/docs/dezvoltare-rurala/2021/PNDR.2020_V12_26.01.2021.pdf) as well as through other national projects (IMBREA, 2011).

In order to obtain high corn yields, each technological link must be observed; rotation, land preparation and fertilization (TESFAMARIAM ET AL., 2015, AGAPIE ET AL., 2016, AGAPIE ET AL., 2018, KRISHNENDU ET AL., 2019, CAUȘ ET AL., 2021), the genetic material used (VENCOVSKY ET AL. ., 2012, FROMME ET AL., 2019), sowing density (BORDEAN ET AL., 2013, ONAT ET AL., 2017, DHALIWAL AND WILLIAMS, 2019), crop maintenance works (Borcean et al., 2010,), combating diseases and pests and last but not least, the way of preserving the harvest (DUDA AND IMBREA, 2012).

Climatic factors, such as air humidity, precipitation, temperature, can influence crop yields (AJADI ET AL., 2011, MUNEEB ET AL., 2017, ADISA ET AL., 2018). Thus, reducing the amount and distribution of precipitation during the main vegetative phenophases slow down plant growth and development (TESFAMARIAM ET AL. 2010). Similar to rainfall, high temperatures on the background of low rainfall can compromise the harvest (HATFIELD ET AL. 2008, PEREIRA ET AL., 2010). On the other hand, excessive increase in precipitation intensity

over a period of time, beyond the rate of soil infiltration, leads to soil loss through erosion (ONCIA ET AL., 2013), which may further affect the agricultural production (WENBIN ET AL. 2015). Similarly, a high rate of precipitation, beyond the soil's ability to retain water, has the effect of leaking nitrates beyond the radius of the plant's roots (Tesfamariam et al. 2015) and it can cause groundwater contamination (SURESH AND INDRAJEET, 2017).

In this context, the paper aims to assess the degree of similarity / diversity for a set of maize hybrids, obtained from inbred lines created at the Agricultural Research and Development Station Lovrin, regarding the stas kernels production per hectare, under the given conditions, in order to select valuable, drought-resistant hybrids.

MATERIAL AND METHODS

During 2020, in the experimental field of the maize breeding laboratory, from Lovrin Agricultural Research and Development Station, Timiș county, an experience with 20 maize hybrids was placed.

Administrative Territorial Unit Lovrin is located in the western part of Romania (Fig.1). The area is favorable for corn cultivation (BORCEAN ET AL., 2010, DAVID ET AL., 2010, IMBREA, 2011), in terms of physical and geographical conditions specific to the plain area of Banat: flat relief with small variations (POSEA AND BADEA, 1984, BÂRLIBA AND COJOCARIU, 2010, COPĂCEAN ET AL., 2019), high level of groundwater and soils with high natural fertility (ROGOBETE ET AL., 2015), with a strong microbial activity (RADU ET AL., 2010, BOROZAN ET AL., 2013) and a climate conducive to the development of field crops (COJOCARIU ET AL., 2008).

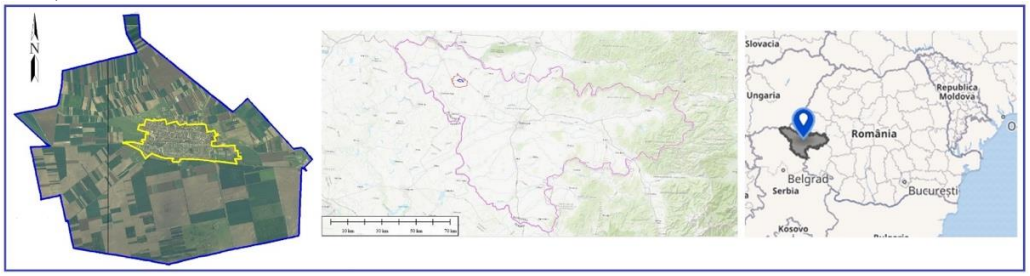

Fig. 1. Location of the study area
(processing after ANCPI Archive, www.geospatial.org)

For the climatic characterization of the interest area, punctual data recorded at the meteorological station of ARDS Lovrin were used.

In terms of local climate, from the analysis of the most important meteorological parameters: air temperature and atmospheric precipitation, the experimental year 2020 (April-September) presents some characteristics that differentiate it from the previous years (ȘMULEAC ET AL., 2020), respectively from multiannual averages (Fig.2, Fig.3).

