STUDY OF DRY MATTER ACCUMULATION ON SIMPLE HYBRIDS IN CYCLIC CROSS SYSTEM

Andreea ONA[1], I. HAŞ[1,2], Rodica POP[1], Voichița HAŞ[2]

[1] ***University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, Department of Plant Breeding***
3-5 Mănăștur Street, postcode 40037, Cluj-Napoca, Romania
andreea_ona@yahoo.com
[2]***Agricultural Research and Development Station Turda***

Abstract:

Dry matter accumulation in grains at the harvesting time is one of the most faithful indicators of the growing season of maize. The paper presents the obtained results of the dry matter accumulation in maize, in the experiments fields conducted at Agricultural Research and Development Station Turda, using simple hybrids in a cyclic cross system, between 2011-2012. The goal of this paper is to identify some inbred lines that are sending a rapid dry matter accumulation in grains at the harvest time and to highlight the genic effects involved in this process. At the harvesting time, for each studied plot was determined grain moisture using GRANOMAT device. Analysis of variance for dry matter content in grains at the harvesting time indicates statistically highly significant differences between variants. Differences occurred also between experimental simple hybrids and the three control hybrids (Turda 201, Turda Favorit and PR39 D81). The effects values for the general combining capacity ranged between -0,75% and +1,43% dry matter at the inbred lines and between -0,79% and +0,72% dry matter at the testers. The effects values for the specific combining ability ranged from -0,77% to 1,07% dry matter. Among the testers inbred lines, the highest dry matter accumulation in maize grains at harvesting time, was sent by the inbred line TC 399 (80,77%); additive genic effects for this value were 0,72%, statistically significant. Among the tested inbred lines, the highest dry matter accumulation in maize grains was recorded by TE 229 (81,48%), the earliest inbred line from the experimental system. Compared with the average of experimental system, there was +1,43% in the general combining ability effects. The highest values for non-additive genic effects were recorded for hybrid combination TE 317 x TC 385A (+1,07%), followed by TE 335 x TC 399 (+0,84%). The heredity of the maize growing season involves additive gene action, but also non-additive interactions. There is a dominance of the early parental forms, simple hybrids being earlier than the parental forms. Our results indicate relatively equal influence of additive and non-additive genic effects for the determinism of dry matter accumulation in maize grains at the harvesting time.

Keywords: *dry matter accumulation (DMA), general combining ability (GCA), specific combining ability (SCA).*

INTRODUCTION

Dry matter accumulation in grains at harvest is one of the most faithful indicators of the growing season of maize. There are many indicators of maize growing season used by those that are working in the field of plant breeding: the number of days from sowing to stigma emergence, the number of days from sowing to technical maturity, the amount of useful heat degrees from sowing to stigma emergence, the amount of useful heat degrees from sowing to technical maturity, and the dry matter content in grains, at the harvesting time (the complement of grains moisture at harvest) (CĂBULEA et al., 1981; HAŞ, 1992, 2001; TR. SARCA, 2004).

Dry matter accumulation in maize grains at the harvesting time is a more complex feature than other indicators of maize growing season, because it takes into account also the period after reaching physiological maturity, when is manifesting the accelerated loss of

contained water in maize grains. (CĂBULEA et al., 1980; COSMIN et al., 1987; CIOCĂZANU et al., 1998; DUVICK, 1999 (b); TROYER, 2001).

The goal of this paper is to identify some inbred lines that are sending a rapid dry matter accumulation in grains at the harvest time and to highlight the genic effects involved in this process.

MATERIAL AND METHODS

The study was conducted at the same experimental device that the yield potential of maize simple hybrids in a cyclic cross system was studied (ONA ANDREEA et al., 2013).

At the harvesting time, for each studied plot was determined grain moisture using GRANOMAT device.

Tester inbred lines and tested inbred lines are matching, according to the amount of useful heat degrees recorded from sowing to stigma emergence and from sowing to physiological maturity, in the goups of early and semi-early lines (tabel 1).

Tabel 1

Maize inbred lines used to crosses in cyclic system

Inbred line		The amount of active heat degrees from sowing to stigma emergence	The amount of active heat degrees from sowing to physiological maturity
Tester inbred lines			
1.	TD 268	643	1176
2.	TC 385A	583	1112
3.	TC 399	643	1112
Tested inbred lines			
1.	TE 229	583	1023
2.	TE 202B	657	1031
3.	TA 452	683	1131
4.	TE 330A	628	1086
5.	TD 364	697	1086
6.	TE 317	628	1131
7.	TE 335	657	1171

It is known that one of the effects of maize heterosis refers to acceleration of physiological processes; it is expected that most of the studied simple hybrids fit in the early hybrids group, with accumulation of dry matter in control hybrids.

RESULTS AND DISCUSSION

Analysis of variance for dry matter content in grains at the harvesting time (Tabel 2) indicates statistically highly significant differences between variants. Differences occurred also between experimental simple hybrids and the three control hybrids (Turda 201, Turda Favorit and PR39 D81).

