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INTROGRESION OF HETEROTIC SEGMENT IN AN INBRED LINE OF MAIZE (*ZEA MAYS L.*)

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ABSTRACT

In order to increase the efficiency in the production of maize hybrids seeds it is necessary high grain yield with a relative low cost of production. It needs an expansion of the basic knowledge of the heredity of the characters that may be developing new breeding technique.
The balanced lethal system (BLS) permit to study the relative contribution of different chromosome segments to hybrid vigour due to the heterocigozity of certain chromosome segments while the rest of the genome go to homocigozity for continuous selfing . In this way, theses segments can be transfer to inbreed lines in order to increase the grain yield and tassel size with pollen production.
The objective of this work was to transfer heterotic segments of a line regulated by a balanced lethal system (BLS), through crossing and backcrosses, to an inbred line derivate of a commercial hybrids ACA 2000 of closs pedigree, with the finality of increase the grain yield or pollen production.
The variance analysis and principal components showed a significance improvement in the grain yield and tassel size with pollen production in the inbred lines, with the heterotic segment of the BLS line.

INTRODUCTION

In order to increase the efficiency in the production of maize hybrids seeds it is necessary high grain yield with a relative low cost of production. It is very important to have inbred lines with high grain yield in order to do the single hybrid in maize (D. Duvick, 1977,1996,1999,2001). It needs an expansion of the basic knowledge of the heredity of the characters that may be developing new breeding technique.
The knowledge of quantitative genetics and the aplications in plant breeding was well documented (Falconer,1981; Hallauer and Miranda,1981; Wallace, 1970; Mather and Jinks,1971; Harth, 1980; Gallais, 1990; Russell, 1991; Wright, 1968,1969,1977,1978 and Carson,1967).

The developed of teoretical quantitative genetics models using mendelian concept in genetics, started with the Works of Cockerham (1954) and Kempthorne (1954) on epistasis and the work of Schnell (1963) on linkage. The genetics models for the estimation of genetics parameters and desing of coupling was developed by Comstock and Robinson (1948, 1952); Griffing (1956); Cockerham (1963); Gardner and Eberhart (1968) and others.
The hybrid vigor in maize, was considered one of the mayor innovation in XX century.
The heterosis studies is showing that colud be explained by the result of different combination of aleles of a gen due to the interaction of those genes (Whaley, 1964; Stuber, 1994; Stuber et.al., 1992; Gustafsson, 1946).

The overdominance hipótesis was explained between 1940 and 1950 (Crow, 1999). Nevertheless the general acceptance of dominance hypothesis, studies of fenotipic estimations and molecular markers (QTLs) for grain yield, showed overdominance (Lu et al, 2002; 2003).

The important o f dominant effect was recently confirmed for a high significance correlation between the level of heterozygisity and the fenotipic stability, especialy for grain yield. Some chromosomic regions presented QTLs of overdominance for seedling weight, plant heigh, number of kernels per plant and yield, suggesting pleiotropic effect on plant vigor (Frascaroli et al, 2007).

Dijkhuizen (1996), find that after the F2 of open polination maize for 4 generations by random, only 38 of 95 original markers of QTL linked for the grain component, stay significantly in the population.

Birgham (1998), find this effect as parcial to complete dominante.

The study of genetic load in maize population was considered at the Instituto de Genética, finding balanced lethal system (BLS), linked to high grain yield, Salerno (1981, 1984, 1986,1989, 1994, 1997, 1998,1999, 2000, 2001,2007); Robredo y otros (1997); Boggio et. al (1997).

The balanced lethal system (BLS) permit to study the relative contribution of different chromosomic segment to the hyrbid vigor.

THe intogresion of this systems in inbred lines with a good combinig ability, but loud grain yield or production of pollen, would be improvemento. The problem of linkage between lethal gen and other growh factors, as this kina of lethals is distribuited in different chromosome in maize, the selection against the letal recessive genes in a breeding program, remove favorables genes thata were in the same chromosome (Lindstrom (1920), Wentz and Goodsell (1929), Gustafsson (1946, 1947, 1953), Allard et al (1964), Band et al (1961, 1963), Jones (1945, 1952), Redei (1962), Apirion et al (1961).

In this work, it was studied the contribution of three balanced segment in an inbred line of maize of clossed pedigree, through the variance biometric analysis, consider de variables that involve the efficience of lines in the production of maize single hybrid.