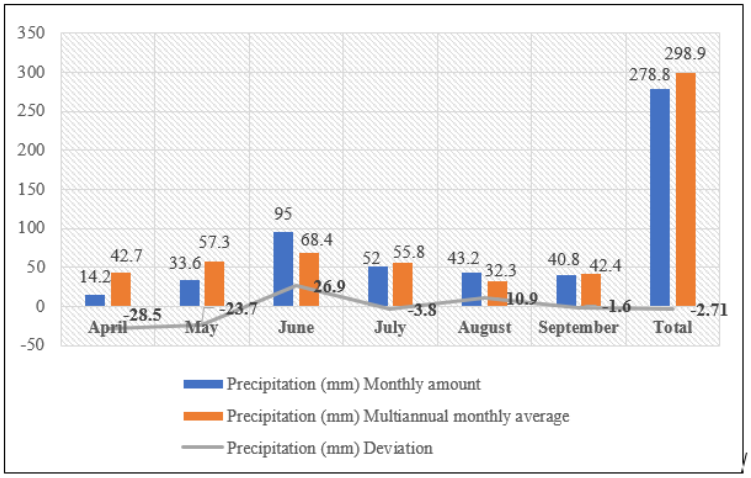

Fig. 2. Precipitation amounts during April-September 2020

The experimental year 2020 was excessively hot during the whole period of maize vegetation. The fallen precipitation during this period registered an uneven distribution, below the multiannual average, except for the months June and August.

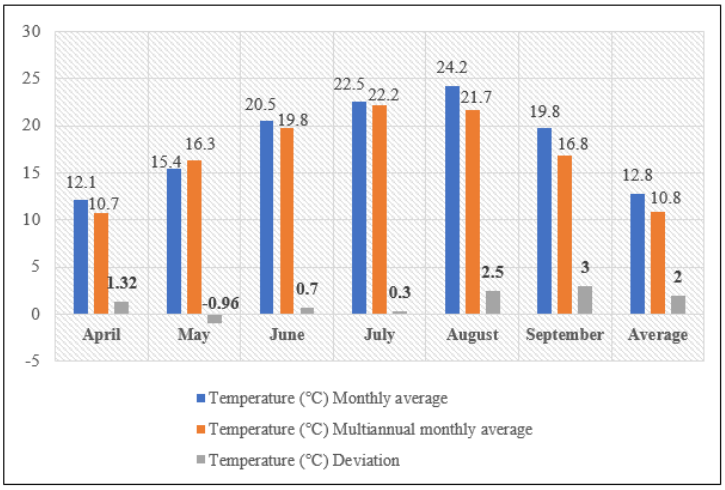

Fig. 3. Average temperature for April-September period (2020)

Twenty maize hybrids (noted: C1-7001...C20-7020), obtained from inbred lines created at ARDS Lovrin, were studied. The experience was arranged according to randomized blocks, in two repetitions, with a density of 50.000 plants per ha^{-1}.

This comparative culture with maize hybrids was included in a four-year crop, using conventional cultivation practices. The sowing took place on 08.04.2020 and the harvesting took place on 12.09.2020.

In order to calculate the production per hectare ($kg.ha^{-1}$), at harvest, the following aspects were noted and analyzed: the total number of cobs per plot, the total weight of the cobs per plot, the yield, the humidity at harvest.

The analysis of stas kernels per hectare production was performed by processing the data obtained, using Statistics 10 package (free version).

RESULTS AND DISCUSSIONS

At ARDS Lovrin, Timiș county, there is a long tradition in corn breeding, respectively to improve the initial genetic material, valuable in obtaining hybrids with superior production characteristics (SUBA DANA ET AL., 2016, SUBA D., 2017,). There is a positive correlation between the biological value of the parental forms and hybrids heterosis, fact highlighted also by other studies in the field (HALLAUER ET AL., 1981).

In the present paper, 20 maize hybrids were evaluated in terms of stas grain production / hectare, under the conditions of Agricultural Research and Development Station Lovrin, Romania (Fig. 4). As a control variant, the average of the experience was used.

