

RESEARCHES REGARDING THE MAIZE HYBRID BEHAVIOUR IN RELATION TO THE ENVIRONMENTAL FACTORS IN THE MAIZE ECOSYSTEMS OF DÂMBOVIȚA COUNTY

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Abstract

The cultivar is known as the most important technological link from the perspective of the production stability, but its quantity and quality are influenced by the climatic conditions. The identification of some cultivars or hybrids having genetic characteristics which should offer a better adaptability is particularly important. Within the experiments which have been made on the experimental fields of C.T.S. Târgoviște for the maize cultivation, the notes were taken between 2009 and 2012 Regarding the drought resilience, we can notice that the hybrids show values between 1.25 and 2.25, which means that the plants did not have the leaves twisted and they showed a normal turgescence. Anyway, the CSM 7717 and KXA 8481 hybrids stand out as more resilient. We may notice a good heat resilience of all the hybrids, the average grades ranging within 1 and 2.5. The highest resilience was the one shown by the CSM hybrid. Regarding the shrivelling, we may notice that all monitored hybrids during the experiment showed less than 20 shrivelled kernels, the average grades ranging between 1.20 and 1.33. Concerning the root resilience, it is very good at all hybrids. The best values, as those of the witness plant, are recorded at the CSM 7717, CSM 7769 and KXA 8481 hybrids. From the stalk resilience perspective, the lowest value was recorded for the CSM 7769 hybrid, and regarding the highest value, we can notice that all hybrids show good stalk resilience. All the hybrids studied during the experiment can be cultivated in the climatic conditions of Dâmbovița county, the CSM 7717, CSM 7769 and KXA 8481 hybrids yielding the best results.

Keywords: maize, hybrids, drought, root resilience, stalk resilience.

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1. INTRODUCTION

In Romania, maize is the main crop, occupying the first place in point of volume (on average 30% of the arable land), and production (total and average per hectare). Therefore, the production and economic efficiency of maize crops are a matter of national interest (Sarca et al, 2007). For a better use of the farm lands and natural resources for maize, in order to reach a profitable production, a sensible choice of the location of the areas for cultivated hybrids, depending on climate resources and biological needs of hybrids, is required (Melut et al., 2011).

The development of improved germplasm to meet the needs of future generations in the light of climate change and population growth is of the highest importance (Easterling et al., 2013). The experience of the past has demonstrated that the use of new varieties along with

improved management options can offset yield losses by up to 40% (Thornton et al., 2009).

Drought is a worldwide problem and dangerous for arable field crops growth and subsequently for food security (Jaleel et al., 2009). Current selection criteria are applied for a good variety selection being superior to breeding techniques which are time consuming (Zhu, 2002).

Drought stress or water deficit stress is a globally renowned feature of the climate, and also an alarming threat to our agriculture, which could be unavoidable. Different studies have shown that one third of the arable land of the world is faced with this water shortage which also disturbs the crop production (Kramer, 1980).

The soil drought effect on growth was studied in experiments done in greenhouse and the conclusion was that the genetic makeup of maize shows variation in drought tolerance and

is better manipulated under severe drought conditions (Grzesiak, 2001).

Water shortages and soil water losses due to environmental change and land use change are challenges to maize production. An experiment was conducted to investigate the physiological responses of the maize cultivars Doge, Vero and Luce to drought conditions. As a result of that, Doge was classified as less drought-tolerant (Efeoğlu et al., 2009).

Out of the eight maize cultivars studied in point of resilience to drought, the cultivars KSC720, KSC 710 GT stand out as tolerant and cultivar KSC appears as highly resilient (Naghavi et al., 2013).

Several donors tolerant to drought and combined drought and heat stress, notably La Posta Sequia C7-F64-2-6-2-2 and DTPYC9-F46-1-2-1-2, need to be incorporated into maize breeding pipelines (Cairns et al., 2013).

2. MATERIALS AND METHODS

Experiments were carried out and notes were taken in the experimental fields of C.T.S. Târgoviște, between 2009 and 2012. Nine maize hybrids of the average precocity group were monitored in the present study.