The evaluation of principal component (CP1 and CP2) was made for a well variable component. Also, it was considered the correlation matriz coeficient; correlation matriz probability; selfvalio; self vectors for e1 and e2 and the correlations with the originals variable and the corresponding cofenetic correlation, through the multivariate analysis (Infostat,2004). The biplot graphic (Gabriel, 1971) permit to see the observations and variables in a minimun space, definning asociations between them.

MATERIALS AND METHODS

It was used an inbred line of maize of the Instituto de Genética, Argentina, that have a balance letal system with heterotic segment, denominated LPBLS14, that was crossed with a normal inbred line derivated of the single commercial hybrid ACA2000 (LMACA2000) of closed pedigree. The cross was made by hand, using the normal inbred lines as a female. In the next three generations, it was made de backcrosses one, two three, to the normal inbred line (LMACA2000).

After that it was evaluated the variables involved in a complete block design trials, with three replications.

It was made the variance statistic análisis, and the principal component using Infostat system (Infostat,2004) of the line LMACA2000, Line LPBLS14-F1-R1-R2-R3, involved the matriz of correlation/Coefficient; matriz of correlation/ Probabilities; selfvalue; selfvectors and Correlations with the original variables and cofenetics, for the variables grain yield in kg/ha (KG/HA), ear lenght in mm.(LE), 100 kernells weight in grams (P100K), Number of grain ear row (NH), grain deepht (TG) and cob percentaje in % (%MARLO) in a one way; and in other way, the variables plant height in cm. (HP), ear inserction height in cm. (HE), tassel lenght in mm. (LP) and number of tassel Branch (NRP).

RESULTS AND DISCUSSION

The table 1 showed the variance analysis for grain yield variable in kg/ha for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: Grain yield (KGHA)

Variable	N	R^2	R^2 Aj	VC
KGHA	18	0,97	0,95	9,00

F.V.	CS	gl	MC	F	p-value
Model	123964094,39	7	17709156,34	48,66	<0,0001
TREAT	119475684,28	5	23895136,86	65,66	<0,0001
REP	4488410,11	2	2244205,06	6,17	0,0180
Error	3639472,56	10	363947,26		
Total	127603566,94	17			

Test:Tukey Alfa:=0,05 MSD:=1710,86978. *Error: 363947,2556 gl: 10*

TABLE 1.- Variance analysis for line LMACA2000-line LPBLS14-F1-R1-R2-R3

TREAT	Means	n				
F1	9546,33	3	A			
R1	8407,00	3	A	B		
R2	8010,00	3	A	B		
R3	7737,00	3		B		
LPBLS14	4365,00	3			C	
LMACA2000	2165,00	3				D

Same letters indicate significance differences (p<= 0,05)

TABLE 2.- Grain yield for line LMACA2000-line LPBLS14-F1-R1-R2-R3.

It was observed that the grain yield of the backcrosses was significance higher than the line LMACA2000 *per-se*

The table 3 showed the variance analysis for ear length in mm. for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: EAR LENGHT IN mm.(LE)

Variable	N	R^2	R^2 Aj	VC
LE	18	0,64	0,39	11,09

F.V.	CS	gl	MC	F	p-value
Model	7740,17	7	1105,74	2,56	0,0867
TREAT	7135,83	5	1427,17	3,30	0,0511
REP	604,33	2	302,17	0,70	0,5201
Error	4326,33	10	432,63		
Total	12066,50	17			

Test:Tukey Alfa:=0,05 DMS:=58,98719. *Error: 432,6333 gl:10*

TABLE 3.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 4 showed the ear lenght and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
R1	216,33	3	A	
F1	208,33	3	A	
R2	187,67	3	A	
R3	183,67	3	A	
LPBL14	169,00	3	A	
LMACA2000	160,00	3		A

Same letters indicate significance differences (p<= 0,05)

TABLE 4.- Ear lenght in mm. for line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

The ear lenght of backcrosses was higher than the line LMACA2000 *per-se*.