Tabel 2

Analysis of variance for dry matter accumulation in maize grains in the cyclic cross system m x n

Variability cause	SP	GL	s^2	Sample F according to:	
				Error	Variance of interaction „genotypes x years”
Total	814,97	239			
Repetitions	7,88	4			
Columns	6,82	4			
Years	449,09	1	449,09	1952,57**	350,85**

Genotypes	278,74	23	12,12	51,80**	9,48**
Simple hybrids (SH)	141,04	(20)	7,05	30,66**	5,51**
Testers (T)	48,36	((2))	24,18	105,13**	18,89**
Lines (L)	63,06	((6))	10,51	45,70**	8,21**
TxL Interactions	29,62	((12))	2,47	10,73**	1,93
Control hybrids (CH)	92,81	(2)	46,41	201,77**	36,26**
SH –CH Comparisons	44,88	(1)	44,88	195,15**	35,07**
Years x Genotypes	29,39	23	1,28	5,46	
Error	43,05	184	0,23		

Using non-orthogonal decompositions of 2nd rank, were decomposed the variances of experimental simple hybrids according to tester inbred lines, tested inbred lines and "tester lines x tested lines" interactions (T x L); between the studied factors, differences were statistically significant; when the variance was compared by the variance of "genotypes x years" interactions, the interaction "tester lines x tested lines" was not statistically significant.
Dry matter content of simple hybrids (average of experimental years 2011-2012), testers and tested inbred lines average, effects of general and specific combining ability are presented in Tabel 3. The dry matter content in samples at harvest time ranged between 78,05% to TE 317 x TD 268 hybrid and 82,08% to TE 229 x TC 399 hybrid.

Tabel 3

Dry matter accumulation in grains at harvesting time, effects of general combining ability ($\hat{g}_{m,n}$) and effects of specific combining ability ($\hat{s}_{mxn}$) to the cyclic cross system on maize inbred lines

Tester inbred line / Tested inbred line	TD 268		TC 385A		TC 399		Average percentage of d.m. in grains at harvest	Line G.C.A. ($\hat{g}_n$)
	% d.m.	$\hat{s}_{mxn}$	% d.m.	$\hat{s}_{mxn}$	% d.m.	$\hat{s}_{mxn}$	% d.m.	$\hat{g}_n$
TE 229	81,18	0,50	81,17	-0,39	82,08	-0,11	81,48***	1,43
TE 202B	80,08	0,54	80,62	0,21	80,30	-0,75	80,33	0,28
TA 452	78,95	0,18	79,57	-0,07	80,17	-0,11	79,56	-0,49
TE 330A	78,93	0,12	79,27	-0,41	80,62	0,29	79,61	-0,45
TD 364	78,68	0,18	79,03	-0,34	80,18	0,17	79,30^{oo}	-0,75
TE 317	78,05	-0,76	80,75	1,07	80,00	-0,32	79,60	-0,45
TE 335	78,92	-0,77	80,48	-0,07	82,03	0,84	80,48	0,43
Average % of d.m.	79,26^{oo}		80,13		80,77*		80,05	
Tester G.C.A. ($\hat{g}_m$)		-0,79		0,08		0,72		
DL	P=5% 0,55			P=1% 0,73			P=0,1% 0,94	

Among the testers inbred lines, the highest dry matter accumulation in maize grains at harvesting time, was sent by the inbred line TC 399 (80,77%); additive genic effects for this value were 0,72%, statistically significant. The lowest dry matter accumulation was recorded in simple hybrids with the tester TD 268 – 79,26%; the value of additive genic effects was -0,79%, highly significant statistically from the simple hybrids average.

Among the tested inbred lines, the highest dry matter accumulation in maize grains was recorded by TE 229 (81,48%), the earliest inbred line from the experimental system. Compared with the average of experimental system, there was +1,43% in the general combining ability effects.

The lowest percentage value of dry matter was of TD 364 inbred line (79,30%); additive genic effects were of -0,75%, statistically negative highly significant.

The highest values for non-additive genic effects were recorded for hybrid combination TE 317 x TC 385A (+1,07%), followed by TE 335 x TC 399 (+0,84%). Non-

additive genic effects, but with statistically significant values were recorded for TE 229 x TD 268 and TE 202B x TD 268 combinations.

Statistically highly significant values, negative, were recorded for the hybrid combinations TE 317 x TD 268 (-0,76%) and TE 335 x TD 268 (-0,77%).

Our results indicate relatively equal influence of additive and non-additive genic effects for the determinism of dry matter accumulation in maize grains at the harvesting time.

Our result partially confirms what claimed CĂBULEA et all. (1980), HALLAUER and MIRANDA (1981), TROYER (2001), who affirmed the existence of partial domination for early parental forms in the growing season heredity. Certainly, for the early maize hybrids, with a rapid loss of water from the grains after harvest, are required parental forms which possess, at additive level, genes for this trait determinism (HALLAUER, 1999).

CONCLUSIONS

1. In crosses between inbred lines from Lancaster Sure Crop heterotic group and inbred lines unrelated with those, it is posible to obtain hybrids with a faster dry matter accumulation in maize grains at the harvesting time.
2. In the heredity of dry matter accumulation in maize grains are involved additive genic effects, but also non-additive genic effects are important.
3. Among the tester inbred lines, the line TC 399 transmitted, at additive level, dry matter accumulation in grains at harvest, and among the tested inbred lines, TC 229 transmitted the most rapid accumulation of dry matter.

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