Comparison among Inbreeding Systems in Maize

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ABSTRACT

The use of less severe inbreeding systems than self-fertilization has been suggested as a means of developing more vigorous maize lines (Zea mays L.). To compare different inbreeding systems, nine traits were evaluated in inbred lines developed by full-sib mating (F=0.5), self-fertilization (F=0.5), half-sib mating (F= 0.305), from the following populations: BR 105, a synthetic variety, and ESALQ-PB 4 , which is a composite of wide genetic base. The means and genetic parameters comparisons showed no important advantages of full-sib crosses over selfing. The inbreeding depression values for grain yield were similar between these groups of lines and inferior for half-sib lines. The inbreeding depression rates / 1% of expected homozigosity were similar among the three inbreeding systems. We conclude, in view of large inbreeding depression showed by tropical populations of maize in Brazil, that it is more reasonable to allocate resources and time in breeding source populations than to use milder forms of inbreeding.

KEY WORDS: Maize, Zea mays, Inbreeding, Inbreeding depression, Tropical maize populations.

INTRODUCTION

Due to its rapid approach to homozygosity self-fertilization is the inbreeding system used in maize to obtain inbred lines. However, it is the most drastic system of inbreeding. So, less severe inbreeding systems, such as full-sib mating and half-sib mating, have been suggested to develop more vigorous lines (Macaulay, 1929; Cornelius and Dudley, 1974; Good and Hallauer, 1977). Theoretically, full-sib and half-sib inbreeding systems would allow less rapid fixation of deleterious aleles, increasing the opportunities for selection during inbreeding. The question to be answered is whether the advantages of using a less severe inbreeding system would surpass the advantages of using a rapid approach to homozygosity through self-fertilization. The results of some research works have sugested reduced inbreeding depression in less severe systems (Cornelius and Dudley, 1974; Obilana and Hallauer, 1974; Rice and Dudley, 1974; Bartual and Hallauer, 1976; Good and Hallauer, 1977; Hallauer and Miranda Filho, 1981). However, these systems were not considered significantly better than self-fertilization (Cornelius and Dudley, 1974; Good and Hallauer, 1977). Bartual and Hallauer (1976) didn´t observe any yield advantage for lines developed by full-sibing over selfing, although the estimates of genetic variances for yield were two-fold greater for the full-sib lines than for selfed lines.

Studies of this nature have not been conducted in brazilian maize populations, which have showed large genetic load in several research reports (Geraldi and Vencovsky, 1980; Geraldi et al., 1982; Vianna et al., 1982; Silva and Pinto, 1982; Lima et al., 1984; Miranda Filho and Meirelles, 1986; Pinto et al., 1987;

Marques, 1988; Santos et al., 1992; Gama et al., 1995; Ferrão et al., 1994; Lopes et al., 1998; Terezawa Jr. and Miranda Filho, 1996). Therefore, information on the effects of different inbreeding systems is important since the use of less severe inbreeding systems could increase the value of these populations as line sources.

The objective of our study was to compare three inbreeding systems (self-fertilization, full-sib mating, and half-sib mating), based on the following aspects: (a)comparison between means and genetic parameters at similar levels of inbreeding by self-fertilization and half-sib mating; and, (b)analysis of levels and rates of inbreeding depression for lines developed by self-fertilization, full-sib and half-sib mating.

MATERIAL AND METHODS

Maize populations ESALQ-PB 4, a composite of wide genetic base, and BR 105, a synthetic population, were used as sources of lines in the present study. S_1 lines showing an inbreeding coefficient (F) of 0.5 were randomly obtained by self-fertilization of S_o plants from each population. Full-sib families were developed from each population through controlled crossing of pairs of S_0 plants. After three generations of full-sib crossings, lines with inbreeding coefficient (F) of 0.5 were developed. Using fertilization of S_0 plants with pollen gathered from a sample never smaller than 50 plants, half-sib families from each population were developed. After three generations of half-sib crossings, lines with inbreeding coefficient (F) of 0.305 were developed (Hallauer and Miranda Filho, 1981). From the ESALQ-PB 4 population, 56 S_1, 37 full-sib and 24 half-sib lines, totaling 117 lines were developed. From the BR 105 population, 53 S_1, 55 full-sib and 44 half-sib lines, totaling 152 lines were developed.