The table 5 showed the variance analysis for 100 kernells weight in grams, for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: 100 KERNELLS WEIGHT IN GR. (P100K)

Variable	N	R^2	R^2 Aj	CV
P100K	18	0,91	0,86	8,38

F.V.	SC	gl	MC	F	p-value
Model	784,22	7	112,03	15,37	0,0001
TREAT	778,44	5	155,69	21,36	<0,0001
REP	5,78	2	2,89	0,40	0,6829
Error	72,89	10	7,29		
Total	857,11	17			

Test:Tukey Alfa:=0,05 MSD:=7,65647. *Error: 7,2889 gl: 10*

TABLE 5.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 6 showed the 100 kernells weight and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
F1	40,00	3	A	
R2	38,00	3	A	
R3	35,00	3	A	
R1	33,33	3	A	
LMACA2000	25,00	3		B
LPBL14	22,00	3		B

Same letters indicate significance differences (p<= 0,05)

TABLE 6.- 100 kernells weight in gr., for the line LMACA2000-line LPBLS14-F1-R1-R2-R3.

It was observed that the 100 kernells weight in gr. of the backcrosses was significance higher than the line LMACA2000 *per-se*.

The table 7 showed the variance analysis of Number of grain ear row, for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: NUMBER OF GRAIN EAR ROW (NH)

Variable	N	R²	R² Aj	CV	
NH	18	0,70	0,49	7,82	
F.V.	SC	gl	MC	F	p-value
Model	28,00	7	4,00	3,33	0,0419
TREAT	26,67	5	5,33	4,44	0,0216
REP	1,33	2	0,67	0,56	0,5905
Error	12,00	10	1,20		
Total	40,00	17			

Test:Tukey Alfa:=0,05 MSD:=3,10662.*Error: 1,2000 gl:10*

TABLE 7.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 8 showed the number of grain ear row and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
R1	16,00	3	A	
R2	14,67	3	A	B
LMACA2000	14,00	3	A	B
F1	14,00	3	A	B
R3	13,33	3	A	B
LPBL14	12,00	3		B

Same letters indicate significance differences (p<= 0,05)

TABLE 8.- Number of grain ear row, for the line LMACA2000- line LPBLS14-F1-R1-R2-R3.

It was observed that The number of ear row of the backcrosses R1 and R2, was higher than the line LMACA2000 *per-se* and the R3 was less than the same line.

The table 9 showed the variance análisis of Grain deepht (TG), for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: GRAIN DEEPHT IN mm. (TG)

Variable		N	R²	R² Aj	VC
TG		18	0,91	0,84	10,75
F.V.	CS	gl	MC	F	p-value
Model	277,06	7	39,58	13,86	0,0002
TREAT	264,94	5	52,99	18,56	0,0001
REP	12,11	2	6,06	2,12	0,1707
Error	28,56	10	2,86		
Total	305,61	17			

Test: Tukey Alfa:=0,05 MSD:=4,79229. *Error: 2,8556 gl: 10*

TABLE 9.-Variance Analysis for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

The table 10 showed the grain deepht and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
F1	20,33	3	A	
R3	19,33	3	A	
R1	17,33	3	A	
R2	16,00	3	A	
LPBL14	11,00	3		B
LMACA2000	10,33	3		B

Same letters indicate significance differences (p<= 0,05)

TABLE 10.- Grain deepht in mm., for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that The grain deepht of the backcrosses R1, R2 and R3, was higher than the line LMACA2000 *per-se*.

The table 11 showed the variance analysis of Cob percentaje in %, for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: COB PERCENTAJE IN %

Variable	N	R²	R² Aj	VC	
%COB	18	0,88	0,79	13,10	
F.V.	CS	gl	MC	F	p-value
Model	309,50	7	44,21	10,28	0,0007
TREAT	299,17	5	59,83	13,91	0,0003
REP	10,33	2	5,17	1,20	0,3407
Error	43,00	10	4,30		
Total	352,50	17			

Test: Tukey Alfa:=0,05 MSD:=5,88074. *Error: 4,3000 gl:10*

TABLE 11.- Variance Análisis for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

The table 12 showed the cob percentaje and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n			
LMACA2000	23,33	3	A		
R2	18,00	3	A	B	
R3	15,67	3		B	C
R1	15,00	3		B	C
LPBL14	12,00	3			C
F1	11,00	3			C

Same letters indicate significance differences (p<= 0,05)

TABLE 12.- Cob porcentaje for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that the cob porcentaje was of the backcrosses R1, R2 and R3, was minor than the line LMACA2000 *per-se*.

