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General and Specific Combining Ability Studies for Leaf Area (LA) in some Maize Inbreed Lines (*Zea mays* L.) in Agroecological Conditions in Kosova

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Abstract

In the methods of diallel crossing which are based on Hayman, (1954), Jinks,(1954), Griffing, (1956), Mather and Jinks, (1971), can produce values of hybrid combination and methods of heritage for a particular trait of selection. The use of heterosise in the world has started since the year 1933 in USA, where about 1% of the total surfaces were planted, while latter in the year 1953 the hetorsis of the maize hybrids was expanded up to 96% (Sprague, 1962). The cultivation of the maize hybrids started after the year 1960 in about 4.38%, and the seed was provided by the USA. Now, in Kosovo, about 95% of of surfaces are planted with different types of hybrids (Fetahu, 1998). The main object was to test and identify the reaction of some hybrid combinations of the F1 generation for leaf area (LA). Research includes 10 inbreed lines that had been in diallel crossing for GCA and SCA. The formula that provides the component of genetic variance was Griffing's (1956) method 2, the mathematical model I.Xij= μ+gi+gj+sij+e. With maximal LA where heterozygote combination from inbreed lines was L6xL10, xg=788.6 cm^2, while minimal value was combination L4xL5, xgj=558.9 cm^2. The experimental average value of F1 generation was μ= 678.8 cm^2. With maximal and minimal average differences for LA of F1 generation were + 109.8 cm^2 or 17%, respectively -119.9 cm^2 or 18%, comparing with value μ. The total variability between genotypes were ± 35%, with high significance. ANOVA for combination ability of GCA and SCA for LA provided with high phenotypes differences that were significant for P ≤ 0.05 and 0.01. Higher value for GCA obtained L2= +31.326, while with lower combination, the value was L4 = – 38.069. For SCA with higher values had L6xL10= + 156.73, with high significance for P ≤ 0.01.

Keywords: maize inbreed line, diallel crosses F1, GCA and SCA, leaf area

Introduction

The leaf area is a very important photosynthetic organ in the photosynthesis process for all plants, but especially for maize (Sylvester et al.,1990). The LA is an indication for the evaporation process and the larger LA is, the larger will be the transpiration and production characteristic of maize genotypes. The needs for higher production of plants depend on how much they absorb solar energy and thus, the larger will be their production in interaction with other factors of production. The level of absorbed energy depends on leaf and genotype characteristics, but also on the level of application for agro techniques during cultivation. There are many researches in these field. Jevtic S. (1977), in his research obtained that the total surfaces of leaf /plant was between 0.3-1.2 m2, while earlier (Niciporovic, 1956, 1961 and Gotlin) it was concluded that the level of absorbed energy gets higher with the increase of LA with the value of 25.000 m2 /ha. Toming, (1977) concludes that the participation of assimilated LA for maize of more than 40-50.000 m2 /ha doesn't have any effect in the increase of energy usage. Aliu S. (1995, 2003) in his researches in Agro ecological condition in Kosova for LA of some maize inbreed lines, obtained average maximal and minimal values of 0.56 -0.75 m^2 that influenced yield production, while (Salillari et al., 1982) in some inbreed lines for LA, obtained different values from 0.40- 0.80 m^2. Also, Jakovljevic, (1989) obtained other results with values of 0.79 m^2.