The experimental materials were grown at the PLANAGRI S.A Research Center, located in Goianésia-GO, Brazil, during the growing season of 1990/91. A triple lattice design was used. For the ESALQ-PB 4 population and its lines, the treatments were divided into two rectangular lattices 6x7, and one square lattice 6x6. Two cheks, ESALQ-PB 4 population and BR 201 double-cross were included between of the lattice design. For the BR 105 population and its lines, two rectangular lattices 6x7, and two square lattices 6x6 were used. Two cheks were also included between the lattice blocks the BR 105 population and U 503 double-cross (Sementes Planagri). Experimental plots consisted of two 4m rows with 1m between rows and 0.20 m between plants. Nine traits were evaluated: grain yield, ears / plant, plant height, ear height, days to pollen shed, days to silk emergence, percentage of stalk lodged plants, percentage of root lodged plants, and percentage of ears with husk problems. Grain yield was adjusted to 13% moisture and to the average stand at each experiment, using covariance analysis. For the percentage of stalk lodged plants, root lodged plants, and ears with husk problems, the arc sine $\sqrt{\%}$ transformation was used, according to Steel and Torrie (1980) recommendation. The analysis of variance followed the procedure for lattice design of Cochran and Cox (1957). Whenever the lattice was not more efficient than the randomized complete block design, the analyses of variance followed the randomized block model. The experiments showing ratios between error mean squares smaller than four were grouped without adjustment. However, when this difference was higher, the adjustment in the error degrees of freedom was performed, following the Cochran (1954) methodology.

The inbreeding depression percentage (ID%) and the inbreeding depression rates (DR) / 1% of expected homozigosity were calculated as follows:

$$ID\% = \frac{S_n - S_0}{S_0}.100 \; ; \; DR = \frac{S_n - S_o}{F.100}$$

where S_0 and S_n stand for the means of the non-inbred and the inbred (F=0.5 or 0.305) populations; F refers to the inbreeding coefficient. For the lines developed from full-sib crossings and self-fertilization, with the same inbreeding coefficient of 0.5, estimates of genetic parameters were obtained according to Vencovsky (1987) and Vencovsky and Barriga (1992).

RESULTS AND DISCUSSION

Half-sibs were excluded from the comparisons among lines in tables 1, 2 and 3 due to their low inbreeding coefficient. Tables 1 and 2 show the pooled analysis of variance for the nine traits in the two populations and their derived lines. The high coefficients of variability for grain yield were influenced by lines means. For BR 105 population, the contrast between groups IG vs S_1 was statistically significant for five traits: grain yield, plant height, ear height, days to pollen shed, days to silk emergence and percentage of stalk lodged plants. Among those traits that showed significance for the contrast IG vs S_1, only grain yield showed nonsignificant t test for the comparison between the general means of full-sib and S_1 lines (Table 3). The S_1 lines were more vigorous than the full-sib lines for the other four traits.

For the ESALQ-PB 4 population, the contrast between groups were significant for grain yield and for plant height in the analysis of variance. However, only for grain yield, the means of full-sib and S_1 lines differed significantly by the t test. The S_1 lines were 11,23% higher yielding than the full-sib lines. In both populations the significant differences indicated the opposite of what was theoretically suggested. According to Cornelius and Dudley (1974), a possible explanation for this superiority could be any non-intencional selection during the inbreeding process, which could tend to be higher under a more severe inbreeding system.

