Bulletin USAMV-CN, 63/2007

AGRONOMIC PERFORMANCE OF MALE-STERILE AND FERTILE MAIZE HYBRID DEVELOPMENT AT TURDA – ROMANIA

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Keywords: maize hybrid, the cytoplasm, male-sterility, grain yield, dry matter of grain

Abstract

The use of cytoplasmatic male-sterility in maize seed production contributes to increase economical efficiency and to obtain great genetical seeds. Through this theme one has followed the realization of a comparative study between some hybrids obtained to Turda on C and T cytoplasm their homologues, developed with normal and through the castration of the maternal parents. The researches aimed mainly the phenotypic and genotypic variability of the hybrids, the degree of male-sterility and the capacity of production, in phytotechnic conditions in different densities.

INTRODUCTION

Cytoplasm male sterility is the male sterility which is determined by certain hereditary factors localized the in cytoplasm. This is a feature transmitted on a maternal line and consists in the abortion of the farina along with the sustentation fertility of the female organs and a natural vegetative development.

Obtaining the corn hybrid through cytoplasm male sterility involves two parental forms, one mother, carrying cytoplasm male sterility and one father form which is the restores fertility of the farina.

The effect of cytoplasmic male sterility of maize received a great deal of attention as an inexpensive means of producing hybrid seed of high genetic purity. Several investigations concentrated on possible changes in general agronomic performance with special emphasis on grain yield, dry matter of grain and erect plants at harvest. Some authors reported a no or inconsistent increases ingrain yield as a result of cytoplasmic male sterility (cms) (Duvick, 1957; Josephson et al., 1978, Kálmán et al., 1985; Sangoi and Salvador, 1996; Voichita Has et al., 2001; Weingartner et a., 2002) investigated male-sterile inbreds and their single-crosses and found that the most of the male-sterile inbreds outperformed their normal fertile counterparts, while differences in grain yields, due to the different cytoplasms, were inconsistent with hybrids. Increases in grain yield as a result of male sterility were observed under stress conditions such as narrow spacing and varying amounts of N fertilizer, water supply (Voichita Has et al., 1989; Miku and Partas, 1990; Stamp et al., 2000).

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Negative effects of male sterility on grain yield have been reported (Noble and Russell, 1963).

The potential of some male sterile hybrids to produce consistently higher yields have been neglected for past decades; however, a positive impact on yield was found in the studies of some authors (Kálmán et al.,1985; Has et al., 2002; Stamp et al., 2000; Weingartner et a., 2002).
There will always be an interest in inexpensive, pure genetic seeds. Thus, we consider the use of male sterile maize with regard to grain yield and some agronomic characteristics in this study.

MATERIAL AND METHOD

The present investigations were carried out with 18 released hybrids, in two years (2005 and 2006 at Agricultural Research Station Turda.

The biologic material used in the research was the simple hybrids, unomologated, which were obtained through the crossing of some inbreed lines, considered constant parental forms which have a normal, cmsC, cmsT cytoplasm with various inbreed lines. These hybrids were tested with sterile and fertile counterparts. Plant densities were 50,000 and 70,000 plants / ha^{-1}. Each genotype was evaluated for: early vigor, days from planting to anthesis, when 50% of plants shed pollen and from planting to silking when 50% of plants showed silk, the date of physiological maturity (black layer formation), percent of barren stalk plants, number of ears per plant, percent of erect plants dry matter of grain at harvest, 1000-kernel weight and grain yield. Combined analysis of variances were conducted for each character over the four tests, assuming years and locations to be fixed variable. The total entry variance was partitioned into variance among hybrids and variance among cytoplasmic sources within hybrids (fertile or male sterile).

The plot was organized in the under plot methods, and the studied factors were: A factor – years B factor –density, with two graduations (a_1 = 50 000 plants/ha; a_2 = 70 000 plants/ha); C factor – the hybrid, with 18 graduations (b_1, b_2, b_3……..b_{18}); D factor – the cytoplasm, with two graduations. (c_1, c_2). (table 1)

Table 1

The experimental factors

A factor- years	**B factor Density**	**C factor hibrid**	**D factor cytoplasm**
a_1 - anul 2005 a_2 - anul 2006	b_1 50 000 plante/ha, b_2 70 000 plante/ha	1-18	d_1 cms C d_2 cms T

For a better ecologic expression of the two hybrid types the sowed was made in two densities (50 000 plants/ ha; 70 000 plants/ ha), thing that permitted the achievement of some information about the interaction of the genotypes with the environmental conditions. We have considered that with the density conditions the differences would be better marked. The results were expressed by the variance analysis and with the Duncan test.