The drought resilience was appreciated on a 9 grade scale.

For the heat resilience, the assessment was done in grades on a scale from 1 to 9, depending on the number of dry leaves.

The shrivelling degree is obtained by the multiplication of the process intensity (grade) and frequency (grade). It is determined during the harvest, within an average trial of 100 kernels.

The percentage of sterile plants is calculated using the total number of plants that exist on the plot and is determined during the harvest, at the same time with the counting of the plants.

For the root resilience, the grading is done before harvest. For the 1st grading, the naturally fallen plants, under the environmental factor action are recorded, and for the 2nd grading, the plants falling by bending down until the panicle touches the plants' panicles on the neighbouring row are added. The determination

of the fallen plant percentage is done in all the 4 repeated steps, by recording the average percentage on cards, with no decimal.

For the assessment of the stalk resilience, 2 assessments are done. The first grading represents the natural breaking, and the second represents the one produced by the plants' bending, which cumulates the first, as well. Determinations are done in all the four repeated steps, after removing the eliminations of the raw ends, by recording the average percentage of broken plants on cards.

3. RESULTS AND DISCUSSION

Under the climatic conditions of the year 2009, by analyzing table 1, we can notice that the drought resilience of the 10 hybrids analyzed is very good.

Thus, 2 hybrids were assessed by grade 1 (just like the witness plant Fundulea 322), and the remaining hybrids were assessed by grade 2, which means that the plants did not have twisted leaves and had a normal turgescence.

As far as the heat resilience is concerned, the results were as follows: 4 hybrids (CSM 7717, CSM 7769, KXA 8481, KXA 9483) had a very good resilience, superior to that of the witness plant, being assessed by grade 1- respectively the leaves under the panicle did not show signs of being affected; 2 hybrids (EGZ 9505, KXA 7482) had the first two leaves under the panicle, having a scalded appearance and were graded by grade 2; 3 hybrids (EGZ 8301, EGZ 9501, NJ 5481) had 3-4 leaves under the panicle with a scalded appearance and were assessed by grade 3.

Regarding the shrivelling resilience, expressed by the shrivelling degree (a grading scale from 1 to 5), we can notice that all hybrids show close values, between 1.2% and 1.3%, respectively all the hybrids have a good shrivelling resilience (between 1 and 20 shrivelled kernels).

In 2009, sterility was zero, for all the hybrids in experiment. It was determined for each hybrid, within the repeated steps 1 and 3, then, the average was calculated.

Regarding the root resilience, it was very good for the CSM 7717, CSM 7769, EGZ 9505 and EF 5209 and KXA 8481 hybrids. The plants fallen naturally under the environmental factor action are assessed by grade 1. Thus, the EGZ 830, EGZ 9501 and NJ 5481 hybrids were assessed by grade 1. The highest percentage of

fallen plants, where it could be noticed that their panicles touched the panicles of the next row, was noticed at the hybrid KXA 9483, this being given grade 2.

Regarding the stalk resilience, the KXA 7482 hybrid was the poorest (grade 3).

Table 1. The behavior of maize hybrids on the environmental factors between 2009 and 2012