Estimates of inbreeding depression values for BR 105 and ESALQ-PB 4 (Table 4) agree with estimates reported in the literature (Hallauer and Miranda Filho, 1981). There was a decrease in plant height with inbreeding and an increase in the number of days to silk emergence. Although there were some positive values of inbreeding depression for days to pollen shedding, they were very close to zero, not necessarily indicating an increase in vigor, which is associated with early-maturing in inbreeding systems for maize.

Grain yield showed rates of inbreeding depression similar for the two populations: -52,21% for full-sib lines and -51,34% for S_1 lines in population BR 105; and -53,95% for full-sib lines and -48,89% for S_1 lines in ESALQ-PB 4 population (Table 4). Silva and Pinto (1982) and Lima et al. (1984) observed inbreeding depression in S_1 lines ranging from -29 to -40% for synthetics, and from -39 to -69% for composites and open-pollinated varieties. Inbreeding depression for the two groups of lines were high for a synthetic population, as BR 105. Furthermore, BR 105 had been previously submitted selection based on S_1 lines , which should have contributed to a smaller inbreeding depression. For ESALQ-PB 4 population, these values ranged within the expected limits for a composite having broad genetic base (Geraldi and Vencovsky, 1980; Geraldi et al., 1982; Viana et al., 1982; Silva and Pinto, 1982; Lima et al., 1984; Miranda Filho and Meirelles, 1986; Pinto et al., 1987; Marques, 1988; Santos et al., 1992).

Vianna et al. (1982) observed that the synthetic SUWAN DMR, from which the BR 105 population originated, presented unstable performance when exposed to water deficiency and normal water conditions. In the water deficient environment, average inbreeding depression was -57% compared to the -31% found in the normal water environment. SUWAN DMR had the highest inbreeding depression for the populations studied in the water deficient environment, but had the smallest under normal water conditions. Population SUWAN DMR was developed from the selection and recombination of 16 S_1 lines, and has a narrow genetic base (Vianna et al., 1982). The narrowing of the genetic base of SUWAN DMR population could have caused the loss of the alleles responsible for the resistance to water deficit. Water was not a limiting factor in the present study. This suggests that the narrow genetic base of the BR 105 population has limited the performance of its derived inbred lines under other conditions besides water deficit. Evidences of environmental influence on inbreeding depression values in maize populations in Brazil are also shown by Geraldi et al. (1982) and Lima et al. (1984), and thus, the high levels of inbreeding depression observed for the BR 105 population can be attenuated under other environmental conditions.

According to Carlone Jr. and Russell (1988), the use of lines with an intermediate inbreeding level to develop single-crosses could have some advantages in relation to the use of highly inbred lines. The main advantage is the higher vigor and, consequently, higher production of hybrid seeds. Meanwhile, it is expected that these lines will be less sensitive to environmental variations. The results of some studies have shown the potential of these cross systems (Davis, 1934; Kinman, 1952; Wellhausen and Wortman, 1954; Stangland and Russel, 1981; Carlone Jr. and Russell, 1988, 1989). Córdova (1986) observed that the use of interpopulation hybrids developed from full-sib progenies resulted in heterosis values up to 60%, permitting the development of hybrids at a short term. The inbreeding depression values (Table 4) indicated that the use of hybrids from lines with intermediate inbreeding levels in these two populations is easeable. Lines with smaller inbreeding levels, such as the use of half-sib lines should be used. Half-sib lines showing minimal inbreeding depression values scored close to the population mean in the BR 105 population case and 24,0 6% above the population mean in the ESALQ-PB 4 population case. Four half-sib lines from ESALQ-PB 4 population were higher yielding than the population itself (data not shown).

