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The Cytoplasm Origin Influence, the Teser Influence and the Nucleus-Cytoplasm Interactions Influence on Agronomic Traits for Maize Isonuclear Lines

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Abstract: The maize is one of the most important crops in the world due to its high productivity and multiplexing usage in human nutrition, animal breeding and industry. The isonucleus inbred lines study has been initiated from the demand of clarifying if the cytoplasm source has a positive or negative influence on the corn cars, plants, grain traits and some maize cultural features. The research has been conducted in the experimental field provided by the Maize Breeding laboratory from ARDS Turda, ARDB Târgu-Mureş, ARDS Secuieni, ARDS Livada, ARDS Suceava in 2009. The cell nucleus transfer activity for 12 elite inbred lines on various cytoplasm types has begun in 1992 starting from the assumption that among cytoplasm of different origin could exist differences in the genetic value. The ultimate objective of breeding works is to obtain a higher grain yield and the yield quality to be at the desired level of farmers. For this reason it was studied the effect of different types of cytoplasm on grain yield, kernel dry matter at harvest and unbroken plants percentage at harvest, all these traits are important to achieve secure yield, mechanized harvestable. The kernel dry matter at harvest is one of the indicators of vegetation period, the most used in choice of early single crosses.

Keywords: maize, dry matter , grain yield , unbroken plants, cytoplasm.

INTRODUCTION

The maize is one of the most important crops in the world due to its high productivity and multiplexing usage in human nutrition, animal breeding and industry.

The work assumption for some elite inbred lines nucleous transfer on different cytoplasm sources has had as starting point some observations realized on cytoplasm male sterile inbred lines which have shown phenotypic differences compared to the fertile corresponding lines (unrestorers) mainly as regarding the broken plants percentage and kernel moisture content at harvest (Sarca and Barbu, 1982; Laughan and Gabay, 1983; Wych, 1988; Haş *et al.,* 1989; Haş, 2002).

The maize yield capacity is a complex feature, an outcome of the genetic, ecological and technical factors interaction (Mureşan *et al.,* 1972). From this reason any perturbation of one of these factors leads to lower and unprofitable yields.

MATERIALS AND METHODS

The research has been conducted in the experimental field provided by the Maize Breeding laboratory from Agricultural Research and Development Station Turda, Agricultural Research and Development Station Târgu-Mureş, Agricultural Research and Development

Station Secuieni, Agricultural Research and Development Station Livada, Agricultural Research and Development Station Suceava in 2009. The cell nucleus transfer activity for 12 elite inbred lines on various cytoplasm types has begun in 1992 starting from the assumption that among cytoplasm of different origin could exist differences in the genetic value.

The transfer has been realized through 10 cross-breeding procedures with the nucleus donor inbred line in 1992-2004 time period. After that, the isonucleus inbred lines maintenance has been realized through self-pollination and SIB pollination. Through the 10 times cross-breeding procedures with the nucleus donor line we can appreciate that the nucleus has been transferred 99,9% on the new cytoplasm (Chicinaş *et al.,* 2009). The nucleus donor inbred lines were: TC 209, TC 243, TC 221, TB 367 şi D 105, and the cytoplasm sources inbred lines were: T 248, TC 243, TC 298, TC 209, K 1080, TC 316, TB 329, TC 221, K 2051, T 291, A 665, W 633 şi TC 177. Each nucleus donor inbred line has been studied on six cytoplasm sources, the nucleus donor line being assumed as control line. The name assignment for the new created lines has been done after the nucleus donor line and the cytoplasm source has been mentioned in brackets: TC 209 (cyt. A 665), TC 243 (cyt. T 248), TC 221 (cyt. K 1080), TB 367 (cyt. K 2051), D 105 (cyt. TB 329). Testing inbred isonuclear lines was done by crossing each of the inbred lines with tester inbred lines. Tester inbred lines were: TC 344, LO3 Rf, TB 329, TD 233, T 291 and TC 209. The results of the experimental field and laboratory measurements and determinations have been than statistically processed through the ANOVA test (Ciulcă, 2006). For the comparing crops where the common "inbred line x tester" cross-breeds have been studied the genotypes variance has been orthogonally split in the following categories: the cytoplasm source influence, the tester influence, the "cytoplasm x tester" interaction influence. For each studied single cross and trait the phenotypic value is described by the following relation:

