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Title: Yield and stability of Synthetic maize varieties for the humid tropic in México

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Introduction

The synthetic maize varieties present advantages of greater adaptability to clime and soil conditions and agronomic management by farmers, besides, they can be used for several planting seasons without affecting the grain yield and is easier and cheaper their seed production, (Sierra et al., 2016; Reyes, 1985)

The adaptability of the genotypes permit to know the response to different environments which are defined by the clime, soil and the agronomic management. (Márquez 1992; Sierra et al., 2018)

Objectives

The objectives of this research were to know the yield, adaptability and the agronomic characteristics of the synthetic maize varieties for the humid tropic

Methodology

Localization. *This research was carried out during the spring summer season in 2013, 2016 and 2018 and Autumn Winter season in 2013/14 in the locations Cotaxtla Experiment Station and Carlos A. Carrillo in Veracruz and Huimanguillo in Tabasco State. The clime conditions are Aw1, Aw2 and Am for each location, respectively, which of them, according with the clime classification, described by Köppen modified by García (2004), correspond to the humid and subhumid warm conditions.*

Germplasm used. *The germplasm used in this research were experimental synthetic maize varieties which were formed with experimental normal and quality protein inbred lines, which were selected through the per se grain yield and their General Combining Ability (GCA), and they belong to the Tuxpeño race*

Results

Table 1. Combined Analysis of Variance for grain yield in Synthetic maize varieties across six environments in the humid tropic. CIRGOC INIFAP 2013-2018.

Source of Variation	DF	SS	MS
Varieties (V)	20	81.92	4.10**
Environments (E)	5	635.61	127.12**
Interaction VxE	100	198.78	1.99**
Error	240		0.60

*DF=Degree of freedom; SS=Square Sum; MS=Mean Square; **=Significance for source of variation at 0.01 of probability*

Table 2. Grain yield in synthetic maize varieties across the six environments. CIRGOC INIFAP 2013-2018

Entry	Genealogy	Cot 2013B	Cot 2014A	Cot 2016B	Carrillo 2016B	Huim 2016B	Cot 2018B	Mean	Description
20	VS-536	3.47	5.40	5.67	7.99	4.09	7.1	5.62*	S
2	SYNTHETIC-2B	3.75	5.40	5.58	6.99	3.44	7.09	5.38*	S
5	SYNTHETIC-5B	3.75	5.20	6.17	8.05	2.21	6.63	5.34*	S
14	SYNTHETIC-2C	3.80	4.70	4.85	6.77	4.67	6.73	5.25*	S
17	SYNTHETIC-11C	3.75	5.40	5.82	7.78	1.25	7.21	5.20*	S
1	SYNTHETIC-1BQ	4.32	4.50	5.63	7.55	3.6	4.94	5.09**	S
16	SYNTHETIC-LPSC3	3.10	3.90	5.25	8.70	3.59	5.67	5.04**	S
13	SYNTHETIC-9C	3.15	4.70	5.34	7.43	3.62	5.76	5.00**	S
3	SYNTHETIC-3B	4.30	4.90	5.69	6.32	4.36	4.4	4.99**	BUC
19	SYNTHETIC-10C	3.10	4.60	4.52	6.30	4.56	6.7	4.96**	S
10	SYNTHETIC-7C	3.25	5.10	5.13	7.04	4.01	5.22	4.96**	S
18	SYNTHETIC-8C	3.30	4.80	5.80	6.35	2.97	5.77	4.83	S
21	V-537C	3.40	3.60	4.42	7.07	3.39	5.53	4.57	S
4	SYNTHETIC-4B	3.90	4.90	4.13	7.68	2.53	3.94	4.51	S
12	SYNTHETIC-1C	2.70	4.50	4.01	7.31	3.29	5	4.47	S
15	SYNTHETIC-3C	3.55	5.10	4.94	7.86	0.98	4.32	4.46	S
9	SYNTHETIC-4C	2.45	4.80	5.54	5.87	3.06	4.83	4.42	S
11	SYNTHETIC-TS-6	2.70	4.10	4.19	5.57	1.91	7.19	4.28	S
7	SYNTHETIC-5C	4.00	3.50	4.90	6.53	2.87	3.82	4.27	S
8	SYNTHETIC-3SEQ	2.40	5.30	3.15	5.29	2.4	5.58	4.02	S
6	SYNTHETIC-6C	2.55	3.60	5.48	5.33	2.86	3.1	3.82	S
	Mean	3.37	4.67	5.06	6.94	3.12	5.55	4.78	
	MSE	0.40	0.47	0.35	0.89	0.68	0.82	0.60	
	SMD 0.05	1.24	1.37	1.24	1.56	1.63	1.49	0.51	
	SMD 0.01	1.64	1.82	1.69	2.08	2.16	1.99	0.67	
	CV (%)	18.76	14.68	11.69	13.59	26.45	16.32	16.20	