Because there are generally no significant deviations from the linear model, the effects of epistasis on inbreeding depression do not seem to be important. All the breeding studies relating mean performance to level of heterozygosity seemed to be adequately described by a genetic model that includes only additivity of unliked loci effects (Good and Hallauer, 1977; Hallauer and Miranda Filho, 1981). Statistically significant differences that favors a less severe inbreeding system with a smaller inbreeding depression, measured by the coefficient of regression of generation means on the inbreeding coefficent (F) have been reported (Cornelius and Dudley, 1974; Obilana and Hallauer, 1974; Rice and Dudley, 1974; Bartual and Hallauer, 1976; Good and Hallauer, 1977; Hallauer and Miranda Filho, 1981). Thus, the comparison of inbreeding depression rates including half-sib lines, wich presented lower inbreeding level than full-sib and selfing lines, is a useful procedure to predict the effects of additional inbreeding in half-sib lines. For grain yield the inbreeding depression rates / 1% of expected homozigosity were similar among the three groups of lines for both populations (Table 4). Thus, the observed data indicated no advantage of yield in half-sib lines when compared with full-sibing or selfing to a similar inbreeding level.

The level of inbreeding depression for a trait is directly proportional to the level of dominance of the loci involved in its manifestation (Falconer, 1987). Inbreeding depression, which was higher for grain yield (Table 4) in relation to the other traits studied (Table 5), indicated higher level of dominance for this trait, agreeing with other reports (Jones 1939; Hallauer and Sears, 1973; Good and Hallauer, 1977), except for percentage of stalk lodged plants, percentage agreeing of root lodged plants, and percentage of ears with husk problems. For ears / plant, plant height, and ear height the inbreeding depression was lower for half-sib lines in comparison with full-sib and selfing ones, in agreement with its lower inbreeding coefficient. For days to pollen shed (DPS) and days to silk emergence (DSE) the inbreeding depression estimates were small in magnitude in the three systems and didn´t suggest important differences among them.

Since inbreeding is involved, the estimates of the additive component of genetic variance wasn’t available, unless restrictions were imposed either on gene frequency or the genetic model (Hallauer and Miranda Filho, 1981). The genetic paramaters estimated in this work are useful to test if a less severe inbreeding system would be more suitable to select more vigorous inbred lines. For both populations, the estimates of genetic parameters were similar between full-sib crosses and selfing (Tables 6 and 7). Due to the low mean squares values observed for percentage of root lodged plants in S_1 lines from BR 105 population and days to silk emergence and percentage of root lodged plants in full-sib lines from ESALQ-PB 4 population, the estimates of genetic variances obtained were negative. For practical purpose, differences in extracting lines would occur only for percentage of stalk lodged plants in the BR 105 population, since full-sib lines showed higher estimates than S_1 lines. However, the advantage of full-sib crosses to extract lines with better stalk quality was unclear because this trait mean was significantly higher for full-sib than for S_1 lines.

In terms of means and genetic variability our results indicated that there would be no advantage for lines developed by full-sib mating in relation to selfing, with a comparable inbreeding level. This is in agreement with previous reports on non-tropical maize populations (Cornelius and Dudley, 1974; Good and Hallauer, 1977). Then, the main reason for use of milder systems of inbreeding remains the enhanced opportunity for selection enhanced due a less rapid fixation of alleles. The advantages of selfing to develop inbred lines are obvious. Three generations of full-sib matings and six generations of half-sib matings, are needed to produce the same level of inbreeding than one generation of self-fertilization. In view of large inbreeding depression showed by brazilian tropical populations, it seems more reasonable to allocate resources and time in breeding source populations that would increase the probability of extraction of more vigorous inbred lines. In this sense the intrapopulational recurrent selection have been effective (Lamkey and Smith, 1987; Marques, 1988; Eyherabide and Halluer, 1991). According to Vasal et al. (1995a, 1995b) recurrent selection using selfed progeny has attained improved yield and reducing inbreeding depression in tropical maize populations.

Tabel 1 - Pooled analysis of variance for grain yield (GY), ears / plant (EP), plant height (PH), ear height (EH), days to pollen shed (DPS), days to silk emergence (DSE), percentage of stalk lodged plants (SLP% - arc sine $\sqrt{\%}$), percentage of root lodged plants (RLP% - arc sine $\sqrt{\%}$), and percentage of ears with husk problems (EHP% - arc sine $\sqrt{\%}$), for the BR 105 maize population.