$HS_{cyt.\, i \times tester\, j} = \mu + \hat{g}_{cyt.\, i} + \hat{g}_{tester\, j} + \hat{s}_{ixj}$, where:

-μ= experimental mean;

-$\hat{g}_{cyt.\, i}$= the overall combining capacity of the mother inbred lines with the „i" cytoplasm, respectively the overall „i" cytoplasm combining capacity;

-$\hat{g}_{tester\, j}$= the „j" tester inbred line overall combining outcomes;

-$\hat{s}_{ixj}$= the peculiar combining capacity outcomes between the „i" mother cytoplasm source and the „j" tester gene. (Racz and collab, 2011).

RESULTS AND DISCUSSION

The year 2009, when there have been tested in the experimental field the crossbreeds from the previous year, hasn't been favorable for the maize crop at ARDS Turda, mainly when speaking about rain falls in the first part of the vegetation period. In the others experimental locations (Târgu-Mureş, Secuieni, Livada, Suceava) the climate conditions have been better, but even here there has been registered a deficit in rain falls in the after-seeding period. From this reason, both at ARDS Turda and the other locations, there have been observed troubles during the crop emergence period with negative impact on the maize growth.

The ultimate objective of breeding works is to obtain a higher grain yield and the yield quality to be at the desired level of farmers. For this reason it was studied the effect of different types of cytoplasm on grain yield, kernel dry matter at harvest and unbroken plants percentage at harvest, all these traits are important to achieve secure yield, mechanized harvestable. The kernel dry matter at harvest is one of the indicators of vegetation period, the most used choice in creating of early maize single crosses.

Each isonucleus inbred lines have been studied on two comparative crops in two agricultural research stations. In what follows are highlighted the significative results in one research station.

For grain yield are presented the results for isonucleus TC 209 inbred line cluster from Târgu-Mureş (Tab. 1), for isonucleus TB 367 inbred line cluster from Livada (Tab. 2) and for isonucleus D105 inbred line cluster from Suceava (Tab. 3).

The general combining ability values for cytoplasms ranged between -137,67 kg/ha and +136,52 kg/ha for isonucleus TC 209 inbred line cluster, between -310,84 kg/ha and +739 kg/ha for isonucleus TB 367 inbred line cluster and between -169,84 kg/ha and 478,10 kg/ha for isonucleus D 105 inbred line cluster. Except for the last analysed situation, the differences between the minimum and maximum values were insignificant statistically.

Study of general combining ability effects due to testers found higher values in all cases: for isonucleus TC 209 inbred line cluster ranged between -1467,86 kg/ha and +1152,30 kg/ha-statistically significant differences; for isonucleus TB 367 inbred line cluster ranged between -644,98 kg/ha and +583,95 kg/ha- statistically insignificant differences; for isonucleus D 105 inbred line cluster ranged between -139,26 kg/ha and +105,36 kg/ha-statistically insignificant differences. In all three cases presented, the values for "cytoplasm x tester" interaction were quite high, in some cases statistically significant compared with the average system.

The most productive single crosses in all three comparative crops were:

TC 209 (cyt TC 177) x TC 344- 10743 kg/ha- statistically very significant, exceed the system average;

TB 367 x T 291-13465,68 kg/ha- exceeded statistically distinct significant the system average;

D 105 (cyt TB 329) x TC 209- 6861,13 kg/ha- exceeded statistically distinct significant the system average.