RESULTS AND DISCUSIONS

The eighteen cytoplasmic male sterility hybrids, tested in two experimental years: 2005 and 2006 had 2.9 % higher grain yield. (table 2).

Analysing the grain yield of hybrids to observe four combinations cms with difference very positives significantly comparative with theirs fertiles forms: C335-79, C243-219, C243-220, C243-350

Differences very negatives significantly comparative with theirs fertiles forms present five cms-hybrids: C344-76, C344-71, C334-78, C344-225, C344-127. This grain yield neagative difference between male-steriles and fertiles hybrids forms indicate particularly the interaction between cms x hybrid for both hybrids.

Concerning dry matter of grain at harvest it observe at most cases of experimentals hybrids a easily increase at male-steriles formes comparative with their fertiles formes. The justification of this is the sum more advantageous at male-steriles plants comparative with fertiles plants. . (Voichita Has et al., 1987)

Regarding the erect plants at harvest at most cases of experimentals hybrids it observe the superiority of male-sterile formes of hybrids comparative with theirs omologues androfertiles. Thus the difference very positives significantly comparative with theirs fertile forms present male-sterile hybrids formes: C243-219, A428-1, C243-255, C399-1, C243-350.

Table 2

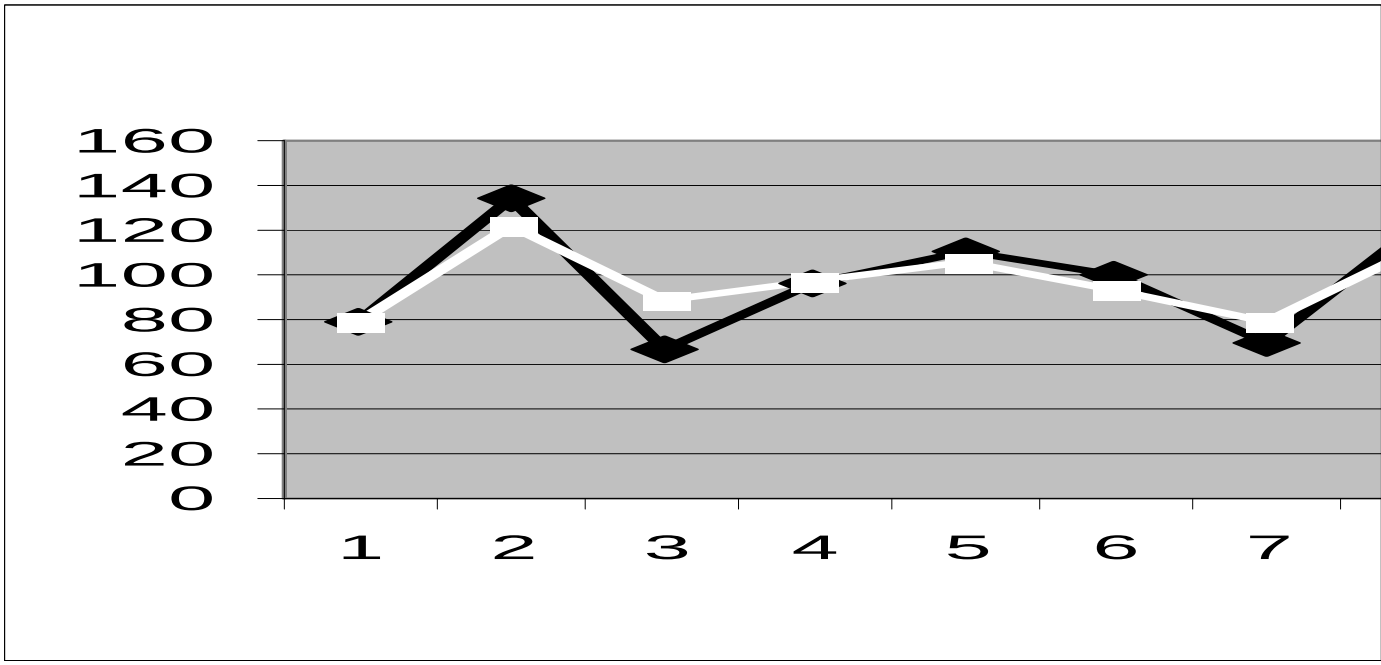
The effects of cytoplasmic male sterility x hybrid interactions on grain yield, dry matter of grain and erect plants at harvest tested in two years at Turda