Materials and methods

In this research, 10 inbreed maize lines (L1, L2, L3, L4, L5, L6, L7, L8, L9, L10) are used as base material with medial maturity, originating in the Agricultural University of Tirana (AUT)- Albania. A study for the adoption and evaluation of inbreed lines in the agro ecological conditions of Kosova, Ferizaj Location is evaluated for a period of three years. In the fourth year the ten (10) mentioned maize inbreed lines were crossed using the diallel system (Griffing, 1956), and experimental fields (EF) with F1 generation (combination) are placed in the fifth year, when the study of general (GCA) and specific (SCA) combining ability is compleated. The model of mathematical statistics (MMS) involved was randomized block experimental design with three replications based on reticulate methods: (9x9) =81

Tabel 1 Model of ANOVA for GCA and SCA

S	d.f	S.S	M.S	F-Value
GCA	P – 1	Sg	Mg	$s^2+(p+2)(1/p-1)\sum gi^2$
SCA	P(p-1)/2	Ss	Ms	$s^2+2/p(p-1)x \sum_{i<j} \sum sij^2$
Error	M	Se	M'e	s^2

combination (CF_1) x 3 replications (R) = 243 Experimental Fields(EF). Plant density was 55000ha^{-1}, cultivated with intensive agro techniques, including NPK(15:15:15) Fertilizer, URE 46% and Herbicides. Genetic interpretations and analyses are provided in numerous papers such as those by Hayman, (1954) , Griffing, (1956). The diallel crossing model for specific combining ability for all combinations was the n(n-1)/2 formula. Differences among observed individuals, within each combination, were analysed by Griffing's (1956) method 2, the mathematical model I: $X_{ij}=\mu+gi+gj+s_{ij}+e$, where the formula gives the component of genetic variance and gene values.

The formula to calculate GCA and SCA was:

Sg = 1/(p+2) (∑(T+ii)2 -4/pGT2)

Ss =∑x2 ij–1/p+2(∑(Ti+ii)2+1/(p+1)x(p+2)x GT2

gi = 1/p +2(Ti + ii)- 2/p GT and

Sij =Xij–1/p+2(Ti + ii)+(Tj+jj)+2/(p+1)x(p+2) GT

F -test :F (p -1, m) = Mg/M'e and

F x p (p-1)/2, m = Ms/M'e

Whereas standard error(SE), between the two parents for GCA and SCA :

SE = $\sqrt{2/p+2}\cdot M'e$; and

SE = $\sqrt{2p/p+2}\cdot M'e$

The LA index its calculated based on the Montgomery formula (1911) and was used by other scientists (Francis et al., 1969), (Whigham et al., 1974), (Pearce et al., 1975).

A = L x W x 0.75.

Results and discussion

According to researches that genotype of F1 generation was obtained, from the combination of inbreed lines L6xL10, which presented with an average maximal value for LA Xg =788.6 cm ^{2} that was characterized by a larger assimilated area /plant, while in the opposite position there was the combination F1 generation L4 x L5, Xg= 558.9 cm^2. The average value of LA for all researched genotypes was μ =678.8 cm^2. The difference between genotypes with larger assimilated area was + 109.9 cm^2 or 17 %, while genotypes with smaller assimilation of -119.9 cm^2 or -18 % differences. Distinctions of extreme values of researched genotypes were D=(L6 xL10 ,Xg=788.6 cm^2) –(L4xL5, Xg=559.9 cm^2) = 229.7 cm^2 or 35 % that render them significantly different for level P≤0.05 and 0.01. Total LA for all genotypes was CV = 3.33% ,while SE =± 21.3 (Figure1).

All genotypes of the F1 generation had positive heterosise, compared with the parents, of an average value μ =48%, compared to maximal and minimal average value differences, which are +48 or 100% and 29 or 61%.