For all these single-crosses in grain yield determinism were involved the following actions:

For isonucleus lines cluster TC 209:

10743,17 kg/ha=8921,89 kg/ha (μ) +88,07 kg/ha ($\hat{g}_{cyt}$) + 1152,10 kg/ha ($\hat{g}_{tester}$) + 580,91 kg/ha ($\hat{s}_{cyt. x\ tester}$)

For isonucleus lines cluster TB 367:

13465,68 kg/ha =10866,44 kg/ha (μ) +486,31 kg/ha ($\hat{g}_{cyt}$) + 583,95 kg/ha ($\hat{g}_{tester}$) +1528,99 kg/ha ($\hat{s}_{cyt. x\ tester}$)

For isonucleus lines cluster D 105:

6861,13 kg/ha =6050,01 kg/ha (μ) +478,10 kg/ha ($\hat{g}_{cyt}$) + 105,37 kg/ha ($\hat{g}_{tester}$) +227,65 kg/ha ($\hat{s}_{cyt. x\ tester}$)

Tab. 1

The influence of the type of cytoplasm on the grain yield for hybrids with isonuclear lines TC 209 (Târgu-Mureş, 2009)

tester (t) ♂ / cytoplasm (c) ♀	TC 344		Lo3 Rf		TB 329		TD 233		Cytoplasm average	
	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{g}_{cit}$
TC 209	9793	-216.42	9054	-27.42	9408	527.76	7172	-217.05	8857	-64.98
TC209 (cyt A665)	10405	307.34	9286	115.45	8636	-332.91	7454	-22.99	8945	23.32
TC 209 (cyt T291)	10031	-179.67	8833	-449.90	9748	665.69	7621	30.76	9058	136.52
TC 209 (cyt 248)	10068	35.11	9760	653.96	8558	-346.62	7138	-275.56	8881	-40.82
TC 209 (cyt W633)	9985	-84.51	9296	153.96	8536	-405.15	7852	402.59	8917	-4.44
TC 209 (cyt TC177)	10743	580.91	8651	-583.71	9046	12.75	7599	56.93	9010	88.07
TC 209 (cyt D105)	9494	-442.75	9147	137.67	8686	-121.53	7342	25.32	8784	-137.67
Tester average $\hat{g}_t$	10074	1152.30	9147	224.94	8946	23.74	7454	-1467.86	8922	

LDS P=5%	849,3
LDS P=1%	1132,4
LDS P=0,1%	1462,0

Tab. 2

The influence of the type of cytoplasm on the grain yield for hybrids with isonuclear lines TB 367 (Livada, 2009)

tester (t) ♂ / cytoplasm (c) ♀	T 291		TC 209		TD 233		Cytoplasm average	
	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{g}_{cit}$
TB 367	13466	1528,99	9630	-1783,48	10962	254,49	11353	486,31
TB 367(cyt T 248)	10410	-819,65	11830	1124,03	9696	-304,38	10645	-221,05
TB 367(cyt TB 329)	10156	-1123,73	12809	2052,35	9122	-928,62	10695	-170,95
TB 367(cyt TC 208)	11891	658,61	10140	-569,53	9914	-89,08	10649	-217,94
TB 367(cyt TC 221)	10245	-900,18	11518	896,13	9920	4,05	10561	-305,47
TB 367(cyt TC 209)	11328	188,71	10187	-429,82	10152	241,11	10556	-310,84
TB 367(cyt K 2051)	12658	467,25	10378	-1289,69	11784	822,44	11606	739,93
Tester average $\hat{g}_t$	11450	583,95	10927	61,04	10221	-644,98	10866	

LDS P=5%	1773,70
LDS P=1%	2370,78
LDS P= 0,1%	3117,14

Tab. 3

The influence of the type of cytoplasm on the grain yield for hybrids with isonuclear lines D 105 (Suceava, 2009)