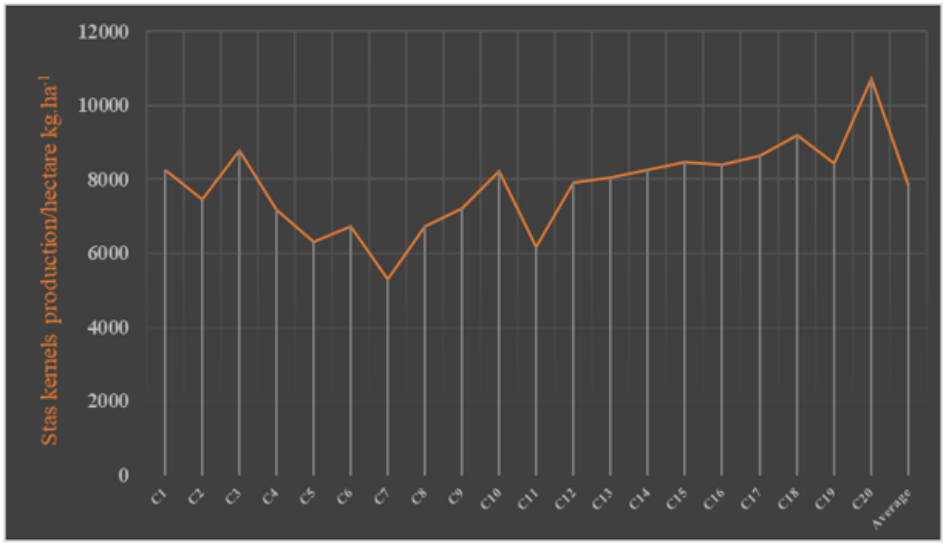

Fig. 4. Stas kernels production / hectare [kg.ha^{-1}] for the maize hybrids C1 - C20

From figure 4 it can be noticed that the production of stas kernels in the experimental year is reduced, much lower than during the previous years (SUBA DANA ET AL., 2020), the explanation being the excessive temperatures from June, July and August on the background of some low rainfall.

The influence of climatic factors on the productivity of maize hybrids is also discussed in other studies (JOCKOVIĆ, Đ., 2010, VARGA A. ET AL., 2016, RAM REDDY AND JABEEN, 2016).

In case of decreasing production capacity, factor A (maize hybrid) has a small variation in production (Coefficient of Variation: 7.22%); the production differences between these 20 analyzed maize hybrids being statistically ensured (for $\alpha = 0.1\%$) according to table 1.

Table 1

Analysis of variance on STAS grain production in the analyzed maize hybrids

Source	Degrees of freedom	Sum of squares	Variance S^2	F Test	Significance
Repetition	1	1198198.225	1198198.225	3.7509	0.0678
A Factor	19	56879555.275	2993660.804	9.3715	***
Error	19	6069419.275	319443.120		
Total	39	64147172.775			

From table 2, regarding the production results recorded for the studied hybrids under the given conditions, a series of pertinent conclusions can be deduced, which will be taken into account in the subsequent researches.

Table 2

Analysis of stasis kernels production recorded in maize hybrids

The hybrid / variant	Stas kernels production		Difference kg.ha^{-1}	Significance
	Kg.ha^{-1}	%		
C1-7001	8271	106	446	
C2-7002	7452	95	-373	
C3-7003	8790	112	965	
C4-7004	7185	92	-640	
C5-7005	6314	81	-1511	0
C6-7006	6741	86	-1084	
C7-7007	5290	68	-2535	000
C8-7008	6738	86	-1087	
C9-7009	7211	92	-614	
C10-7010	8239	105	414	
C11-7011	6167	79	-1658	00
C12-7012	7896	101	71	
C13-7013	8034	103	209	
C14-7014	8271	106	446	
C15-7015	8466	108	641	
C16-7016	8399	107	574	
C17-7017	8653	111	828	
C18-7018	9203	118	1378	*
C19-7019	8442	108	617	
C20-7020	10731	137	2906	***
Average hybrids–control variant (C)	7825	100	mt	

Degrees of freedom: DL5 % = 1183 kg.ha^{-1} DL 1% = 1617 kg.ha^{-1} DL 0.1% = 2195 kg.ha^{-1}

Analyzing table 2 it is found that, compared to the average of the experience (7825 kg.ha^{-1}) were obtained 5 differences statistically ensured for our studied hybrids, respectively: C5-7005, C7-7007, C11-7011, C18-7018 and C20-7020.

The hybrid C20-7020 obtained the highest production of stas kernels, which exceeded the average experience by 37%. The production of this hybrid, in the conditions of the experimental year 2020, is clearly higher than the average of the experience, statistically assured as being very significant.

C18-7018 hybrid had an increase of 18% compared to the average, being a significant increase. The difference of 1378 kg.ha^{-1} compared to the average experience is considered to be significant.