Source of Variation	Mean Squares									
	D.F.	GY	EP	PH	EH	DPS	DSE	SLP%	RLP%	EHP%
Experiments	3	—	—	—	—	—	—	—	—	—
FS/Exp.	51	1.842**	0.136*	0.088**	0.050	2.007**	2.270	0.028*	0.056**	0.050**
S_1/Exp.	49	2.609**	0.186**	0.048*	0.046**	1.911*	2.308	0.014	0.025	0.044**
FSxS_1/Exp.	4	1.225**	0.020	0.301*	0.111**	6.874*	7.982**	0.015	0.074	0.070
Treatments	104	1.835**	0.135**	0.069**	0.047**	1.934**	2.970	0.022	0.037**	0.052**
Error [1/]	304	0.478	0.089	0.033	0.020	1.247	2.427	0.020	0.023	0.019
General mean		3.331	1.151	1.88	0.96	58.34	61.29	0.109	0.200	0.109
C.V. (%)		20.94	25.89	9.68	14.84	1.91	2.54	130.01	75.91	127.83

[1/] (GY) D.F.= 285, (DPS) and (DSE) D.F.= 289.
*, ** Significant at the 0.05 and 0.01 probability levels, respectively, according to the F test.

Tabel 2 - Pooled analysis of variance for grain yield (GY), ears / plant (EP), plant height (PH), ear height (EH), days to pollen shed (DPS), days to silk emergence (DSE), percentage of stalk lodged plants (SLP% - arc sine $\sqrt{\%}$), percentage of root lodged plants (RLP% - arc sine $\sqrt{\%}$), and percentage of ears with husk problems (EHP% - arc sine $\sqrt{\%}$), for the ESALQ-PB4 maize population.

Source of Variation	Mean Squares									
	D. F.	GY	EP	PH	EH	DPS	DSE	SLP%	RLP%	EHP%
Experiments	3	---	---	---	---	---	---	---	---	---
FS/Exp.	34	0.729**	0.071*	0.036	0.036	1.666**	1.515	0.008	0.110**	0.059**
S_1/Exp.	53	0.897**	0.096**	0.045	0.038	1.360**	2.262**	0.025**	0.079**	0.047**
FSxS_1/Exp.	3	0.994**	0.046	0.132*	0.064	0.965	0.871	0.005	0.040	0.065
Treatments	117	1.334**	0.127	0.054	0.040	1.568**	1.822**	0.018	0.085**	0.047**
Error [1/]	234	0.338	0.045	0.035	0.029	0.946	1.224	0.012	0.034	0.029
General mean		2.248	0.954	2.06	1.16	60.60	63.41	0.055	0.494	0.118
C.V. (%)		25.86	22.29	9.14	14.68	1.60	1.74	199.40	37.31	144.42

[1/] (GY) D.F.= 213, (PH) D.F.= 201, (EH) D.F.= 216, (DPS) D.F.= 201 e (DSE) D.F.= 219.
*, ** Significant at the 0.05 and 0.01 probability levels, respectively, according to the F test.

Tabel 3 - General means for full-sib and S_1 lines in the BR 105 and ESALQ-PB 4 maize populations.

Trait	Line	Population BR 105	ESALQ-PB 4
Grain yield (ton/ha)	FS	2.975 a	1.874 a**
	S_1	3.030 a	2.079 b
Ears / plant	FS	1.14	0.92
	S_1	1.12	0.92
Plant height (m)	FS	1.78 a*	2.00 a
	S_1	1.89 b	2.04 a
Ear height (m)	FS	0.91 a*	1.12
	S_1	0.97 b	1.14
Days to pollen shed	FS	58.15 a**	60.52
	S_1	58.71 b	60.58
Days to silk emergence	FS	61.12 a**	63.36
	S_1	61.63 b	63.39
Percentage of root lodged plants	FS	3.80	1.11
	S_1	2.78	1.85
Percentage of stalk lodged plants	FS	9.24 a*	29.13
	S_1	6.18 b	25.22
Percentage of ears with husk problems	FS	3.77	4.61
	S_1	3.29	5.44

General means followed by different letters in the same column are significantly different at the 0.05 (*) and 0.01 (**) probability levels, respectively, according to the t test.

