MOISTURE LOSS DYNAMICS IN SOME INBRED LINES, PARENTAL FORMS OF MAIZE HYBRIDS, CREATED AT ARDS TURDA

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Abstract. *The main purpose of the research was to characterize the inbred lines from the capacity of moisture loss point of view, in the shortest amount of time after the cob reached maturity. Recently the search for hybrids that have the capacity to lose a lot of moisture in a short amount of time has increased, the research in the field being more focused in the favor of harvest and storage at lower costs. The originality and the degree of novelty of the research made are derived from the lack of research on the dynamics of moisture loss in maize inbred lines, from the existent germplasm at ARDS-TURDA. The limiting factor of research was represented by the weather conditions that can negatively influence the experience. The biological material taken into the study was represented by five inbred maize lines, parental forms, created at ARDS Turda , current lines used to obtain hybrids that show a high potential in creating new hybrids. The experiment was conducted in the form of an observation field. The determination of moisture loss was made in dynamic after 5 measurements were made at different time dates. Moisture loss in the biological material studied was measured using the Granomat device. The date obtained from the determination was analyzed and interpreted using specialized software. Three different lines were noted that presented a good moisture loss rhythm, one being an early line and another a late line compared to the average of the studied inbred lines. The obtained results can be useful, especially in the improvement of maize lines and in creating new hybrids that can reach a high level of competitiveness on the agricultural market. Creating new hybrids that have a good moisture loss rate is very important because a high rate of drying in the field can reduce the costs of production for farmers and growers, meaning reduced costs in artificial drying and reducing economic loss due to late harvest. Alongside the economic loss there is also the added loss of impairments in seed quality.*

Key Words: *inbred lines, maize, hybrids, moisture loss, dynamics*

INTRODUCTION

The rate of moisture loss of the maize field relates generally to the drying of the maize and to reduce grain moisture after physiological maturity (YANG, 2010). Evolution of grain moisture and water loss are correlated with grain filling period. After GAY (1984), it goes through the following stages:

- milk stage - kernel reached final shape and size, the humidity is over 60%;
- waxy stage - the color yellow kernel and humidity is between 50-60%;
- vitreous stage - the kernel is tough, humidity 40%;
- full maturity stage - the kernels humidity<35%.

An increased rate of drying in the field can reduce production costs of farmers / growers, namely artificial drying grain costs and reduce economic losses caused by a late harvesting(YANG, 2010). To all these losses are added impairments, which decrease of quality seed.

To reduce the grain moisture to a percentage of 12-14%, it is necessary to dry in artificial conditions, at a temperature of between 35-45^{o} C. The drying temperature is higher than 45^{o}C, temperature considered deleterious to the viability of the maize seeds (CRAIG, 1977; BURRIS AND NAVRATIL, 1980).

If the grain moisture at harvest, exceed 20% is recommended drying it in two stages:

- ✓ first at a temperature of 35-38^{o}C, the moisture content until this decreased to 20%
- ✓ second at 35-40^{o}C, until the moisture content of the kernels reached 12 -13%.

Research objectives were determination of the studied inbred lines to lose water as soon as the grain is at full maturity and establish schedule maize harvest genetic material studied.

MATERIAL AND METHODS

The biological material studied were five inbred lines of maize, parental forms created from ARDS Turda, topical lines which have a high potential for creating new hybrids, used to obtain hybrids.

Experience has been designed as an observations field.

Determination of moisture was achieved dynamic, conducted during 2015, with five determinations on different dates:

-Step 1 - 24. August (coinciding with full maturity phenophase all lines studied);
-Step 2 - 27.August;
-Step 3 - 31.August;
-Step 4 - 03.September;
-Step 5 - 24.September (last measurement was performed before the harvest, when humidity allows harvesting and storage of grain production);

Grain moisture loss dynamics determination was performed using the apparatus Granomat. Determining the humidity of the rachis, was carried out by weighing each cob and comparing with a scale, moisture loss was calculated using the formula:

Obtained results from measurements were statistically analyzed using ANOVA analysis of variance.