Crt. no.	Cultivar/ Hybrid	Drought resilience grade				Heat resilience grade				Shrivelling degree %				Sterility %				Root resilience grade				Stalk resilience grade				
		2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	
		1	Fundulea 322	1	1	1	1	2	2	1	1	1,2	1,2	1,2	1,2	0	0	0	0	0	0	0	0	1	3	0
2	CSM 7717	1	2	1	1	1	1	1	1	1,3	1,3	1,2	1,2	0	0	0	0	0	0	0	0	1	2	0	0	0
3	CSM 7769	1	2	2	2	1	2	2	2	1,2	1,3	1,3	1,2	0	0	0	0	0	0	0	0	1	0	0	0	1
4	EF 5209	2	2	1	2	2	2	2	1	1,3	1,3	1,2	1,2	0	0	0	0	0	0	1	2	0	2	0	1	
5	EGZ 8301	2	3	2	2	3	2	3	2	1,2	1,2	1,2	1,2	0	0	0	0	1	0	1	2	0	0	3	1	
6	EGZ 9501	2	3	2	2	3	2	1	2	1,2	1,2	1,2	1,2	0	0	0	0	1	0	0	1	0	1	2	1	
7	EGZ 9505	2	3	1	2	2	2	2	3	1,3	1,6	1,2	1,2	0	0	0	0	0	1	4	1	0	0	0	1	
8	KXA 7482	2	1	2	1	2	1	1	2	1,2	1,2	1,2	1,2	0	0	0	0	0	0	2	1	3	0	0	0	
9	KXA 8481	2	1	1	1	1	1	3	3	1,3	1,2	1,2	1,2	0	0	0	0	0	0	0	1	0	0	2	1	
10	KXA 9483	2	2	1	2	1	1	1	2	1,2	1,3	1,3	1,3	0	0	0	0	2	4	0	1	1	4	2	1	
11	NJ5481	2	2	1	1	3	1	1	2	1,2	1,3	1,3	1,3	0	0	0	0	1	0	1	1	2	0	1	0	

For the year 2010, the results obtained regarding the drought resilience showed that 2 hybrids were assessed by grade 1: KXA 7482 and KXA 8481; 5 hybrids had grade 2, and 3 hybrids had grade 3 (EGZ 8301, EGZ 9501, EGZ 9505).

Regarding the heat resilience, the 10 hybrids were assessed by grades 1 and 2.

The shrivelling degree varied between 1.2 and 1.6%, meaning that all the hybrids had shrivelled kernels under 20%.

Sterility was zero for most of the hybrids, except for the EGZ 9505 hybrid, where the degree 1 was recorded, namely, 8 plants out of the 100 analyzed showed an inappropriate fecundation.

Regarding the root resilience, a high percentage of fallen plants can be noticed at the KXA 9483 hybrid. In addition, this hybrid was less resilient from the perspective of the stalk resilience.

Under the climatic conditions of the year 2011, the drought resilience is very good, as all the hybrids were assessed by grades 1 and 2.

From the heat resilience perspective, 2 hybrids showed 3-4 leaves under the panicle with a scalded appearance and were assessed accordingly (grade 3) – EGZ 8301 and KXA 8481, the rest of the hybrids having a very good behaviour.

Regarding the shrivelling, we can notice that all the hybrids have a good resilience, recording values between 1.2 and 1.3.

In the year 2011 there were no sterile plants recorded.

The root resilience was very good at the CSM 7717, CSM 7769, EGZ 9501 and KXA 8481 and KXA 9483 hybrids. The EF 5209, EGZ 8301, EGZ 9505 and NJ 5481 hybrids were assessed by grade 1. The KXA 7482 hybrid was assessed by grade 2.

Regarding the stalk resilience, the EGZ 8301 hybrid was the least resilient, being given grade 3.

Regarding the heat resilience, in the year 2012, the KXA 8481 hybrid stood out by its lower resilience.

The shrivelling degree varied between 1.2 and 1.3, indicating a very good behaviour of all the hybrids, concerning this index.

All the plants were fertile in 2012 (sterility was zero for all hybrids).