tester (t) ♂ / cytoplasm (c) ♀	T 291		TC 209		TD233		Cytoplasm average	
	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{s}_{cxt}$	kg/ha	$\hat{g}_{cit}$
D 105	5675	-261,07	6566	558,09	5466	-297,02	5902	-147,90
D 105 (cyt T 2941)	6268	-6,30	6066	-280,21	6388	286,51	6241	190,53
D 105 (cyt T 248)	5766	-50,69	5646	-241,51	5936	292,21	5783	-267,38
D 105 (cyt T 243)	6447	485,51	5770	-263,05	5566	-222,46	5928	-121,98
D 105 (cyt TC 209)	5491	-422,81	6401	415,84	5748	6,96	5880	-169,84
D 105 (cyt K 1080)	6678	555,48	5777	-416,80	5811	-138,68	6088	38,48
D 105 (cyt TB 329)	6262	-300,13	6861	227,65	6461	72,48	6528	478,10
Tester average $\hat{g}_t$	6084	33,89	6155	105,37	5911	-139,26	6050	

LDS P=5%	551,00
LDS P=1%	736,52
LDS P= 0,1%	968,33

The percentage of kernel dry matter at harvest (grain moisture at harvest complement) is one of the indicators of the vegetation period, the most used choice in creating of early maize single crosses.

For the percentage of kernel dry matter at harvest will be presented the values of isonucleus TC 209 inbred line cluster from Turda (Tab. 4), for the isonucleus TC 221 inbred line cluster from Secuieni (Tab. 5) and for isonucleus TB 367 inbred line cluster from Livada (Tab. 6).Values for general combining ability related to cytoplsms ranged between -1,20% and +1,77% for isonucleus TC 209 inbred line cluster, between -0,95% and +1,29% for isonucleus TC 221 inbred line cluster and between -1,09% and +1,30% for isonucleus TB 367 inbred line cluster. In all three cases analyzed differences between the minimum and maximum for general combining ability related to cytoplasms were statistically significant. In absolute numbers, the highest or lowest values for general combining ability effects due testers were similar in all three experimental systems analyzed with gene actions due cytoplasm.

In the three experimental systems that single crosses had the highest content of kernel dry matter at harvest were:

For isonucleus lines cluster TC 209: TC 209(cyt. A 665) x TB 329 (86,30%)

For isonucleus lines cluster TC 221: TC 221 (cyt. TC 209) x TC 209 (85,20%)

For isonucleus lines cluster TB 367: TB 367 (cyt. TC 208) x T 291 (83,33%)

In determinism of kernel dry matte rat harvest are involved for each single cross in part the following actions:

For isonucleus lines cluster TC 209:

86,30 %=83,02 % (μ) +1,77 % ($\hat{g}_{cyt}$) + 1,12 % ($\hat{g}_{tester}$)+0,40 % ($\hat{s}_{cyt.x\ tester}$)

For isonucleus lines cluster TC 221:

85,20 %=82,18 % (μ) +1,29 % ($\hat{g}_{cyt}$) + 1,52 % ($\hat{g}_{tester}$)+0,21 % ($\hat{s}_{cit.x\ tester}$)

For isonucleus lines cluster TB 367:

$83{,}33\ \% = 80{,}92\ \%\ (\mu) + 1{,}30\ \%\ (\hat{g}_{cyt}) - 0{,}35\ \%\ (\hat{g}_{tester}) + 1{,}46\ \%\ (\hat{s}_{cyt.x\ tester})$

Tab. 4

The influence of the type of cytoplasm on the dry matter for hybrids with isonuclear lines TC 209 (ARDS Turda, 2009)

tester (t) ♂ / cytoplasm (c) ♀	TC 344		Lo3 Rf		TB 329		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TC 209	80,13	-1,98	81,23	0,98	82,97	-0,18	83,80	1,07	82,03	-0,98
TC209 (cyt A665)	85,53	0,67	82,60	-0,40	86,30	0,40	84,70	-0,78	84,78	1,77
TC 209 (cyt T291)	85,00	1,92	80,23	-0,98	82,93	-1,18	83,83	0,14	83,00	-0,02
TC 209 (cyt 248)	81,57	-1,47	81,93	0,77	84,83	0,77	83,47	-0,18	82,95	-0,07
TC 209 (cyt W633)	84,63	0,11	82,73	0,07	85,43	-0,13	84,97	-0,17	84,44	1,43
TC 209 (cyt TC177)	81,20	-0,70	78,67	-1,37	83,93	1,00	83,47	0,96	81,82	-1,20
TC 209 (cyt D105)	83,63	1,47	81,23	0,93	82,53	-0,67	81,73	-1,04	82,08	-0,93
Tester average $\hat{g}_t$	83,10	0,08	81,23	-1,78	84,13	1,12	83,71	0,69	83,02	

