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Research Paper

Estimation of Genetic Parameters of Inbred Lines in Maize (*Zea mays* L.)

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Abstract

Genetic variability was estimated on different quantitative characters in 25 maize inbred lines. Significant differences among the inbred lines were noticed for the studied characters. Ear height, cob diameter and number of kernels/row showed high genotypic coefficient of variation and heritability with high genetic advance in percentage of mean indicating the importance of these characters for selection breeding programme. High heritability for those characters supported the ideas. Grain yield had significant and positive correlation with number of kernels/row and number of grains/cob as expected. Path analysis revealed that highest direct effect on grain yield was exhibited by number of rows/cob followed by number of kernels/row supporting the results of genotypic coefficient of variation and heritability.

Keywords: Inbred line, Heritability, Genetic parameter, Maize.

INTRODUCTION

Maize has great yield potential and attained the leading position among the cereals based on production as well as productivity (Keshin *et al*., 2005). Superior position of maize is due to its very wide and varied utilization. Maize is a very potential crop in Bangladesh which can be grown throughout the year because of its photo-insensitiveness. With the introduction of hybrid maize varieties in the country the prospect of maize cultivation has become bright. Maize is a unique crop because of its versatile use and low cost per unit production (Banik *et al*., 2009). Because of very wide utilization of maize, the main goal of all maize breeding programs is to obtain new inbreds and hybrids that will outperform the existing hybrids with respect to a number of characters (Sreckov *et al*., 2010).

The appropriate knowledge of such interrelationships between grain yield and its contributing components can significantly improve the efficiency of breeding programme through the use of appropriate selection indices (Mohammadia *et al*., 2003).

The nature of association between yield and yield components determine the appropriate characters to be used in indirect selection for improvement in grain yield. Correlation of particular character with other characters contributing to grain yield is of great importance for indirect selection of inbreds for higher grain yield. Since yield components are interrelated, and develop sequentially at different growth stages, correlations may not provide a clear picture of the importance of each component in determining grain yield. The correlation studies simply measure the associations between yield and other characters. Path coefficient analysis provides more information among variables than do correlation coefficients since this analysis provides the direct effects of specific yield components on yield, and indirect effects via other yield components (Nastasic *et al*., 2010). The main objective of the present investigation was to estimate of mean performances, genetic variance, heritability, correlations and direct and indirect contributions of different characters to grain yield.

MATERIALS AND METHODS

Current study was carried out with 25 maize inbred lines based on Randomized Block Design with three replications at the Experimental Research Field of Botany Department, University of Rajshahi, Bangladesh. The plot size was 0.1×0.3m. Recommended doses of fertilizers were applied. Necessary intercultural operations and irrigation were done during the crop period to ensure normal growth, development of the plants and to raise the crop uniformly.

Five randomly selected plants were used for recording observations on ear height (EH), cob length (CL), cob diameter (CD), number of rows/cob (NRC), number of kernels/row (NKR), number of grains/cob (NGC) and grain yield/plant (GYP). Data from five plants of each genotype were averaged replication wise and mean data was used for statistical analysis. The collected data were analyzed following the biometrical techniques of analysis as developed by Mather (1949) based on mathematical model of Fisher (1925). Mean with standard error, range and genotypic variance, phenotypic variance, genotypic coefficient of variation and phenotypic coefficient of variation were estimated as suggested by Singh and Chaudhary (1979). Broad sense heritability was calculated as suggested by Johnson *et al.* (1955) and genetic advance was estimated using the formulae suggested by Johnson *et al.* (1955) and Hanson *et al.* (1956). Genotypic covariance was estimated according to the formulae suggested by Singh and Chaudhaury (1979). Genotypic correlation coefficient was calculated using the formulae suggested by Miller *et al.* (1958). Path coefficient analysis at genotypic level was done following the method as suggested by Dewey and Lu (1959). As per suggestion of Robinson *et al*. (1951) yield was also included as one of the independent characters. The analysis was carried out by applying standard statistical techniques for analysis of variance to establish significance level among the inbreds as described by Singh and Chaudhaury (1979).