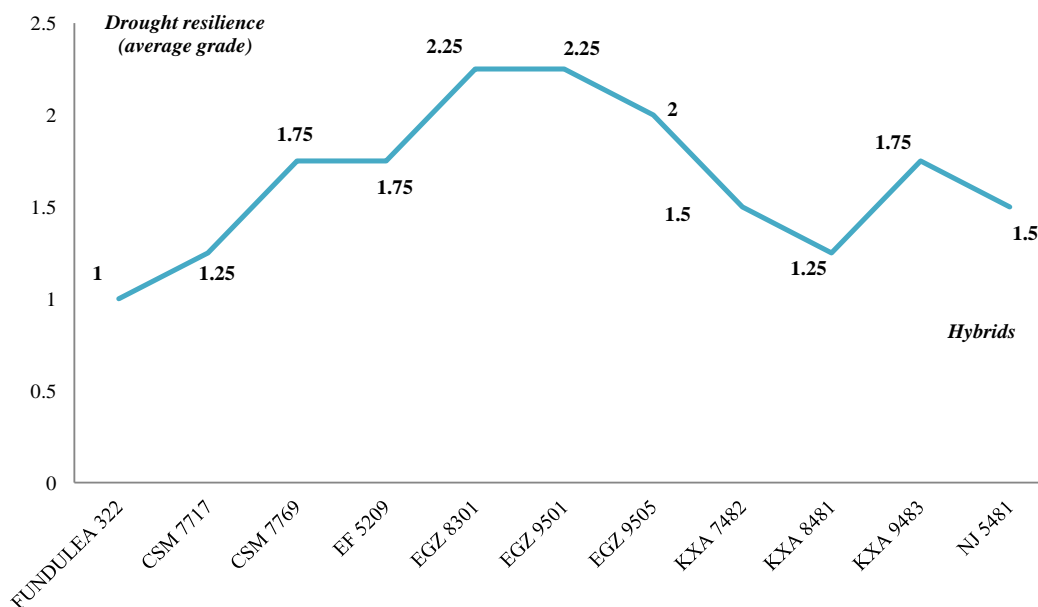


Figure 1 – Drought resilience of the maize hybrids between the years 2009 and 2012