The table 13 showed the variance analysis of Plant height in cm. (HP), for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

***Variable:* PLANT HEIGHT IN cm..(HP)**

Variable	N	R²	R² Aj	VC
HP	18	0,93	0,88	3,88

F.V.	CS	gl	MC	F	p-value
Model	8076,33	7	1153,76	18,99	0,0001
TREAT	8042,00	5	1608,40	26,47	<0,0001
REP	34,33	2	17,17	0,28	0,7597
Error	607,67	10	60,77		
Total	8684,00	17			

Test: Tukey Alfa:=0,05 MSD:=22,10703.*Error: 60,7667 gl:10*

TABLE 13.- Variance Análisis for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

The table 14 showed the Plant height and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n			
F1	235,67	3	A		
R1	213,33	3		B	
LPBL14	211,33	3		B	
R3	186,67	3			C
R2	179,67	3			C
LMACA2000	177,33	3			C

Same letters indicate significance differences (p<= 0,05)

TABLE 14.- Plant height in cm. for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that the plant height was of the backcrosses R1, R2 and R3, was higher than the line LMACA2000 *per-se*.

The table 15 showed the variance analysis of ear inserction height in cm. (HE), for the line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: EAR INSERCTION HEIGHT IN CM. (HE)

Variable	N	R²	R² Aj	VC
HE	18	0,97	0,95	5,03

F.V.	CS	gl	MC	F	p-value
Model	7119,06	7	1017,01	50,88	<0,0001
TREAT	7014,94	5	1402,99	70,19	<0,0001
REP	104,11	2	52,06	2,60	0,1229
Error	199,89	10	19,99		
Total	7318,94	17			

Test: Tukey Alfa:=0,05 MSD:=12,67921.*Error: 19,9889 gl:10*

TABLE 15.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 16 showed the ear inserction height and the respective Tukey test, for determine the statistic differences.Análisis de la Variancia para la Línea LMACA2000-Línea LPBLS14-F1-R1-R2-R3

TREAT	Means	n			
F1	120,33	3	A		
R1	106,33	3		B	
LPBL14	94,33	3		B	
R2	74,67	3			C
R3	72,33	3			C
LMACA2000	65,67	3			C

Same letters indicate significance differences (p<= 0,05)

TABLE 16.- Ear inserction height in cm. for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that the ear inserction height of the backcrosses R1, R2 and R3, was higher than the line LMACA2000 *per-se*.

The table 17 showed the variance analysis of tassel lenght in mm. (LP) for line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: TASSEL LENGHT IN mm. (LP)

Variable	N	R²	R² Aj	VC
LP	18	0,73	0,54	8,33

F.V.	CS	gl	MC	F	p-value
Model	23893,56	7	3413,37	3,88	0,0265
TREAT	21746,44	5	4349,29	4,94	0,0155
REP	2147,11	2	1073,56	1,22	0,3360
Error	8807,56	10	880,76		
Total	32701,11	17			

Test: Tukey Alfa:=0,05 MSD:=84,16382. *Error: 880,7556 gl:10*

TABLE 17.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 18 showed the tassel lenght and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
F1	389,67	3	A	
R3	382,33	3	A	
R2	370,67	3	A	B
LPBL14	368,00	3	A	B
R1	340,00	3	A	B

Same letters indicate significance differences (p<= 0,05)

TABLE 18.- Tassel lenght for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that the tassel lenght of the backcrosses R1, R2 and R3, was higher than the line LMACA2000 *per-se*.

The table 19 showed the variance analysis of number of tassel Branch (NRP) for line LMACA2000 *per-se*, line LPBLS14 *per-se*, F1 and backcrosses R1, R2, R3.

Variable: **NUMBER OF TASSEL BRANCH (NRP).**

Variable		N	R²	R² Aj	VC
NRP		18	0,71	0,50	12,44
F.V.	CS	gl	MC	F	p-value
Model	163,06	7	23,29	3,43	0,0385
TREAT	135,61	5	27,12	4,00	0,0298
REP	27,44	2	13,72	2,02	0,1831
Error	67,89	10	6,79		
Total	230,94	17			

Test: Tukey Alfa:=0,05 DMS:=7,38919. *Error: 6,7889 gl:10*
TABLE 19.- Variance analysis for line LMACA2000-line PBLS14-F1-R1-R2-R3

The table 20 showed the number of tassel Branch and the respective Tukey test, for determine the statistic differences.

