PLANT POULATION EFFECTS ON FEW YIELD PARAMETERS IN SOME „TURDA" MAIZE HYBRIDS

EFECTUL DENSITĂȚII ASUPRA UNOR ELEMENTE DE PRODUCȚIE LA UNII HIBRIZI DE PORUMB „TURDA"

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Abstract: *Generally the maize yield per unit area responds to density changes. Optimum plant density for maximum grain yield per unit area may differ from hybrid to hybrid. Objective of the study was: to estimate the optimum density for maximum grain yield per unit area to seven hybrids, the density impact on stand uniformity, to evaluate how some hybrids, important yield parameters (yield per plant, ear length and kernel row number) respond to density changes. Experimentation was conducted at the Agricultural Research Station, Turda, Romania, during the 2006 and 2007 seasons under natural conditions, without irrigation. Seven single-cross hybrids (FAO 320 - 450) were grown at three densities (2.5, 4.2, 8.4 pl/m^2). Comparison of means was conducted by least significance difference (LSD) after analysis of variance for a two-factor split-plot design. In maize culture should take the necessary measures to achieve the optimum density for the chosen hybrids and the most uniform stand possible.*

Rezumat: *În general, producția pe unitatea de suprafață, răspunde la schimbarea desimii de cultură.Pentru a se putea obține o producție maximă pe unitatea de suprafață, desimea de cultură optimă diferă de la un hibrid la altul. Obiectivul acestei lucrări constă în determinarea densității care afectează uniformitatea plantelor/parcelă pentru trei caractere cu importanță agronomică: producția/plantă, lungimea ştiuletelui, numărul de rânduri pe ştiuletele principal. Experimentarea s-a efectuat la SCDA Turda, în cursul a doi ani 2006 şi 2007 în condiții naturale, fără irigare,. Şapte hibrizi simpli de porumb (FAO 320 – 450) au fost cultivați la trei densități (2.5, 4.2, 8.4 pl/m^2) Compararea mediilor s-a efectuat pe baza gradului de semnificație al diferențelor (DL) după calculul analizei variançelor pentru o experiență polifactorială cu parcele subdivizate. În cultura porumbului trebuie avut în vedere uniformitatea terenului precum şi asigurarea unei densități optime fiecărui hibrid*

Key words: *yield per plant, ear length, kernel row number, plant population*
Cuvinte cheie: *producția per plantă, lungimea ştiuletelui, numărul de rândur, densitatea plantelor*

INTRODUCTION

The improved grain yield per unit area of modern maize hybrids is due to the increased optimum plant population rather than the improved grain yield per plant. Traits associated with tolerance to various stresses, including high plant populations, and the efficiency of capture and use of resources rendered modern hybrids more productive. Crop yield potential is determined by three components: yield potential per plant, tolerance to biotic and a biotic stresses, responsiveness to inputs. Hybrids improved for these three components are expected to express their crop yield potential at a wider range of plant densities (HAS VOICHITA et al., 2007). Optimum plant population density for maximum crop yield (i.e., yield per unit area) may differ from hybrid to hybrid in maize (*Zea mays* L.) due to strong genotype x density interactions (FARNHAM, 2001), and in turn hybrids exhibit strong density-dependence (FASOULA and TOLLENAAR, 2005). Tolerance to various stresses has been played a crucial role in the improvements in maize yields (TOLLENAAR and WU, 1999). FASOULA and FASOULA (2002) suggested a model of crop yield potential assessment under a single ultra-low density that approaches total absence of competition. Objective of the study was to estimate the optimum density for maximum grain yield per unit area to seven hybrids, the density impact on stand uniformity was evaluated as well as to assess how some hybrids, important yield parameters (yield per plant, ear length, kernel row number) respond to density changes.

MATERIAL AND METHODS

Experimentation was conducted at the Agricultural Research Station, Turda, Romania, under natural conditions, without irrigation, during the 2006 and 2007 seasons. Seven maize single-crosses (FAO 320 - 450) were grown at three densities. The experimental design was a split-plot, with different densities as main plots, randomized in three complete blocks, and the hybrids as subplots. Subplots consisted of four rows, 5 m long with 70 cm between rows. Distances among plants within rows were 57, 34 and 17 cm, to obtain the densities of D1=2.5, D2=4.2 and D3=8.4 plants/m^2, respectively. To determine the elements of productivity were collected 20 plants from the central ranks of each plot trial. The experimental design was a split-plot, with different densities as main plots, randomized in three complete blocks, and the hybrids as subplots. Comparison of means was conducted by least significance difference (LSD) after analysis of variance for a three-factor split-plot design (SAULESCU and SAULESCU, 1967).

RESULTS AND DISCUSSIONS

Analysis of variance showed significance for the main factors of years, densities and hybrids; year x density and year x hybrid interactions were significant too. At each density, significant differences among hybrids for yield parameters (yield per plant, ear length, kernel row number) were found (table 1-3). Average yield of the split-plot experiments was significantly higher in 2007 compared with 2006 (table 5). Decreasing plant density resulted in higher grain yield per plant, ear length and kernel row number also, a reasonable impact on account of more environmental resources available for each plant (table 4). However, differentiation between hybrids enlarged as density decreased. So the first impact found in this study is that phenotypic expression and differentiation increase as density decreases.