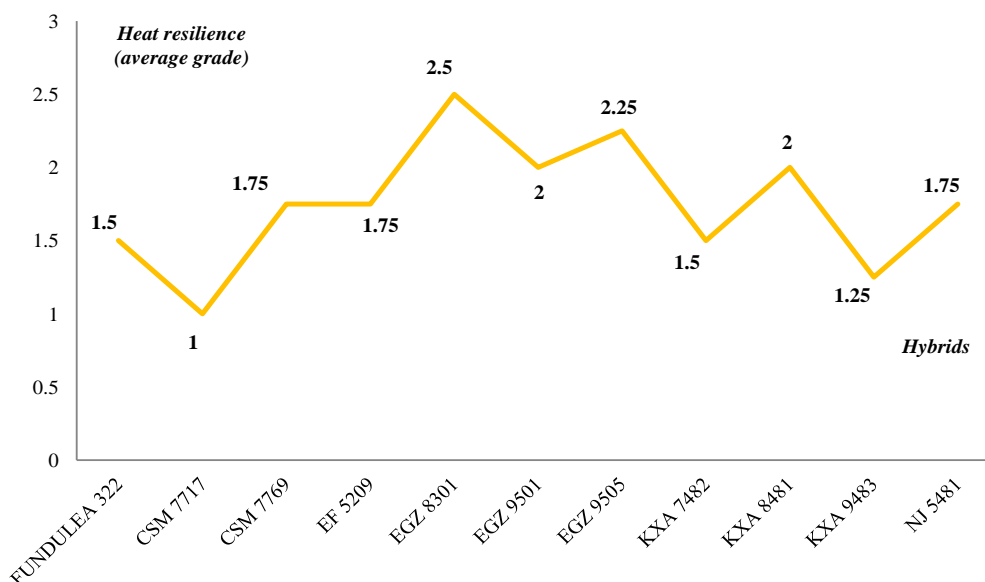


Figure 2 – Heat resilience of the maize hybrids between the years 2009 and 2012

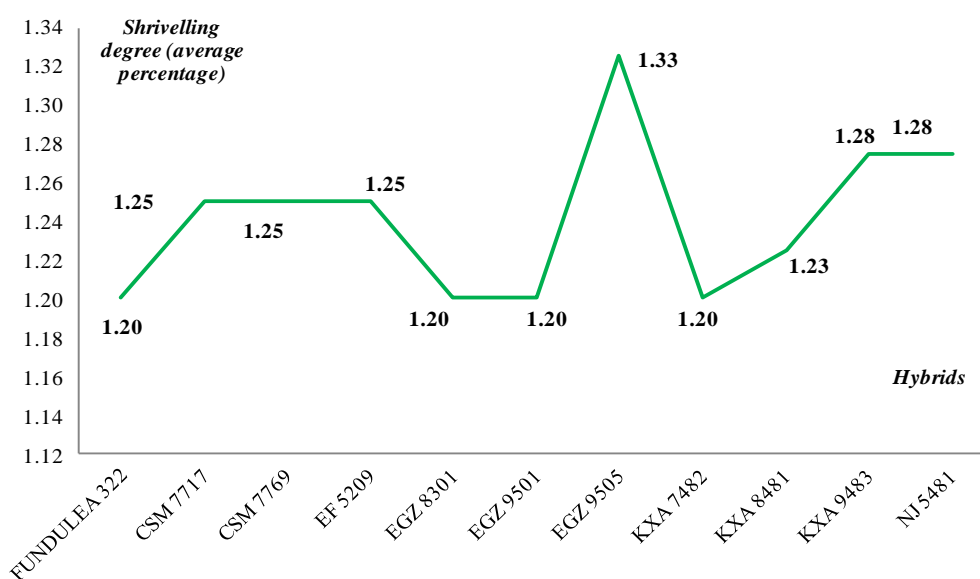


Figure 3 – Shrivelling degree of the maize hybrids between the years 2009 and 2012