TREAT	Means	n		
F1	26,00	3	A	
LPBL14	22,00	3	A	B
R3	21,00	3	A	B
R2	20,33	3	A	B
R1	19,33	3	A	B
LMACA2000	17,00	3		B

Same letters indicate significance differences (p<= 0,05)
TABLE 20.- Number of tassel Branch for Line LMACA2000-Line LPBLS14-F1-R1-R2-R3.

It was observed that the number of tassel Branch of the backcrosses R1, R2 and R3, was higher than the line LMACA2000 *per-se*.

In addition , it was made the principal component using Infostat system (Infostat,2004) of the line LMACA2000, Línea LPBLS14-F1-R1-R2-R3, involved the matriz of correlation/Coefficient; matriz of correlation/Probabilities; selfvalue; selfvectors and Correlations with the original variables and cofenetics, for the variables grain yield in kg/ha (KG/HA), ear lenght in mm.(LE), 100 kernells weight in grams (P100K), Number of grain ear row (NH), grain deepht (TG) and cob percentaje in % (%MARLO) in a one way, showed in table 21 a,b,c,d,e; and in other way, the variables plant height in cm. (HP), ear inserction height in cm. (HE), tassel lenght in mm. (LP) and number of tassel Branch (NRP), showed in table 22 a,b,c,d,e.

Matriz of correlation/Coefficient

	KGHA	P100K	%MARLO	TG	LE	NH
KGHA	1,00					
P100K	0,85	1,00				
%MARLO	-0,53	-0,20	1,00			
TG	0,82	0,77	-0,54	1,00		
LE	0,64	0,53	-0,20	0,43	1,00	
NH	0,35	0,42	0,20	0,22	0,51	1,00

TABLE 21a.- Matriz of correlation and coefficient for the variables KGHA, P100K, %MARLO, TG, LE, NH

Matriz of correlation/Probabilities

	KGHA	P100K	%MARLO	TG	LE	NH
KGHA						
P100K	<0,0001					
%MARLO	0,0229	0,4288				
TG	<0,0001	0,0002	0,0219			
LE	0,0040	0,0237	0,4296	0,0766		
NH	0,1512	0,0817	0,4212	0,3869	0,0319	

TABLE 21b.- Matriz of correlation and probabilities for the variables KGHA, P100K, %MARLO, TG, LE, NH.

Selfvalues

Lambda	Value	Proportion	Prop Acum
1	3,46	0,58	0,58
2	1,36	0,23	0,80
3	0,58	0,10	0,90
4	0,37	0,06	0,96
5	0,17	0,03	0,99
6	0,06	0,01	1,00

TABLE 21c.- Self values for the variables KGHA, P100K, %MARLO, TG, LE, NH.

Selfvectors

Variables	e1	e2
KGHA	0,52	-0,09
P100K	0,47	0,10
%MARLO	-0,26	0,65
TG	0,47	-0,23
LE	0,39	0,28
NH	0,26	0,66

TABLE 21d.- Self vectors for the variables KGHA, P100K, %MARLO, TG, LE, NH.

Correlations with original variables

Variables	CP 1	CP 2
KGHA	0,96	-0,11
P100K	0,88	0,12
%MARLO	-0,49	0,75
TG	0,87	-0,27
LE	0,73	0,33
NH	0,48	0,76

Cofenetic correlation = 0,968

TABLE 21e.- Correlations with the original variables and the cofenetic correlation for the variables KGHA, P100K, %MARLO, TG, LE, NH.

In the figure 1 it was showed the biplot of the relation between the genotypes and genotipos and the original variables.

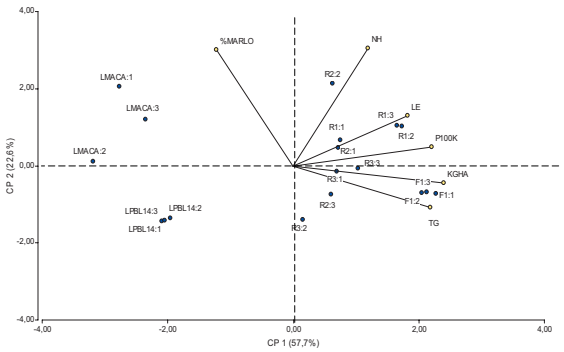

Fig. 1.-: biplot of relation between the genotypes and the variables KGHA, P100K, %MARLO, TG, LE, NH.