LDS P=5%	2,76
LDS P=1%	3,68
LDS P= 0,1%	4,75

Tab. 5

The influence of the type of cytoplasm on the dry matter for hybrids with isonuclear lines TC 221 (Secuieni, 2009)

tester (t) ♂ / cytoplasm (c) ♀	T 291		TC 209		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TC221	80,40	0,10	83,40	0,65	79,90	-0,75	81,23	-0,95
TC 221(cyt T 248)	81,10	0,00	83,80	0,25	81,20	-0,25	82,03	-0,15
TC 221(cyt TC 243)	80,60	-0,46	84,10	0,58	81,30	-0,12	82,00	-0,18
TC 221(cyt TC 208)	82,00	0,64	83,80	-0,02	81,10	-0,62	82,30	0,12
TC221(cyt TC 209)	80,60	-1,93	85,20	0,21	84,60	1,71	83,47	1,29
TC221(cyt K 1080)	82,00	0,77	82,90	-0,79	81,60	0,01	82,17	-0,01
T 221(cyt TC 316)	82,00	0,87	82,70	-0,89	81,50	0,01	82,07	-0,11
Tester average $\hat{g}_t$	81,24	-0,94	83,70	1,52	81,60	-0,58	82,18	

LDS P=5%	0,52
LDS P=1%	0,70
LDS P= 0,1%	0,92

Tab. 6

The influence of the type of cytoplasm on the dry matter for hybrids with isonuclear lines TB 367 (Livada, 2009)

tester (t) ♂ / cytoplasm (c) ♀	T 291		TC 209		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TB 367	80,17	0,02	82,17	0,99	79,17	-1,01	80,50	-0,42
TB 367(cyt T 248)	79,17	-1,37	82,33	0,77	81,17	0,60	80,89	-0,03
TB 367(cyt TB 329)	80,33	-0,76	82,83	0,71	81,17	0,05	81,44	0,52
TB 367(cyt TC 208)	83,33	1,46	82,17	-0,73	81,17	-0,73	82,22	1,30
TB 367(cyt TC 221)	80,17	0,52	80,33	-0,34	79,50	-0,17	80,00	-0,92

TB 367(cyt TC 209)	80,83	-0,37	82,17	-0,06	81,67	0,44	81,56	0,63
TB 367(cyt K 2051)	80,00	0,52	79,17	-1,34	80,33	0,83	79,83	-1,09
Tester average $\hat{g}_t$	80,57	-0,35	81,60	0,67	80,60	-0,33	80,92	

LDS P=5%	0,92
LDS P=1%	1,23
LDS P= 0,1%	1,62

Another important agronomic trait is the resistance of breaking and falling of corn plants to maturity. This trait is quite complex, in its expression being involved the corn plant (root and stem base), the pathogen (*Fusarium sp*.) and the interactions plant x pathogen (Nagy *et al.,* 1988, Nagy and Căbulea, 1996; Nagy *et al.,* 1999). It was determined the number of unbroken plants at harvest at it was calculated the percentage of unbroken plants at harvest. Before using this data in the statistical design the figures have been converted in arcsin √ percent figures.The climate of 2009, at ARDS Turda and in the other research stations where the tests were made favored the illness of roots and stem base with *Fusarium sp*. For this reason the percentage of broken plants at harvest was quite high. The LDS values were quite high in all five experimental systems that were tested with
isonucleus D105 inbred line cluster, the general combining ability due cytoplasm differences were significant. For this reason, the effects of general combining ability for cytoplasms or testers can just talk about trends, not statistically influence.In most systems analyzed maximum and minimum values of general combining ability effects for the cytoplasm were higher in absolute numbers, than the effects due to general combining ability of testers. Values for specific combining ability due to interaction "cytoplasm x testers" had in some cases values sign + or - statistically significant or close to the limit of significance (tab.7-9).