Hybrid	**Cytoplasm**	**Grain yield q/ha**	**Dry matter of grain %**	**Erect plants at harvest %**	**Synthetic relative index [1] % fertile/cms**
1	2	3	4	5	6
C243-146	fertile	79.2	73.8	77.4	100
	cms	78.6	71.9	76.4	95.4
	cms/fertile	99.2 **	97.4*	98,7 **	-
C344-76	fertile	134.3	73.4	91.6	100
	cms	122.2	74.8	85.3	86.3
	cms/fertile	90.9 000	101.9**	93.1	-
C335-79	fertile	66.4	75.5	93.1	100
	cms	88.6	76.9	84.9	123.9
	cms/fertile	133.4 ***	101.8*	91.1	-
C243-203	fertile	96.3	79.4	81.2	100
	cms	96.8	81.4	76.4	96.9
	cms/fertile	100.5	102.5*	94.0	-
C344-75	fertile	110.8	78.5	93.4	100
	cms	105.5	80.2	94.2	98.1
	cms/fertile	95.5 0	102.1*	100.8	-
C335-108	fertile	100	78.3	95.8	100
	cms	93.8	78.1	92.9	90.7
	cms/fertile	93.8	99.7*	96.9	-
C243-219	fertile	69.1	79.3	64.2	100
	cms	79.2	77.3	79.3	138
	cms/fertile	114.6 ***	97.4	123.5 ***	-
C344-71	fertile	123	74.3	88.6	100

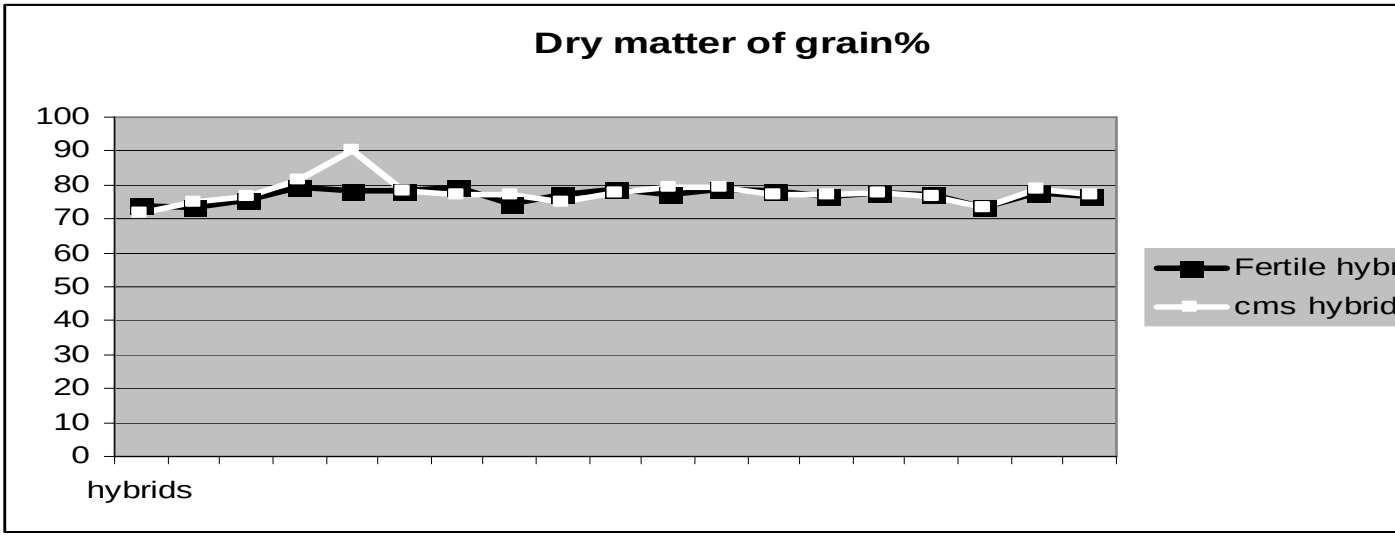
	cms	112.5	77.3	90.3	96.9
	cms/fertile	91.4 000	104**	101.9	-
A428-1	fertile	108.8	77	83.2	100
	cms	104.6	74.8	95.8	107.5
	cms/fertile	96.1 (0)	97.1*	115.1 ***	-
C243-220	fertile	89.8	78.7	79	100
	cms	103	77.9	80.2	115.2
	cms/fertile	114.6 ***	98.9*	101.5 **	-
C334-78	fertile	117.3	77.2	91.9	100
	cms	100	79.3	88.6	84.4
	cms/fertile	85.2 000	102.7*	96.4	-
D345-2	fertile	103.7	78.7	92.9	100
	cms	92.6	79.5	86.5	83.9
	cms/fertile	89.2 0	101*	93.1	-
C243-255	fertile	91.2	78.3	80.9	100
	cms	93.8	77.2	87.2	109.3
	cms/fertile	102.8	98.5*	107.7 ***	-
C344-225	fertile	128.6	76.7	90.4	100
	cms	122	77.3	83.2	87.9
	cms/fertile	94.8 000	100.7*	92	-
C399-1	fertile	109.4	77.5	79.9	100
	cms	107.8	77.5	86.1	106.1
	cms/fertile	98.5	100*	107.7 ***	-
C243-350	fertile	64.9	77.4	69	100
	cms	67.5	76.6	67.9	101.2
	cms/fertile	104 ***	98.9*	98.4 ***	-
C344-127	fertile	127.9	73.6	87.1	100
	cms	103	73.1	78	71.6
	cms/fertile	80.5 000	99.3*	89.5	-
D344-5	fertile	104.3	77.8	85.5	100
	cms	100.4	78.7	81.7	93
	cms/fertile	96.2	101.1*	95.5	-
Trial mean	fertile	101.3	76.9	84.7	100
	cms	98.4	77.2	84.1	96.8
	cms/fertile	97.1	100.3*	99.2	-
		DL(5%)=12.9 DL(1%)=17.4 DL(0.1%)=22.9	DL(5%)=19.8 DL(1%)=26.6 DL(0.1%)= 35.1	DL(5%)=15.6 DL(1%)=20.9 DL(0.1%)= 27.6	