The principal component CP1 y CP2 explained 80% of the datum variability. It was found significance positive correlation between grain yield (KGHA), ear lenght in mm.(LE),100 kernells weight in grams (P100K) and grain deepht (TG), meanwhile the KGHA and TG was correlations in a negative form withn %MARLO. In addition, it was observed no correlation between KGHA and NH.

The variables KGHA, P100K, TG and LE were asociated to CP1, meanwhile NH and %MARLO were associated to CP2.

In other way, it was analysed the principal component of the variables plant height in cm. (HP), ear inserction height in cm. (HE), tassel lenght in mm. (LP) and number of tassel Branch (NRP), showed in table 22 a,b,c,d,e.

Matriz of correlation/Coefficient

	HP	HE	LP	NRP
HP	1,00			
HE	0,95	1,00		
LONPANOJA	0,29	0,27	1,00	
NRAMIPANO	0,60	0,51	0,58	1,00

TABLE 22a.- Matriz of correlation and coefficient fo the variables HP HE LP and NRP.

Matriz of correlation/Probabilities

	HP	HE	LP	NRP
HP				
HE	<0,0001			
LP	0,2452	0,2811		
NRP	0,0086	0,0289	0,0125	

TABLE 22b.- Matriz of correlation and probabilities for the variables HP HE LP and NRP.

Selfvalues

Lambda	Value	Proportion	Prop Acum
1	2,64	0,66	0,66
2	0,96	0,24	0,90
3	0,36	0,09	0,99
4	0,04	0,01	1,00

TABLE 22c.- Self values for the variables HP HE LP NRP.

Selfvectors

Variables	e1	e2
HP	0,56	-0,38
HE	0,54	-0,42
LP	0,36	0,75
NRP	0,50	0,34

TABLE 22d.- Selfvectors for the variables HP HE LP NRP.

Correlations with the original variables

Variables	CP 1	CP 2
HP	0,92	-0,37
HE	0,88	-0,42
LP	0,59	0,74
NRP	0,82	0,33

Correlation coffenetic= 0,984

TABLE 22e.- Correlations with the original variables and the cofenetic correlation for the variables HP HE LP NRP.

In the figure 2 it was showed the biplot of the relation between the genotypes and genotipos and the original variables.

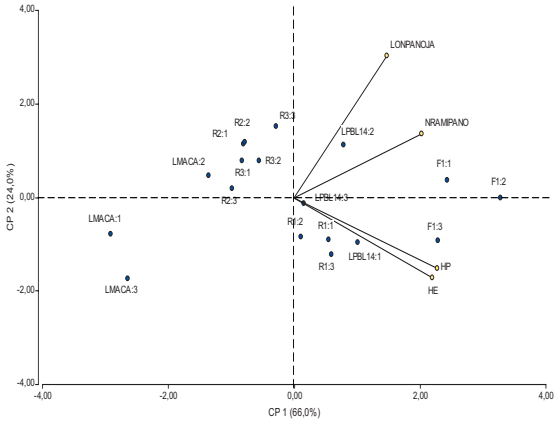

Fig. 2.-: biplot of relation between the genotypes and the variables HP HE LP NRP.

It was showed that the principal component CP1 and CP2 explained 90% of the datum variability. It was found the significance positive correlation between the plant height (HP) and ear inserction height (HE), and between the tassel lenght in mm. (LP) and number of tassel Branch (NRP). It was no correlation between the variables HP-HE and LP. The variables HP, HE and NRP were associated in a positive way to CP1, meanwhile the LP was associated in a positive way to CP2.

These results showed the importance of detection of quantitative traits loci, that involve the heterosis effect in maize, as was demostrated bay Stuber et. al, 1992; Graham et al, 1997).

CONCLUSION

In the research presented here, it was observed a high grain yield, and yield component in the backcrosses of the inbred line LMACA2000, with the introgresion of the heterotic chromosome segment of the line LPBLS14. The classical quantitative genetic analyse revealed a high level of heterosis of the chromosome segment found in the imbred line denominated LPBLS14, transferred to an inbred line of maize.

In this way, the identification of chromosome segment with heterosis effect is an important way in plant breeding.

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