Hybrids who had the highest percentage of unbroken plants at harvest for each system were:

For isonucleus lines cluster TC 209: TC 209(cit. A 665) x TC 344 (80,66%)
For isonucleus lines cluster TC 243: TC 243 (cit. T 248) x TB 329 (89,74%)
For isonucleus lines cluster TC 221: TC 221 (cit. TC 208) x TD 233 (89,74%)
TC 221 (cit. K 1080) x TD 233 (89,74%)

The type of action involved in the determinism of the percentage of unbroken plants at harvest for hybrids with the highest resistance to breaking and falling, have the following composition:

80,66%=68,18 % (μ) -0,07 % ($\hat{g}_{cyt}$) + 2,96 % ($\hat{g}_{tester}$)+9,59 % ($\hat{s}_{cyt.x\ tester}$)
89,74 %=78,41 % (μ) +3,86 % ($\hat{g}_{cyt}$) + 1,66 % ($\hat{g}_{tester}$)+6,29 % ($\hat{s}_{cyt.x\ tester}$)
89,74 %=78,95 % (μ) +0,00 % ($\hat{g}_{cit}$) + 2,20 % ($\hat{g}_{tester}$)+8,59 % ($\hat{s}_{cyt.x\ tester}$)
89,74 %=78,95 % (μ) +5,05 % ($\hat{g}_{cit}$) + 2,20 % ($\hat{g}_{tester}$)+3,54 % ($\hat{s}_{cyt.x\ tester}$)

The single crosses with the highest percentage of breaking and falling plants at harvest were:

For isonucleus lines cluster TC 209: TC 209(cyt. W 633) x TD 233 (56,37%)
For isonucleus lines cluster TC 243: TC 243 (cyt. K 1080) x Lo3Rf (66,83%)
For isonucleus lines cluster TC 221: TC 221 (cyt. TC 208) x T 291 (65,28%)

In these single-crosses, the determinism of the number of unbroken plants were involved the following actions:

56,37%=68,18 % (μ) -1,23 % ($\hat{g}_{cyt}$) -2,65 % ($\hat{g}_{tester}$) -7,94% ($\hat{s}_{cyt.x\ tester}$)
66,83 %=78,41 % (μ) -2,18 % ($\hat{g}_{cyt}$) -6,49 % ($\hat{g}_{tester}$) -2,91% ($\hat{s}_{cyt.x\ tester}$)
65,28 %=78,95 % (μ) +0,00 % ($\hat{g}_{cyt}$) -1,64 % ($\hat{g}_{tester}$) – 12,03% ($\hat{s}_{cyt.x\ tester}$)

Tab. 7

The influence of the type of cytoplasm on the unbroken plants for hybrids with isonuclear lines TC 209 (ARDS Turda, 2009)

tester (t) ♂ / cytoplasm (c) ♀	TC 344		Lo3 Rf		TB 329		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TC 209	75,14	0,47	69,63	-1,52	72,65	0,88	69,42	0,35	71,71	3,53
TC209 (cyt A665)	80,66	9,59	58,17	-9,38	67,60	-0,57	66,01	0,55	68,11	-0,07
TC 209 (cyt T291)	66,25	-2,72	69,27	3,81	64,89	-1,18	63,65	0,28	66,01	-2,16
TC 209 (cyt 248)	67,87	-1,22	66,67	1,10	60,90	-5,29	69,06	5,59	66,12	-2,05
TC 209 (cyt W633)	68,04	-1,87	78,39	12,00	64,99	-2,01	56,37	-7,94	66,95	-1,23
TC 209 (cyt TC177)	69,94	-1,78	63,58	-4,62	73,57	4,74	67,97	1,85	68,76	0,59
TC 209 (cyt D105)	70,05	-2,47	67,62	-1,38	73,05	3,43	66,23	-0,68	69,56	1,38
Tester average $\hat{g}_t$	71,14	2,96	67,62	-0,56	68,24	0,06	65,53	-2,65	68,18	