Si % (col.6) = {[col.3 x 4 x 5 (cms)] / [col. 3 x 4 x 5 (fertile)]} x 100

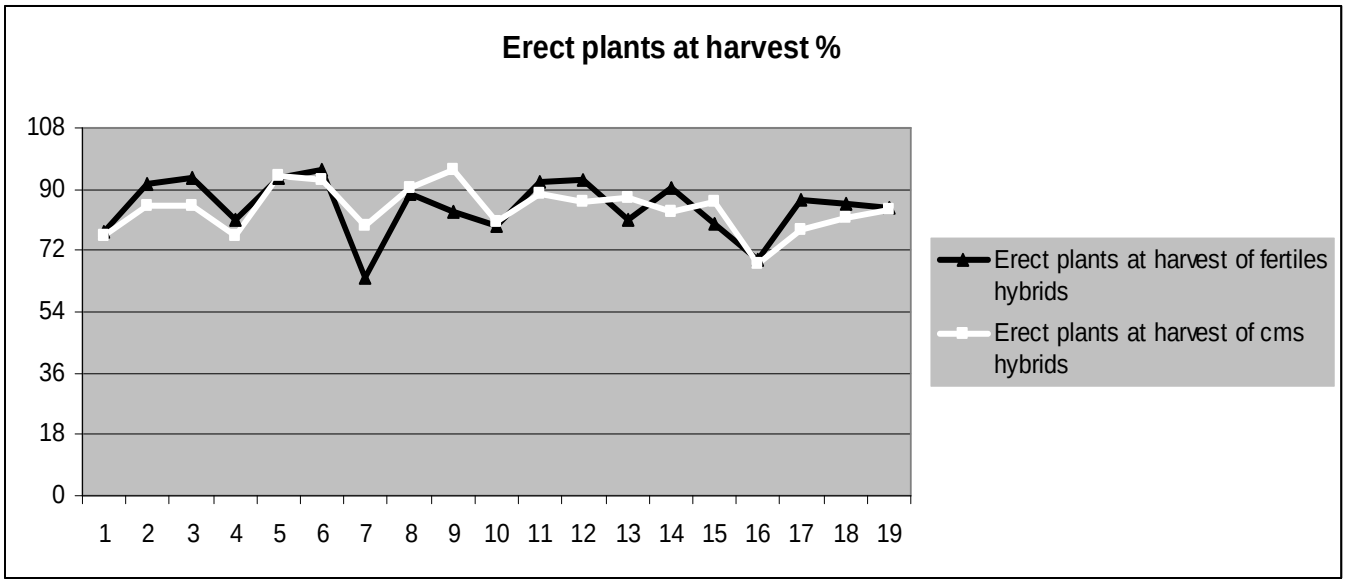
Graphic 1



Graphic 2



Graphic 3



CONCLUSIONS

- Despite strong variation among the hybrids, we conclude that cytoplasmic male sterility of high-yielding modern hybrids can increase the grain yields of maize.
- Cms hybrids showed a easy superiority for dry matter of grain. This fact stimulate the cultivation of cms –hybrids, for obtains superiories crops .
- Regarding the plant resistance to breaking and lodging, the cms-hybrids showed a significante superiority comparative with their omologues .
- Under stress environments cms hybrids achieved more favorable yields.
- Choosing hybrids with a positive yield response to cms is suggested.

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