** and **= Significance of the treatments al 05 and 0.01 of probability; A= Autumn Winter season; B= Spring Summer season; Cot= Cotaxtla Experimental Station; Carrillo= Municipality of Carlos A. Carrillo; Huim= Huimanguillo, Tab.; S= Stable Variety; BUC= Better response in Unfavourable Environments and Consistent; MSE= Mean Square Error; CV= Coefficient of Variation; SMD= Significant Minimum Difference*

Table 3. Environmental indexes in synthetic maize varieties CIRGOC INIFAP 2013-2018

Environment	Grain yield $t\ ha^{-1}$	Environmental Index
C.A. Carrillo, Ver. 2016B	6.94	2.16**
Cotaxtla, Ver. 2018B	5.55	0.77
Cotaxtla, Ver. 2016B	5.06	0.28
Cotaxtla, Ver., 2014A	4.67	-0.12
Cotaxtla, Ver. 2013B	3.37	-1.42
Huimanguillo, Tab 2016B	3.12	-1.67
Mean	4.785	

**=Significance for Environmental index at 0.01 of probability

Table 5. Agronomic characeristics in synthetic maize varieties. Cotaxtla 2016B y Cotaxtla 2018B CIRGOC INIFAP

Entry	Genealogy	DT	PH	Pl asp[1/]	Ear asp[1/]	Pl san[1/]	Ear san[1/]
1	SYNTHETIC-1BQ	51	203	2.58	2.35	2.33	2.44
2	SYNTHETIC-2B	51	224	2.60	2.02	2.26	2.07
3	SYNTHETIC-3B	52	205	2.60	2.64	2.25	2.28
4	SYNTHETIC-4B	52	219	2.33	2.43	2.29	2.37
5	SYNTHETIC-5B	53	222	1.88	2.21	2.07	2.30
6	SYNTHETIC-6C	51	200	2.69	2.68	2.37	2.18
7	SYNTHETIC-5C	52	194	2.63	2.51	2.50	2.45
8	SYNTHETIC-3SEQ	52	215	2.44	2.59	2.45	2.43
9	SYNTHETIC-4C	51	220	2.44	2.44	2.33	2.36
10	SYNTHETIC-7C	52	204	2.62	2.58	2.58	2.44
11	SYNTHETIC-TS-6	50	196	2.42	2.63	2.37	2.27
12	SYNTHETIC-1C	50	196	2.78	3.03	2.78	2.76
13	SYNTHETIC-9C	51	207	2.64	2.71	2.25	2.65
14	SYNTHETIC-2C	52	215	2.42	2.31	2.50	2.28
15	SYNTHETIC-3C	52	186	2.48	2.81	2.25	2.69
16	SYNTHETIC-LPS-C3	50	207	2.61	2.55	2.42	2.31
17	SYNTHETIC-11C	51	201	2.44	2.56	1.99	2.42
18	SYNTHETIC-8C	51	196	2.22	2.50	2.09	2.44
19	SYNTHETIC-10C	52	204	2.16	2.61	2.25	2.16
20	VS-536	53	218	2.34	2.38	2.33	2.44
21	V-537C	53	221	2.31	2.53	2.16	2.47
	Mean	51.43	207.3	2.46	2.53	2.33	2.39
	MSE	2.27	259.18	0.0615	0.108	0.1231	0.1323
	CV (%)	2.93	7.76	10.08	12.98	15.06	15.22

DT=Days to Tassel; PH=Plant Height; Pl asp=Plant aspect; Ear asp=Ear aspect; Pl San =Plant sanity; Ear san=Ear sanity; MSE= Mean Square Error; CV=Coefficient of variation; [1/]=Scale of qualification from 1 to 5 where 1 means the best and 5 the worst

Table 6. Lysine and Tryptophan content, in maize synthetics formed with inbred lines converted to high quality protein character Cotaxtla 2010B. CIRGOC. INIFAP

Genotype	% Lysine	% Relative	Genotype	% Tryptophan	% Relative
Synthetic 1C	0.390	155	Synthetic 5C	0.113	206
Synthetic 5C	0.375	149	Synthetic 1C	0.095	173
Synthetic 2C	0.359	142	Synthetic 4C	0.093	169
Synthetic 4C	0.342	136	Synthetic 2C	0.089	162
General mean	0.367			0.098	
Tuxpeño (normal)	0.252	100		0.055	100

B= Spring summer season; The nomenclature of the Synthetics 1C, 2C, 4C and 5C for indicating quality protein, it means that they were formed with converted inbred lines to quality protein character

Conclusions

There were found experimental maize varieties with high grain yield and favourable agronomic characteristics across the six environments of evaluation.

The synthetics 2B, 5B, 2C and 11C are competitive in grain yield and recorded short height plant with good plant and ear aspect. Besides these ones are characterized as "Stables"

The synthetic maize varieties represent an alternative of using in commercial maize production in tropical area for the southeast of México

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