RESEARCH ON THE EVOLUTION OF MAIN YIELD COMPONENTS OF MAIZE HYBRIDS GROWN IN DIFFERENT CLIMATIC CONDITIONS ON LUVOSOIL FROM SIMNIC AREA

BORLEANU IOANA CLAUDIA[1], PARASCHIVU MIRELA[1], TUȚĂ CLAUDIA ELENA[1]
[1] Agricultural Research and Development Station Simnic

Key words: maize,hybrid, yield,climatic condition,sowing density,yield component

ABSTRACT

Environmental factors strongly influence the yields of cultivated crops. In maize, drought is one of the major factors limiting biomass and seed production. Five maize hybrids sowed in three different planting densities have been evaluated for their response to water stress conditions comparatively with well-watered conditions. Several yield components were measured: grain yield, ears/plant, ear weight, thousand kernel weight. Under water stress conditions it terms of planting densities grain yield, ears/plant, relative yield weren't significantly affected, while ear weight and thousand kernels weight were significantly lower for 50000 pl/ha and 60000 pl/ha comparatively with the control. Relative yield was a stable character with mean values close to one planting density to another. Among all studied characters under normal water conditions only grain yield, ears number/plant and thousand kernels weight were significantly affected by planting density.

INTRODUCTION

Beside low soil fertility, drought is one of the abiotic stress factors responsible for limiting maize yield even in areas considerate as having a good rainfall regime. Yield losses due to drought in maize vary by geographic area and are between 15% (Edmeades et al., 1992) and 60% (Heisey and Edmeades, 1998), sometimes leading to compromised crop. There is a positive relationship between mean maize yield and rainfall totals during the growing season in major production areas, indicating that total rainfall may indeed be a simple, useful predictor of areas or seasons that are subject to drought (Edmeades et al., 1997). Beck et al. (1997) and Vasal et al. (1997) have reviewed a variety of options for drought tolerant maize, recommending the use of high density planting together with the process of inbreeding. High density planting and inbreeding, in which male and female flowering must coincide on the same plant, constitute a strategy for maize improvement aimed at „general" stress tolerance (Vasal et al., 1997). These practical methods of exposing maize to an abiotic stress factor have been particularly exploited in temperate maize (Duvick, 1992), as the mechanism of tolerance to drought and to high plant density appear to be related (Dow et al., 1984). Besides breeding programs efforts which target by 2016 drought tolerant maize that provides a 1 ton/ha yield increase under drought stress conditions (LaRovere et al., 2010), technological measures might be used to decrease drought effects. Known that Simnic area have low rainfall regime and extremely high temperatures during the summer, research on the influence of technological measures to different biotic and abiotic stress factors and to yield and its quality for different crops have been the subject of many previous observations done to ARDS Simnic (Ilicevici, 1980, Ilicevici and Radu, 1986, Păunescu Gabriela and Boghici Ofelia, 2008, Paraschivu M. et al, 2008, 2009, Paraschivu Mirela 2009, 2010, Urechian Viorica et al., 2010, 2011, Rotaru et al. 2010, Tuță et al. 2010). Thus, the aim of this study was to evaluate maize yielding capacity and main yield components for six hybrids grown in three different planting densities and different climatic conditions to Simnic area and how technological factors may influence maize drought tolerance.

MATERIAL AND METHODS

During three years (2009-2011) six maize hybrids grown on three planting density (40000pl/ha, 50000pl/ha and 60000pl/ha) have been tested in different climatic conditions in order to evaluate their yielding capacity and main yield components. The material was represented by six maize hybrids (F 475, Kamelias, Danubian, KWS 2376, Rapsodia, Kitty) tested using a split plot design with two factors (Factor A – planting density, Factor B – maize hybrid) in three replications. The size of each plot was 25 m^2. Plots were fertilized at sowing time with 200 kg/ha complex fertilizer NPK 20-20-0 basal applied and 150 kg/ha ammonium nitrate top-dressed during vegetation period. Weeds were controlled in each experimental year using herbicides. For the experiment F 475 and 40000 plants/ha were considered as the control. Grain yield, ears/plant, ear weight, relative yield and thousand kernels weight were determined for each plot and replication. For statistic interpretation was used analyze of variance.