Table 1

Analysis of variance for grain yield/plant (g) of seven maize hybrids at three densities and two years

Sources of variation	Sum of squares	df	Mean squares	F value	LSD
Year (Y)	32,6	1	32,56	0,03	
Error A	2342,1	2	1171,06		
Density (D)	283988,4	2	141994,20	289,28	***
Y x D	24791,6	2	12395,81	25,25	***
Error B	3926,8	8	490,85		
Hybrid (H)	13725,3	6	2287,54	16,23	***
H x Y	5753,5	6	958,91	6,80	***
H x D	5499,5	12	458,29	3,25	***
H x Y x D	3527,4	12	293,95	2,09	**
Error C	10148,5	72	140,95		

*** Significant at the 0.05 and 0.01 probability level

When grain yield per plant was adjusted to grain yield per unit area (ha) it was found that maximum yield (76.9 q/ha) was obtained in second year under the high density of 8.4 plants/m^2 (table 5).

Table 2

Analysis of variance for ear length (cm) of seven maize hybrids at three densities and two years

Sources of variation	Sum of squares	df	Mean squares	F value	LSD
Year (Y)	3,2	1	3,18	3,36	
Error A	1,9	2	0,95		
Density (D)	732,2	2	366,09	298,72	***
Y x D	38,3	2	19,17	15,64	***
Error B	9,8	8	1,23		
Hybrid (H)	82,2	6	13,70	24,84	***
H x Y	9,6	6	1,60	2,90	**
H x D	78,1	12	6,51	11,79	***
H x Y x D	35,7	12	2,98	5,40	***
Error C	39,7	72	0,55		

*** Significant at the 0.05 and 0.01 probability levels

Table 3

Analysis of variance for kernel row number of seven maize hybrids at three densities and two years

Sources of variation	Sum of squares	df	Mean squares	F value	LSD
Year (Y)	205,4	1	205,40	250,95	
Error A	1,6	2	0,82		
Density (D)	261,6	2	130,79	141,70	***
Y x D	23,8	2	11,89	12,88	***
Error B	7,4	8	0,92		
Hybrid (H)	60,3	6	10,06	19,73	***
H x Y	33,4	6	5,57	10,93	***
H x D	17,8	12	1,48	2,91	***
H x Y x D	16,6	12	1,38	2,71	***
Error C	36,7	72	0,51		

*** Significant at the 0.05 and 0.01 probability levels

Table4

Grain yield parameters averages (2006-2007) of each hybrid at tree densities

Hybrid	Grain yield/plant (g)				Ear length (cm)				Kernel row number			
	D1	D2	D3	Mean	D1	D2	D3	Mean	D1	D2	D3	Mean
1	194	154	69	139	22	20	15	19	18	17	14	16
2	211	146	88	148	20	18	14	17	18	17	15	17
3	180	117	73	123	21	18	14	18	17	15	14	15
4	215	159	84	153	21	20	15	19	19	18	15	17
5	193	136	77	135	23	19	15	19	20	18	15	18
6	174	142	67	128	19	18	14	17	17	17	15	16
7	175	134	72	127	20	19	16	18	18	18	15	17
Mean	192	141	76	136	21	19	15	18	18	17	15	17

Table 5

Grain yield/ha averages (q/ha) of each hybrid across two seasons and three densities

Hybrid	Grain yield (mean)	2006				2007			
		D_1	D_2	D_3	D_M	D_1	D_2	D_3	D_M
1	57.1	52.3	61.0	42.8	52.0	44.8	68.2	73.4	62.1
2	62.7	56.9	61.6	59.1	59.2	48.7	60.9	88.8	66.1
3	51.8	46.0	54.3	45.1	48.5	43.8	44.2	77.6	55.2
4	63.8	61.8	68.3	59.4	63.2	45.8	65.7	82.0	64.5
5	56.8	49.7	48.6	46.2	48.2	46.8	65.8	83.7	65.4
6	53.0	51.3	60.8	49.8	54.0	36.0	58.5	61.6	52.0
7	53.5	49.8	57.7	49.6	52.4	37.7	54.6	71.4	54.6
Mean	57.0	52.5	58.9	50.3	53.9	43.4	59.7	76.9	60.0

CONCLUSIONS

The second season was significantly higher yielding (60.0 q/ha) compared with the first (53.9 q/ha).

There was registered the difference among hybrids at the same season or among the hybrid across the three densities.

Optimum density for the grain yield in the first season was under middle density (4.2 plants/m^2) and for the second year under high density (8.4 plants/m^2).

In maize culture should take the necessary measures to achieve the optimum density for the chosen hybrids and the most uniform stand possible.

The hybrid H4 gave the highest grain yield/ha averages in the first year of experimentation, respectively H5 in the second year.

The optimum density varied, for grain yield, per plant from 2.5 until 4.2 plants/m^2, with significant differences between the hybrids.

Following the results obtained in the two years of research (2006, 2007) can not be concluded to the optimum density specification in obtaining maximum grain yield per unit area and requires at least another year of research.

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