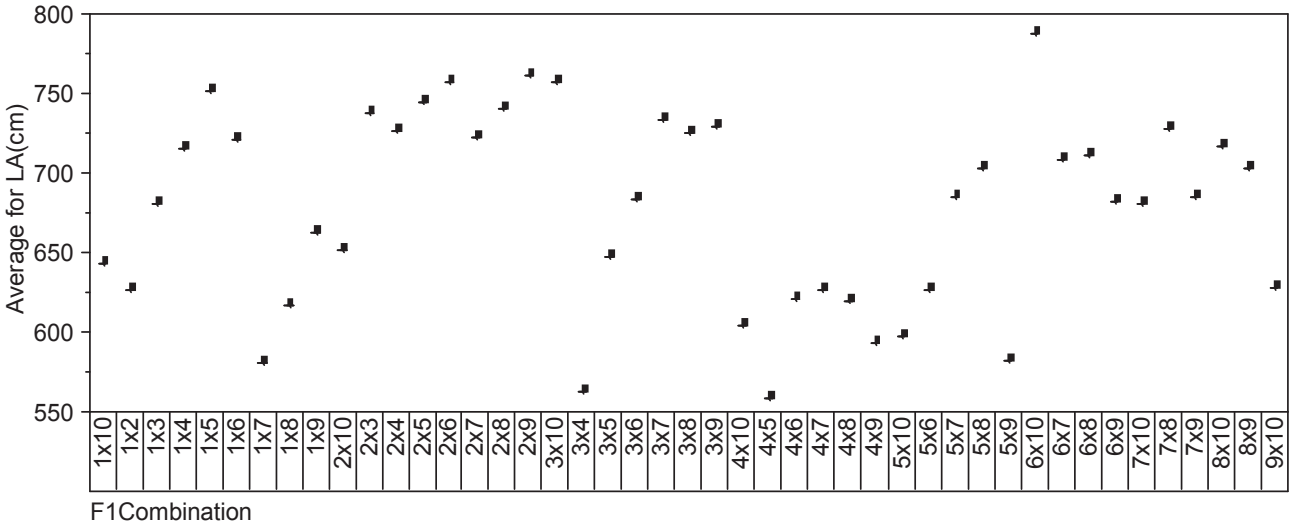

Figure 1 Variability Chart (LA) for Average F1 combination (cm^2)

Genotype variability of extreme phenotype values are obtained for genotypes D = (L6xL10, xgj=96%)-(L3xL4, xgj=19%)=+77 or 161%. These distinctions were demonstrated in the F1 generation because of the heterotic and combination effects of lines that makes them important for level probability 0.05 and 0.01, with a higher significance. Kojic, (1982) obtained positive values compared to parents, between 27.7-85.9%, while later Bocanski, (1995) concluded that this way of LA heritage can explain a phenomenon of over-domination compared with the parents, based on the results for this phenotype, with average values between 655.26-613.20 cm^2. Genotype variability in our research concludes clearly that genotypes can be ranged as earlier groups, with low-level assimilated areas and they were placed under value μ, while genotypes with longer vegetation had larger LA and were above the value. Distinctions of total genotype average value of the F1 generation compared to parents were D=(F1 –MP) =+221.45 cm^2. These can be interpreted as a power heterosise or vigor, created with combinations of genes and alleles in heterosis form of the F1 generation and dominant expression of genes for LA in maize.

For the combination ability in our researches and statistical analyses, it result that there are significance distinctions between GCA/SCA, because non additive effect of genes have important roles during the heritage process for LA proportion to additive genes, because the report between GCA and SCA was 0.40. Kojic, (1982) obtained a value of 0.36 for the report of LA between GCA/SCA, which is close to the result of our researches. According to Rutger, (1971), with the exception of non additive genes, an important role also presents genetic additive variance, which was later confirmed by Mason and Zuber, (1976).

A higher value for GCA was L2= + 31.326 with significance differences based on value F, which genetic constitution makes possible in dominants' way to carry heritage characteristics in the F1 generation (Figure 2).