RESULTS AND DISCUSSION

Because climate is variable through time, exposure to drought also varies from year to year and decade to decade. Global warming and the probability that drought and other extreme climatic events may become more frequent in the future may translate into increased exposure to drought (WorldBank, 2006). Despite maize yield potential exposure to water stress year (droughty year) affected equally yield and main yield components comparatively with the results recorded in normal years. Yield potential is a composite trait explained by different specific traits which can include tolerance to drought, pests and diseases, and performance under erratic rainfall pattern. The differences in grain yield between hybrids increased with the intensity of drought stress (Betrán et al., 2003). Under water stress conditions it terms of planting densities grain yield, ears/plant, relative yield weren’t significantly affected, while ear weight was significantly and very significantly lower for 50000 pl/ha and 60000 pl/ha comparatively with the control. Thousand kernel weights decreased also significantly for 60000 pl/ha comparatively with the values recorded for the control (Table 1).These results suggest that under water stress conditions when planting density increased ear weight and thousand kernel weight were affected because plants didn`t find sufficient elements for grain development due to a smaller nutrition space. Among all tested maize hybrids were noticed F 475, Kamelias, KWS 2376 with significant grain increases for 60000 pl/ha comparatively with the control planting density (40000 pl/ha). For Kamelias this grain increase was due to higher number of ears/plant. The hybrids KWS 2376 and Rapsodia were affected the most by water stress recording significant decreases of ears/plant especially at a density of 50000 pl/ha. Under water stress conditions for most of tested hybrids showed positive or negative deviations for the characters studied especially at a density of 60000 pl/ha. Among all studied characters under normal water conditions only grain yield, ears number/plant and thousand kernels weight were significantly affected by planting density (Table 2).

Table 1

Yield and main yield components on the influence of hybrid and planting density in the conditions of water stress year – 2009

Hybrid	Grain Yield		Ears/pl		Ear weight		Relative yield		TKW	
	q/ha	%	Nr.	%	g	%		%	g	%
40.000 pl/ha										
F475	53.0	100.0	0.83	100.0	205	100.0	81	100.0	229	100.0
Kamelias	58.0	100.0	0.86	100.0	189	100.0	84	100.0	264	100.0
Danubian	58.8	100.0	0.79	100.0	244	100.0	78	100.0	253	100.0
KWS 2376	53.5	100.0	0.94	100.0	190	100.0	81	100.0	275	100.0
Rapsodia	61.8	100.0	0.98	100.0	204	100.0	81	100.0	224	100.0
Kitty	63.3	100.0	0.84	100.0	218	100.0	85	100.0	253	100.0
Mean	**58.1**	**-**	**0.87**	**-**	**208**	**-**	**82**	**-**	**249**	**-**
%	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**
50.000 pl/ha										
F475	58.0	109.4	1.08	130.1**	156	76.1^{ooo}	77	95.1	216	94.3
Kamelias	63.4	109.3	0.84	97.6	182	96.3	87	103.6	252	95.5
Danubian	57.7	98.1	0.78	98.7	225	92.2^{o}	77	98.7	230	90.9
KWS 2376	58.9	110.1	0.84	89.4^{o}	185	97.4	83	102.5	295	107.2
Rapsodia	62.8	98.4	0.82	83.7^{o}	225	90.7^{o}	78	96.3	244	108.9
Kitty	63.2	99.8	1.05	125.0**	154	70.6^{ooo}	82	96.5	193	76.3^{ooo}
Mean	**60.7**	**-**	**0.90**	**-**	**188**	**-**	**80**	**-**	**238**	
%	**104.5**	**-**	**103.4**	**-**	**90.4^{o}**	**-**	**97.6**		**95.6**	
60.000 pl/ha										
F475	59.3	111.9*	0.89	107.2	148	72.2^{ooo}	85	104.9	202	88.2^{o}
Kamelias	65.4	112.8*	1.19	138.4***	124	65.6^{ooo}	84	100.0	200	75.8^{ooo}
Danubian	53.7	91.3	0.71	89.9	171	70.1^{ooo}	82	105.1	188	74.3^{ooo}
KWS 2376	59.2	110.7*	0.94	100.0	138	72.6^{ooo}	84	103.7	241	93.0
Rapsodia	61.5	99.5	0.97	99.0	152	74.5^{ooo}	81	100.0	207	92.4
Kitty	66.2	104.6	0.94	111.9*	157	72.0^{ooo}	83	97.6	194	76.7^{ooo}
Mean	**60.9**	**-**	**0.94**	**-**	**148**	**-**	**83**	**-**	**205**	**-**
%	**104.8**	**-**	**108.0**	**-**	**71.2^{ooo}**	**-**	**101.2**	**-**	**82.3^{oo}**	**-**
s^2	**6.5**		**13.2**		**18.7**		**3.5**		**13.3**	
DL 5%	**6.2**	**10.7**	**0.1**	**11.5**	**15.0**	**7.2**	**4.8**	**5.9**	**26.9**	**10.8**
DL 1%	**8.2**	**14.1**	**0.2**	**23.0**	**21.2**	**10.2**	**6.5**	**7.9**	**35.6**	**14.3**
DL 0,1%	**10.6**	**18.2**	**0.3**	**34.5**	**29.7**	**14.3**	**8.2**	**10.0**	**46.0**	**18.5**

Significance of mean increases is established comparatively with 40000 plants/ha and that for each hybrid comparatively with the values recorded for 40000 plants/ha.