The thermal regime and rainfall

From the speciality literature it is known that there is a close relationship between weather conditions and the production of grain maize; based on a research carried out in our country, that the highest maize yields are obtained in these monthly average temperatures: 16-20° C May 19 to 21° C in June, July 20-23 C, 19-22° C 14-17° C in August and September.Optimum rainfall during the maize growth, are 300-380 mm, with the next monthly allocations: 60-80 mm in May, June 100-120 mm, 100-120 mm in July and August 40-60 mm (after BOREAN 2003 QUOTED BY CERNEA, 2011). Rainfall and temperature have an essential role both in the accumulation of water by the plant and the loss of ripening grain at the same time.

In 2015 experimental year, temperatures were provided as needed rainfall and maize crop conditions are favorable, so it achieved a good harvest of maize. As for the rainfall from May to September inclusive , they were totally 478.7 mm , sufficient rainfall , but that was not appropriate for the maize optimum rainfall regime (Table 1).

Table 1

Conditions of temperature and precipitation patterns

Average air temperature (°C)	2015						
	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.
Monthly average	9.6	15.8	19.4	22.3	21.9	17.3	9.7
Average 57 years	9.8	14.7	17.7	19.6	19.2	14.9	9.6
Deviation	-0.2	+1.1	+1.7	+2.7	+2.7	+2.4	+0.1
Characterization	Normal	Warm	Warm	Hot	Hot	Hot	Normal
Precipitation (mm)	2015						
	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.
Monthly average	32.2	66.0	115.7	52.2	72.2	172.6	45.4
Average 57 years	44.7	67.7	84.5	76.7	55.9	40.3	32.0
Deviation	-12.5	-1.7	+31.2	-24.5	+16.3	+132.3	+13.4
Characterization	Drought	Normal	Heavy rain	Very droughty	Rainy	Excesiv rain	Heavy rain

RESULTS AND DISCUSSIONS

Stages of determination for the studied inbred lines, and the interaction between the two factors had a distinct significant influence on the loss of moisture kernels (Table 2).

Table 2

Analysis of variance for grain moisture dynamics in some forms of parental inbred lines (maturing - harvest, Turda, 2015)

Variability Source	DOF	Sum of squares SS	s^2	F test
Total	74	16884,41		
Determination steps (D)	4	11473,56	2868,39	236,71**
Repetition (R)	2	14,02	7,01	
Error (E)	8	96,94	12,12	
Lines (L)	4	4085,36	1021,34	91,18**
Interaction DxL	16	766,47	47,90	4,28**
Error (L)	4	448,05	11,20	

Analyzing the experimental data obtained from harvesting TC 385A, line stands as an early inbred line, with the lowest moisture at harvest. Values close control (represented by the average of moisture lines) are recorded to the TA452 and TA 447 inbred lines, as late as TC 344 and TA 426 lines(Table 3).

Table 3

Grain and rachis moisture at harvest from the studiet inbred lines

Line	Grain moisture %	Diference (%) ± / Significance	Rachis moisture %	Diference (%) ± / Significance
TC 344	22,5	1,23*	25,6	0,55-
TA 426	23,53	2,26***	33,76	7,61***
TC 385A	17,82	-3,45^{000}	16,15	-9,99^{000}
TA 447	21,9	0,63-	31,03	4,88***
TA 452	20,6	-0,67-	24,22	1,93-
Average	21,27	Mt.	26,15	Mt.
	DL (p 5%)	0,94	DL (p 5%)	2,47
	DL (p 1%)	1,25	DL (p 1%)	3,30
	DL (p 0.1%)	1,64	DL (p 0.1%)	4,34

Analyzing data on moisture loss, after statistical processing can be seen that the line TC 385A is distinguished by a faster pace of loss of moisture from the third stage of determination. This line loss the highest value (in percentage) by first determining until the harvest, the difference in moisture was 13.53 % . At the opposite TA 426 line stands as the most belated decrease in grain moisture from the first to the last measurement, difference in moisture was 10.19 %, this recording the lowest rate of water loss in grain (Table 4). The same trend is observed for the rachis moisture, humidity registered to the TA 426 line was harvest of 33.76 % , with a difference of 7.61 % , very significant positive compared to control.