A lower combination value presented L4 = -38.069. A large proportion between value F and distinctions between inbreed lines for heritage are significant and have different intensity for heritage and variability that depends on the structure of genotype lines that are specific (Maris ,1989). These extreme values have significance differences compared to a probability 0.05 and 0.01, with a total variance of ± 69.40. The effect of crossing lines for GCA (gi-gj) presented a variance from 25.24, while for the average value there was Xij =151.47. Kojic, (1982) for LA obtained

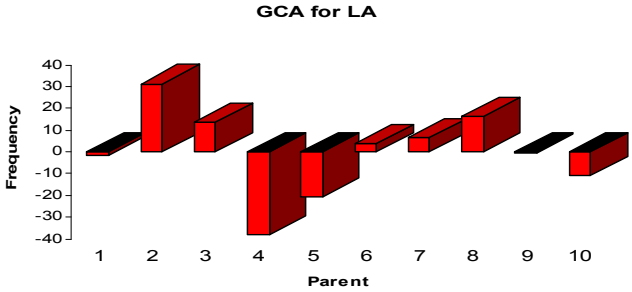

Figure 2 GCA value for LA (cm^2) for F_1 generation

LSD 0.05 = 17.22 S.E(gi) =11.3603

LSD 0.01 = 22.70

maximal and minimal values from +42.971 and -31.314, while SE was ± 11.36 and concludes that genotypes that carry leaf characteristics for GCA have higher vegetative ability compared to other genotypes. Malik et al., (2004) achieved other results for LA, GCA and SCA for different genotypes with values pf +41.32 and -20.27, respectively +0.890 and -0.015.

Achieved results presented SCA results with positive and negative effects for LA, while positive values for combination abilities shows clearly genotype structure for the F1 generation. Combination genotypes of inbreed lines L6xL10 for SCA had a value of +156.73 that was distinct from other combinations, with a high significance for probability 0.05 and 0.01, while having a lower value for SCA, which had a combination of inbreed lines L3xL4= -51.79. The total differences for the extreme value of phenotype variability were + 104.94 in favour of genotype L6xL10, while combination L1xL5 = +135.883 was second, which presented a distinction from genotypes L6xL10 with a value of -20.85. The effect of SE(sij) for the SCA of crossing parents was 128.52. Different results for SCA of LA with significance differences for maximal (+111.71) and minimal (-96.71) values obtained (Kojic,1982).

Conclusions

Based on field and laboratory results of diallel combination obtained from our researches for trait LA of the F1 generation concludes:

Genotypes show variability for LA parameters and Heterosis value.

The total average values μ for all genotypes for the F1 generation was 678.8 cm^2.

Table 2 Analysis of variance for GCA and SCA for LA

S	d.f	S.S	MS	F-Value
A.P.K	9	125598.064	13955.3405	30.71**
A.V.K	45	1572243.672	34938.7483	76.89**
Gabimi (E)	108	49076.532	454.4123	

GCA, LSD 0.05 = 1.97 SCA, LSD 0.05 = 1.48 GCA/SCA=0.40
LSD 0.01 = 2.59 LSD 0.01 = 1.73

Tabel 3 SCA value for LA (cm^2)

Parent	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
P_1	- 146.8	- 43.1	30.62	116.51	135.88	80.30	- 33.1	- 36.4	25.57	17.497
P_2		- 234.3	53.84	94.49	95.16	83.08	46.08	54.94	91.35	- 7.32
P_3			- 193.6	- 51.79	15.50	14.96	74.36	55.19	78.36	116.09
P_4				- 92.48	- 21.5	16.651	18.97	3.34	- 6.94	15.24
P_5					- 157.4	4.42	60.55	69.07	- 34.7	- 9.48
P_6						- 254.4	59.80	53.20	39.58	156.73
P_7							- 189.4	66.09	39.60	46.46
P_8								- 193.6	48.10	73.65
P_9									- 140.9	1.00
P_{10}										- 204.9

LSD 0.05 =54.46 S.E.(sij) = 128. 52
LSD0.01 = 71.80

For total LA, the combination that had maximal average value was L6xL10,xg=788.6 cm ^{2}, while with minimal LA was L4xL5,xg=558.9 cm^2 ,with genotype differences d= 229.7 cm^2 or 35 % that make them significance differences for level probability 0.05 and 0.01.

The Inbreed lines that had a value of a higher GCA was L2, while for SCA, there was the combination L6xL10.

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