Tabel 4 - Grain yield inbreeding depression and inbreeding depression rates / 1% of expected homozigosity for full-sib, S_1 and half-sibs lines in the BR 105 and ESALQ-PB 4 maize populations.

Population	Group	Inbreeding depression (%)			Depression rate	
		Mean	Minimal	Maximum	t/ha	g/plant
BR 105	FS	-52.21	-27.41	-85.12	-0.06	-1.56
	S_1	-51.34	-13.26	-74.01	-0.06	-1.53
	HS	-35.34	-07.87	-71.61	-0.07	-1.72
ESALQ-PB 4	FS	-53.95	-28.79	-78.71	-0.04	-1.06
	S_1	-48.89	-16.15	-78.87	-0.04	-0.96
	HS	-29.37	+24.06	-54.46	-0.04	-0.94

Tabel 5 - Inbreeding depression for S_1, full-sib (FS) and half-sib (HS) lines, in the BR 105 (BR) and ESALQ-PB 4 (ES) maize populations, for ears / plant (EP), plant height (PH), ear height (EH), days to pollen shed (DPS), days to silk emergence (DSE), percentage of root lodged plants (RLP%), percentage of stalk lodged plants (SLP%), percentage of ears with husk problems (EHP%).

	TRAIT / POPULATION															
	EP		PH		EH		DPS		DSE		RLP%		SLP%		EHP%	
Group	BR	ES	BR	ES	BR	ES	BR	ES	BR	ES	BR	ES	BR	ES	BR	ES
FS	-1.9	-17.5	-12.9	- 6.2	-12.9	-11.7	-0.06	+1.20	+0.10	+1.10	-29.7	+17.5	+41.9	+35.1	+469	-23.2
S_1	-3.8	-17.9	- 7.6	-4.5	- 6.5	- 9.9	+0.89	+1.50	+0.94	+1.10	-48.6	+96.1	-5.0	+16.7	+398	-9.4
HS	+2.0	-5.5	-5.0	+1.1	-4.4	-4.0	-0.09	+1.70	+0.04	+1.40	-37.9	+109	+0.3	-21.4	+633	-57.1

Tabel 6 - Genetic variances (ó^2_g), heritabilites (h^2%), genetic coefficient of variation (C.V.$_g$ %), variation index (b) for full-sib (FS) and S_1 lines, in the BR 105 maize population, for grain yield (GY), ears / plant (EP), plant height (PH), ear height (EH), days to pollen shed (DPS), days to silk emergence (DSE), percentage of root lodged plants (RLP% - arc sine Ö%), percentage of stalk lodged plants (SLP% - arc sine Ö%), percentage of ears with husk problems (EHP% - arc sine Ö%).

	ó^2_g [1/]		h^2 %		C.V.$_g$ %		b	
Trait	FS	S_1	FS	S_1	FS	S_1	FS	S_1
GY(t/ha)	435,10±116,3	373,60±106,5	73,11±5,66	70,01±6,41	22,10	20,11	0,95	0,88
EP	15,71±9,12	32,34±12,50	34,66±13,75	52,21±10,22	10,96	16,01	0,42	0,60
PH	18,38±5,79	5,06±3,31	62,46±7,90	31,43±14,67	7,57	3,74	0,74	0,39
EH	9,92±3,29	8,67±3,10	59,45±8,53	56,16±9,38	10,94	9,50	0,70	0,65
DPS	250,10±141,4	204,67±135,2	35,58±13,55	31,13±14,73	0,86	0,77	0,43	0,39
DSY	107,92±201,0	236,53±228,6	11,12±18,70	21,52±16,79	0,54	0,79	0,20	0,30
RLP%	2,70±1,90	-2,18±1,04	28,72±15,00	-	47,15	-	0,37	-
SLP%	10,87±3,66	0,52±1,74	58,59±8,71	6,39±20,02	44,62	12,83	0,69	0,15
EHP%	10,25±3,29	8,22±2,96	61,29±8,14	55,96±9,42	95,12	97,57	0,73	0,65