Table 4

The dynamics of rachis moisture loss in inbred lines parental forms (maturation harvest- Turda, 2015)

Line	Stage 1- MT.		Stage 2		Stage 3		Stage 4		Stage 5	
	Humid.(%)	Signif.	Humid.(%)	Signif.	Humid.(%)	Signif.	Humid.(%)	Signif.	Humid.(%)	Signif.
TC 344	51,42	0	51,39	-0,03 -	48,71	-2,71 - (-2,68) -	46,51	-4,91 - (-2,2) -	25,6	-25,82^{000} (-20,91)^{000}
TA 426	71,1	0	67,17	-3,93 -	65,5	-5,6 - (-1,67) -	59,11	-11,99^{000} (-6,39)^{0}	33,76	-37,34^{000} (-25,35)^{000}

TC 385A	53,18	0	50,06	-3,12 -	42,98	-10,20 ^{00} (-7,08)^{0}	30,44	-22,74 ^{000} (-12,54) ^{000}	16,15	-37,03 ^{000} (-14,29) ^{000}
TA 447	57,38	0	53,21	-4,17 -	53,94	-3,44 - (0,73) -	51,14	-6,24 ^{0} (-2,8) -	31,03	-26,35 ^{000} (-20,11) ^{000}
TA 452	59,45	0	54,66	-4,79 -	55,12	-4,33 - (0,46) -	49,67	-9,78 ^{00} (-5,45) -	24,22	-35,23 ^{000} (-25,45) ^{000}
Average	58,5	0	55,3	-3,2 -	53,25	-5,25 - (-2,05) -	47,34	-11,16 (-5,91)	26,15	-32,35 (-21,19)
DL (p 5%) 5,74 DL (p 1%) 7,83 DL (p 0.1%) 10,65										

During all stages of humidity determination, inbred line TC 385A, reduced the rachis moisture, because this line is the earliest maize line, and also because the kernel depth is reduced and that affected positively the rate of moisture loss togheter with the white rachis color.The studied characters were influenced both from genetical and environmental conditions, and were manifested at all studied genotypes.

Table 5

The dynamics of grain moisture loss in some forms of inbred lines parental forms (maturing- harvest, Turda, 2015)

Line	Stage 1- Controls.		Stage 2		Stage 3		Stage 4		Stage 5	
	Umid. (%)	Ctrl.	Moisture (%)	Significance	Moisture (%)	Significance	Moisture (%)	Significance	Moisture (%)	Significance
TC 344	34,73	0	31,37	-3.36 -	29,77	-4.96 ^{0} (-1.6) -	29,45	-5.28 ^{0} (-0.32) -	22,5	-12.23 ^{000} (-6.95) ^{00}
TA 426	33,72	0	36,12	2.4 -	32,13	-1.59 - (-3.99) -	29,18	-4.54 ^{0} (-2.95) -	23,53	-10.19 ^{000} (-5.65) ^{0}
TC 385A	31,35	0	32,18	0.83 -	25,98	-5.37 ^{0} (-6.2) ^{00}	22,38	-8.97 ^{000} (-3.60) -	17,82	-13.53 ^{000} (-4.56) ^{0}
TA 447	33,33	0	29,65	-3.68 -	30,03	-3.30 - (0.38) -	27,2	-6.12 ^{00} (-2.83) -	21,9	-11.43 ^{000} (-5.30) ^{0}
TA 452	33,82	0	34,63	0,81 -	29,92	-3,9 - (-4,71) ^{0}	28,52	-5,3 ^{0} (-1,4) -	20,6	-13,22 ^{000} (-7,92) ^{000}
Average	33,39	0	32,79	-0,6 -	29,57	-3,82 - (-3,22) -	27,35	-6,04 ^{00} (-2,22)-	21,27	-12,12 ^{000} (-6,08) ^{00}

	DL (p 5%)	4,35
	DL (p 1%)	5,87
	DL (p 0.1%)	7,86

The rate of grain moisture loss for the line TA 426, was reduced during the stage 3 and 4, but had registered a quickly loss between stage 4 and 5, knowing this line is characterized by a late physiological maturity.

CONCLUSIONS

- ✓ TC 344, TA 452 and TC 385A lines were characterized by a faster rate of moisture loss, significant differences were registered from Stage III of determinations.
- ✓ TC 385A line is the earliest, by emphasizing the fastest moisture loss, so the cob and kernels had a faster rate of moisture loss, with a distinct significantly positive differences compared to the control .
- ✓ From the five inbred lines studied, were characterized by low humidity or by precocity, TC 385A line and the latest line was TA 486, with a higher moisture at harvest.
- ✓ TC 385A line had also low humidity of the rachis, and the harvest of only 16.15 % , compared to the TA 486 line (the lately), where the humidity was 33.76 %.

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