Table 2

Yield and main yield components on the influence of hybrid and planting density in the conditions of normal rainfall regime (2010-2011)

Hybrid	Grain Yield		Ears/pl		Ear weight		Relative yield		TKW	
	q/ha	%	Nr.	%	g	%		%	g	%
40.000 pl/ha										
F475	66.3	100.0	1.45	100.0	124	100.0	86	100.0	362	100.0
Kamelias	65.9	100.0	1.56	100.0	112	100.0	88	100.0	327	100.0
Danubian	63.3	100.0	1.36	100.0	131	100.0	86	100.0	287	100.0
KWS 2376	64.4	100.0	1.62	100.0	103	100.0	85	100.0	326	100.0
Rapsodia	64.2	100.0	1.35	100.0	136	100.0	83	100.0	312	100.0
Kitty	75.1	100.0	1.46	100.0	141	100.0	86	100.0	298	100.0
Mean	**66.5**	**-**	**1.47**	**-**	**125**	**-**	**86**	**-**	**318**	**-**
%	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**
50.000 pl/ha										
F475	75.7	114.2**	1.34	92.4	124	100.0	87	101.2	296	81.8^{ooo}
Kamelias	74.6	113.2**	1.42	91.0	117	104.5	85	96.6	330	100.9
Danubian	68.8	108.7	1.24	91.2	133	101.5	85	98.8	282	98.3
KWS 2376	72.1	112.0*	1.51	93.2	106	102.9	87	102.4	332	101.8
Rapsodia	74.0	115.3**	1.26	93.3	142	104.4	87	104.8*	303	97.1
Kitty	78.0	103.9	1.34	91.8	129	91.5	87	101.1	272	91.2^{ooo}
Mean	**73.9**		**1.35**		**125**		**86**		**303**	
%	**111.1***		**91.8^{o}**		**100.0**		**100.0**		**95.3**	
60.000 pl/ha										
F475	75.7	107.2	1.34	92.4	104	83.9^{o}	86	100.0	277	76.5^{ooo}
Kamelias	74.6	97.4	1.12	71.8	111	99.1	86	97.7	279	85.3^{ooo}
Danubian	68.8	94.8	1.22	89.7	97	74.0^{ooo}	84	97.7	250	87.1^{ooo}
KWS 2376	72.1	111.8*	1.37	84.6	98	95.1	84	98.8	318	97.5
Rapsodia	74.0	109.7	1.04	77.0	131	96.3	84	101.2	292	93.6^{o}
Kitty	78.0	97.5	1.33	91.1	113	80.1^{ooo}	88	102.3	273	91.6^{oo}
Mean	**73.9**		**1.24**		**109**		**85**		**282**	
%	**111.1***		**84.4^{oo}**		**87.2^{o}**		**98.8**		**88.7^{ooo}**	
s^2	**7.4**		**10.7**		**12.3**		**1.7**		**9.3**	
DL 5%	**6.6**	**9.9**	**0.1**	**6.8**	**14.2**	**11.4**	**4.0**	**4.7**	**15.2**	**4.8**
DL 1%	**8.7**	**13.1**	**0.2**	**13.6**	**18.7**	**15.0**	**5.7**	**6.6**	**21.6**	**6.8**
DL 0,1%	**11.3**	**17.0**	**0.3**	**20.4**	**23.1**	**18.5**	**7.6**	**8.8**	**27.2**	**8.6**

Significance of mean increases is established comparatively with 40000 plants/ha and that for each hybrid comparatively with the values recorded for 40000 plants/ha.

It was observed that grain yield increased significantly for most tested hybrids at a density of 50000 pl/ha, while at planting density of 60000 pl/ha only KWS 2376 recorded a significantly grain yield increase. Generally, ears number/plant was significantly affected by planting density for both 50000 pl/ha and 60000 pl/ha comparatively with the control. Ears weight was another yield component affected by planning density, recording decreases comparatively with the control at a density of 60000 pl/ha. Thousand kernels weight decreased as planting density increased, the most affected hybrids were F475 and Kitty.

The most affected characters due to water stress were number of ears/plant and thousand kernels weight. Relative yield was a stable character with mean values close to one planting density to another.

CONCLUSIONS

Generally, yield and yield components were affected by water stress for all tested hybrids comparatively with the values recorded in well-watered year. Under water stress conditions it terms of planting densities grain yield, ears/plant, relative yield weren’t significantly affected, while ear weight was significantly and very significantly lower for 50000 pl/ha and 60000 pl/ha comparatively with the control. Among all studied characters under normal water conditions only grain yield, ears number/plant and thousand kernels weight were significantly affected by planting density.

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