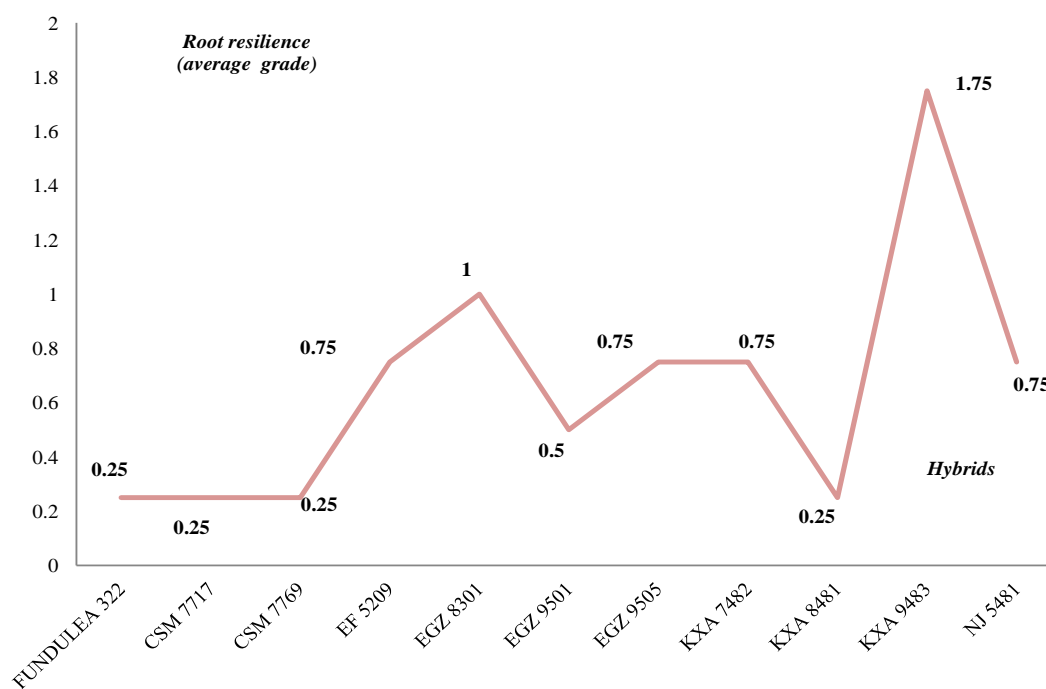


Figure 4 – Root resilience of the maize hybrids between the years 2009 and 2012

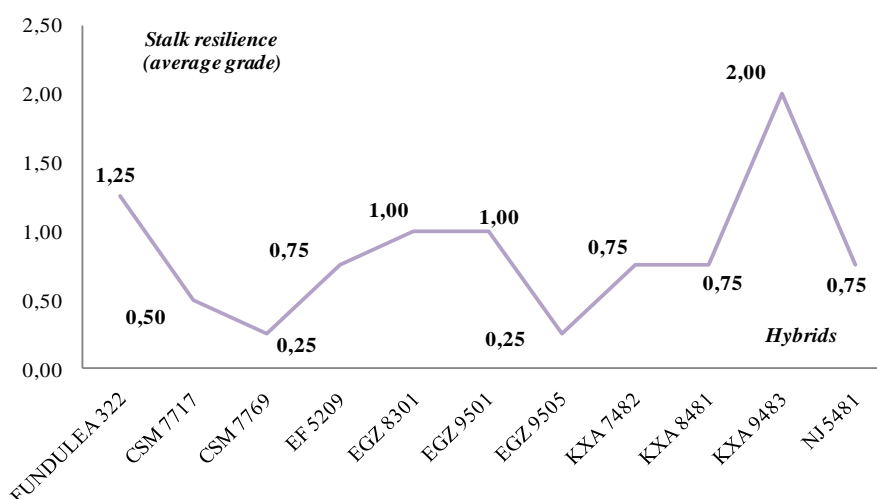


Figure 5 – Stalk resilience of the maize hybrids between the years 2009 and 2012

Root resilience and stalk resilience were good at all hybrids.

As for the results obtained by the comparison of the 4 years of observation (figure 1), regarding the drought resilience, we may notice that the hybrids show values between 1.25 and 2.25, which means that the plants did not have the leaves twisted and showed a normal turgescence. However, the hybrids CSM 7717 and KXA 8481 proved to be more resilient.

The heat resilience (figure 2) is appreciated according to the drying of the leaves under the panicle, by grades between 1 and 9.

Knowing the fact that grade 3 is suitable for the plants whose first leaves under the panicle have a scalded appearance, we can notice a good heat resilience of all the hybrids, as the average grades ranged within 1 and 2.5. We can notice that the CSM 7717 hybrid, which was graded by 1, had the highest resilience, which is a lower value than of the witness, hybrid F 322.

As for the shrivelling, we can notice that all the hybrids in the experiment show under 20 shrivelled kernels, the average grades ranging between 1.20 and 1.33 (figure 3).

Regarding the root resilience (figure 4), this is very good at all hybrids (the average grades: 0.25-1.75).

The best values, like those of the witness plant, are recorded at the CSM 7717, CSM 7769 and KXA 8481 hybrids. Fallen plants are

considered those bent from the basis at an angle over 45° compared to the vertical axis.

From the stalk resilience perspective, the lowest value was the one recorded for the CSM 7769 hybrid, and the highest value was recorded at the KXA 9483 hybrid (figure 5). We can notice that all the hybrids appear to have very good stalk resilience.

4. CONCLUSIONS

Regarding the drought resilience, we can notice that the hybrids show values between 1.25 and 2.25, which means that the plants did not have the leaves twisted and they showed a normal turgescence. Anyway, the CSM 7717 and KXA 8481 hybrids stand out as more resilient.

We may notice a good heat resilience of all the hybrids, the average grades ranging within 1 and 2.5. The highest resilience was the one shown by the CSM hybrid.

Regarding the shrivelling, we may notice that all monitored hybrids during the experiment showed less than 20 shrivelled kernels, the average grades ranging between 1.20 and 1.33.

Concerning the root resilience, it is very good at all hybrids. The best values, as those of the witness plant, are recorded at the CSM 7717, CSM 7769 and KXA 8481 hybrids.

From the stalk resilience perspective, the lowest value was recorded for the CSM 7769

hybrid, and regarding the highest value, we can notice that all hybrids show good stalk resilience.

All the hybrids monitored during the experiment can be cultivated in the climatic conditions of Dâmbovița county, the CSM 7717, CSM 7769 and KXA 8481 hybrids appearing to have the best results.

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