LDS P=5%	13,72
LDS P=1%	18,31
LDS P= 0,1%	23,62

Tab. 8

The influence of the type of cytoplasm on the unbroken plants for hybrids with isonuclear lines TC243 (Târgu-Mureş, 2009)

tester (t) ♂ / cytoplasm (c) ♀	TC 344		Lo3 Rf		TB 329		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TC 243	81,56	0,04	76,76	5,04	72,72	-7,15	81,80	3,19	78,21	-0,20
TC 243(cyt A665)	78,75	-1,86	77,09	6,29	78,16	-0,79	75,15	-2,53	77,29	-1,12
TC 243(cyt T248)	86,80	1,69	67,74	-7,56	89,74	6,29	82,89	0,70	81,79	3,39
TC 243(cyt TC208)	82,54	3,53	66,96	-2,24	78,62	1,26	74,65	-1,44	75,69	-2,71
TC 243(cyt TC221)	80,33	-2,62	76,11	2,97	84,15	2,86	77,93	-2,10	79,63	1,23
TC 243(cyt K1080)	81,05	1,51	66,83	-2,91	77,43	-0,46	79,61	2,98	76,23	-2,18
TC 243(cyt K2051)	81,01	-2,30	71,91	-1,59	79,64	-2,02	79,59	-0,80	80,00	1,59
Tester average $\hat{g}_t$	81,72	3,31	71,91	-6,49	80,07	1,66	78,80	0,40	78,41	

LDS P=5%	11,71
LDS P=1%	15,62
LDS P= 0,1%	20,21

Tab. 9

The influence of the type of cytoplasm on the unbroken plants for hybrids with isonuclear lines TC 221 (Secuieni, 2009)

tester (t) ♂ / cytoplasm (c) ♀	T 291		TC 209		TD 233		Cytoplasm average	
	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{s}_{cxt}$	%	$\hat{g}_{cit}$
TC221	82,92	4,59	77,83	-1,57	79,15	-3,02	79,97	1,02
TC 221(cyt T 248)	79,01	2,77	81,16	3,84	73,48	-6,61	77,88	-1,06
TC 221(cyt TC 243)	78,55	-0,61	76,95	-3,27	86,87	3,88	80,79	1,84
TC 221(cyt TC 208)	65,28	-12,03	81,82	3,44	89,74	8,59	78,95	0,00
TC221(cyt TC 209)	77,55	3,57	76,39	1,33	72,92	-4,90	75,62	-3,33
TC221(cyt K 1080)	84,03	1,67	78,22	-5,21	89,74	3,54	84,00	5,05
T 221(cyt TC 316)	73,81	0,03	76,29	1,44	76,15	-1,47	75,42	-3,53
Tester average $\hat{g}_t$	77,31	-1,64	78,38	-0,57	81,15	2,20	78,95	

LDS P=5%	5,82
LDS P=1%	7,81
LDS P= 0,1%	10,33

CONCLUSIONS

For the highest yield single crosses in the five isonucleus inbred lines testing systems have been implicated the mean actions, followed by the general tester combining capacity actions, the “nucleus x cytoplasm” interactions and, in a smaller measure, the cytoplasm actions.In the kernel dry matter at harvest heredity, for the highest dry matter content single crosses, beside the mean and the general cytoplasm combining capacity also the tester effects are important, less visible being the “nucleus x cytoplasm” interaction influence, except for the TB 367 (cyt. TC 208) x T 291 line where the “nucleus x cytoplasm” interaction influence has been statistically significant.In the unbroken plants trait heredity are implicated the mean actions, followed by the specific “nucleus x cytoplasm” interaction and, in a smaller measure, the cytoplasm actions.

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