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences (p›0.01) among maize inbreds for the studied characters (Table 1) proved the justification for the selected materials. Mean values of the inbreds are presented in Table 1. The genetic parameters study indicates that the studied characters are under the control of polygene effect.

This is supported by the data of wide range values, the narrow difference between PCV and GCV. Besides, this high heritability is associated with GA, further supported the additive gene effects in controlling the studied characters. The polygenic nature of the traits supported the idea that proper using of selection breeding programme can help to increase efficiencies of these traits in maize (Tabassum & Saleem, 2005 and Kumar *et al*. 2005). These results indicated that sufficient genetic variation among the maize inbred lines was present (Table 1). Relatively higher estimates of GCV for cob height and cob diameter suggest that the selection can be effective for these characters. Most of the characters had high heritability estimates indicating preponderance of additive gene action. Higher genetic advance in percentage of mean for cob height and number of kernels/row depicts additive gene effects. High heritability estimates for cob height, number of rows/ear and number of kernels per row were also reported by Yasien (2000), Abd El- Sattar (2003), Rafiq *et al*. (2010) and Wannows *et al.* (2010).

Table 1. Estimation of mean performance, analysis of variance and genetic parameters for grain yield and yield components in maize inbred

Characters	Range	Mean ± SE	MS of inbreds	PCV%	GCV%	h^2b%	GA(%) of mean
Ear height (cm)	52.553-39.160	47.675±1.835	197.908**	32.055	28.273	77.795	51.371
Cob length (cm)	13.181-9.996	11.925±0.387	16.265**	20.03	18.146	57.649	23.180
Cob diameter (cm)	13.414-9.933	12.636±0.381	3.672*	24.636	21.142	73.646	37.376
No. of rows/cob	13.267-10.733	12.064±0.395	5.463*	21.94	17.956	66.980	30.273
No. of kernels/row	15.333-12.60	13.336±0.402	9.395**	19.343	14.524	77.183	40.189
No. of grains/cob	89.210-65.801	86.461±1.677	947.161**	14.718	6.648	66.082	30.691
Grain yield/plant(g)	83.994-65.679	71.126±1.388	68.778**	21.477	18.281	72.449	32.054

** Significant at 5% and 1% level of probability, respectively.

Table 2. Genotypic correlation coefficient of yield and component traits in maize

Characters	CL	CD	NRC	NKR	NGC	GYP
EH	0.618**	-0.634**	-0.902**	0.165	-0.187	0.138
CL		-0.035	0.016	-0.048	0.097	-0.023
CD			0.034	0.918**	0.073	0.154
NRC				0.782**	0.718**	0.247
NKR					0.512*	0.591*
NGC						0.937**

*p<0.05; **p<0.01

LEGENDS: EH=ear height, CL= cob length, CD=cob diameter, NRC= number of rows/cob, NKR= number of kernels/row, NGC= number of grains/cob and GYP=grain yield/plant.