[1/] Values multiplied by 10^3

Tabel 7 - Genetic variances ($ó^{2}_{g}$), heritabilites (h^2), genetic coefficient of variation ($C.V._{g}$), variation index (b) for full-sib (FS) and S_1 lines, in the ESALQ-PB 4 (ES) maize population, for grain yield (GY), ears / plant (EP), plant height (PH), ear height (EH), days to pollen shed (DPS), days to silk emergence (DSE), percentage of root lodged plants (RLP% - arc sine Ö%), percentage of stalk lodged plants (SLP% - arc sine Ö%), percentage of ears with husk problems (EHP% - arc sine Ö%).

	$ó^{2}_{g}$ [1/]		h^2 %		$C.V._{g}$ %		b	
Trait	FS	S_1	FS	S_1	FS	S_1	FS	S_1
GY(t/ha)	125,04±57,80	177,09±56,90	51,90±12,17	60,44±8,38	18,89	20,11	0,60	0,71
EP	8,54±5,74	16,83±6,20	36,19±16,15	52,76±10,00	10,01	14,07	0,43	0,61
PH	2,73±3,84	2,87±3,21	17,62±20,85	18,36±17,29	2,60	2,63	0,27	0,27
EH	2,80±3,03	3,45±2,62	22,77±19,54	26,64±15,53	4,68	5,11	0,31	0,35
DPS	149,80±125,7	139,84±101,08	29,15±17,93	27,75±15,30	0,64	0,62	0,37	0,36
DSE	-25,75±105,6	299,68±146,6	-	40,55±12,59	-	0,86	-	0,48
RLP%	-1,24±0,75	4,43±1,65	-	52,49±10,06	-	117,26	-	0,61
SLP%	25,25±8,68	14,98±5,12	69,05±7,83	56,96±9,11	29,19	24,22	0,86	0,66
EHP%	9,91±4,70	6,04±3,13	50,59±12,50	38,40±13,04	89,97	57,66	0,58	0,46

[1/] Values multiplied by 10^3

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RESUMO

Comparação entre sistemas de autofecundação em milho

A utilização de sistemas de endogamia menos drásticos que a autofecundação tem sido sugerida como forma de obter linhagens mais vigorosas de milho (Zea mays L.). Com o objetivo de comparar diferentes sistemas de endogamia, no ano agrícola de 1990/91 foram avaliados nove caracteres em linhagens obtidas por cruzamento entre irmãos germanos (F = 0,5), por autofecundação (F = 0,5) e por cruzamento entre meios-irmãos (F = 0,305) a partir das populações BR 105, um sintético de base genética estreita, e ESALQ-PB 4, um composto de base genética ampla. A comparação entre médias e parâmetros genéticos não mostrou vantagens importantes das linhagens desenvolvidas por cruzamenots entre irmãos germanos sobre a autofecundação. Para o caráter peso de grãos, os valores de depressão por endogamia foram similares entre estes dois grupos de linhagens e inferiores para as linhagens de meios-irmãos, enquanto as taxas de depressão por endogamia / 1% de homozigose esperada foram similares entre os três sistemas. Concluiu-se que, em vista da elevada depressão por endogamia apresentada pelas populações de milho tropical trabalhadas no Brasil, parece mais razoável alocar recursos e tempo no melhoramento de populações do que na utilização de formas moderadas de endogamia.

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