The corn hybrid C11-7011 gives a lower production than the average experience (control) with 1658 kg.ha^{-1}. This result is distinctly significant. The hybrid C7-7007 gives a production below the average of the experience, the difference being very significant (2535 kg.ha^{-1}), as well as the hybrid C5-7005, which is also below the control, with 1511 kg.ha^{-1} under the experience average. This difference is significant.

As a conclusion for this experience, the highest production of stas kernels per hectare was registered by the C20-7020 maize hybrid, clearly superior production regarding to the control, with an increase of 37%.

Table 3 presents the differences and similarities between the maize hybrids analyzed for stasis grain production / hectare, using the Duncan Test.

The Duncan test highlights the 190 possible comparisons [C220], resulting in classes A - I, for the significance threshold $\alpha = 5\%$. The highest production of 10731 kg.ha^{-1} was obtained by the hybrid C20-7020 - class A, which differs significantly from all other variants. From a statistical point of view, there are no statistically significant differences between hybrids that are in the same class in terms of stas kernel production per hectare.

Table 3

Comparison of maize hybrids in terms of stasis kernel production / hectare

Nr crt.	Hybrid	Stas kernels production/hectare Kg.ha^{-1}	Category
1	C1-7001	8271	BCDE
2	C2-7002	7452	DEFG
3	C3-7003	8791	BC
4	C4-7004	7186	EFGH
5	C5-7005	6314	GHI
6	C6-7006	6742	FGH
7	C7-7007	5291	I
8	C8-7008	6739	FGH
9	C9-7009	7211	EFGH
10	C10-7010	8239	BCDE
11	C11-7011	6168	HI
12	C12-7012	7897	CDEF
13	C13-7013	8034	BCDE
14	C14-7014	8272	BCDE
15	C15-7015	8466	BCD
16	C16-7016	8399	BCD
17	C17-7017	8654	BC
18	C18-7018	9204	B
19	C19-7019	8442	BCD
20	C20-7020	10730	A

Based on similarity, the 20 maize hybrids analyzed are grouped in three large clusters: A - which includes C20-7020, B - which includes the hybrid C7-7007, which recorded the lowest production of stas grain / hectare and cluster C - in which are included the other analyzed maize hybrids, grouped in their turn in other three subclasses (Fig.5).

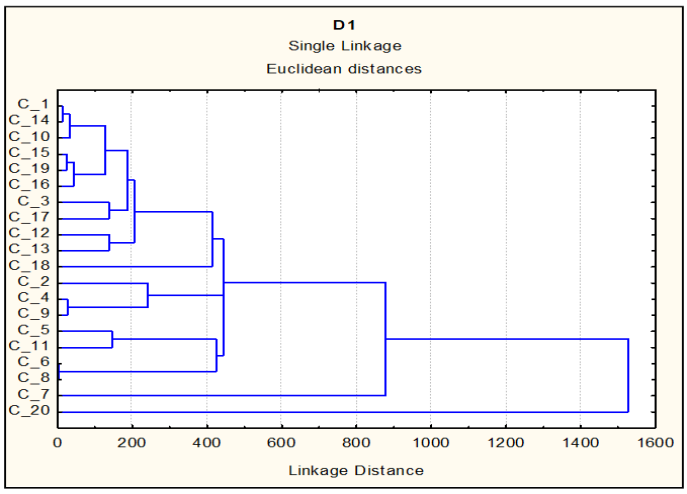

Fig. 5. Cluster analysis for the studied maize hybrids C1 - C20

Even if the production results are not satisfying in the conditions of agricultural year 2020, the maize hybrids that exceeded the average of the experience regarding the production of stas kernels per hectare will be further studied.

CONCLUSIONS

The analyzed corn hybrids had a different behavior, in response to climatic factors specific to 2020, the maximum value being recorded for the hybrid C20-7020 (10731 kg.ha^{-1}). It differs significantly from the other hybrids, registering an increase of 37% compared to the average experience. The hybrid C18-7018 with a production of 9203 kg.ha^{-1} stas kernels is also approaching the maximum value.

The results regarding the production of stasis kernels per hectare classify our 20 studied maize hybrids on the basis of similarity in three classes.

Maize breeding program, an applied and avant-garde science, has first-rate tasks in the future in order to create productive hybrids, adapted to the environmental conditions, respectively to the drought during the summer months specific to the studied area.

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