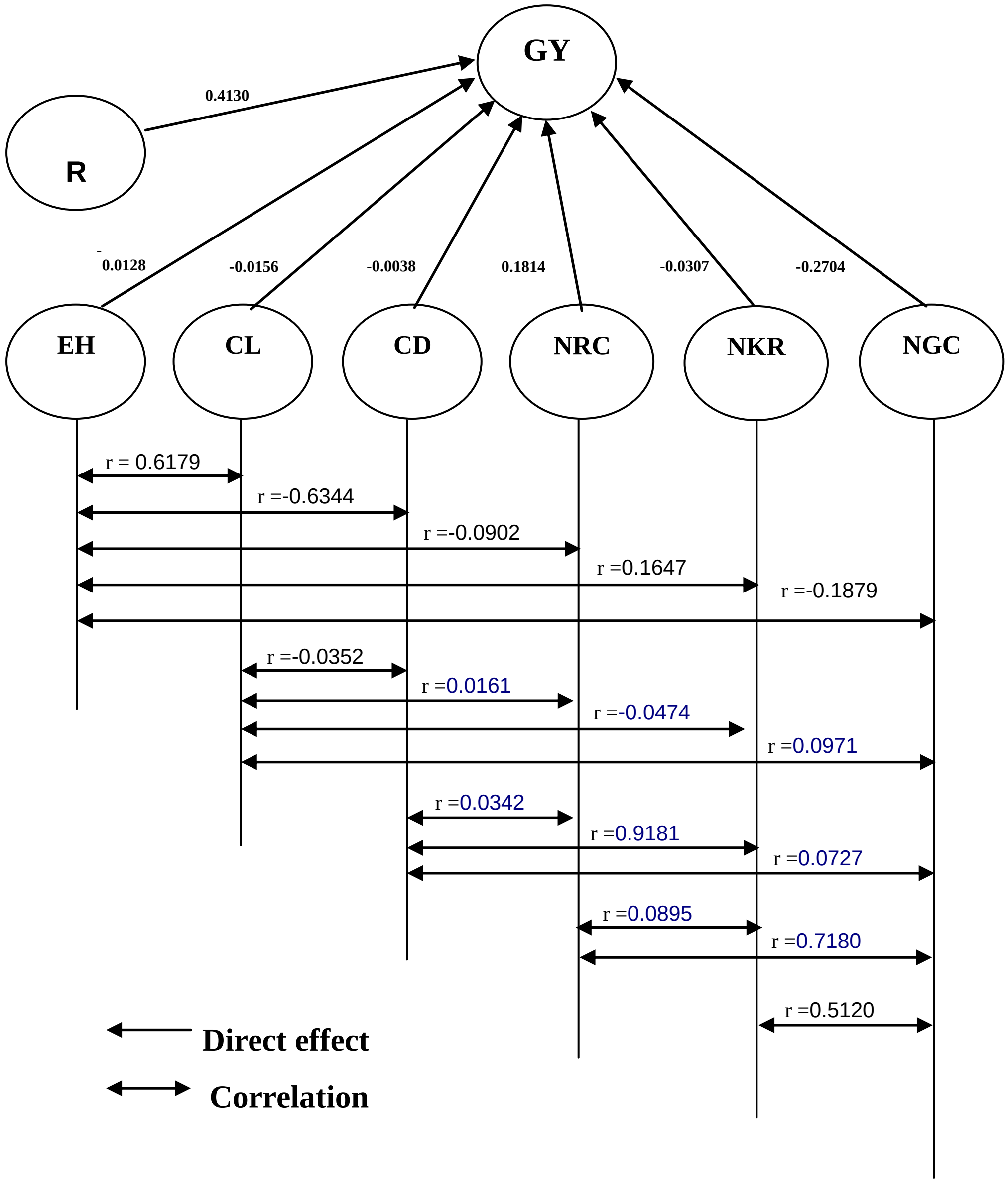

Figure 1. Path diagram of different grain yield contributing characters on yield at genotypic level

The correlation coefficients among the characters are given in Table 2. Correlation and path analysis in maize inbreds among the characters affecting grain yield elucidate true association as they exclude the environmental influences. In this study, the characters studied had positive correlation with grain yield (Table 2). The highest significant positive correlation with grain yield was shown by number of grains/cob at genotypic level. Similar results have been reported in maize by Mohan *et al*. (2002), Mohammadia *et al*. (2003), Rafiq *et al*. (2010) and Khazaei *et al*. (2010).

The path coefficient analysis (Figure 1) revealed that most of the characters had positive direct effect on grain yield. The highest direct effect on grain yield was exhibited by number of grains/cob followed by number of rows/cob, cob length and number of kernels/row. Number of kernels/row had highest indirect effect on grain yield through number of grains/cob (0.672) through number of kernels/row. The indirect effects, via number of kernels/row and number of grains/cob were either negative or very slightly positive. These results are in agreement with the results of many authors (Mohammadia *et al*., 2003; El-Shouny *et al*., 2005, Rafiq *et al*., 2010 and Wannows *et al.*, 2010). The residual effect in path analysis determines how best the component (independent) variables account for the variability of the dependent variable, grain yield/plant (Singh and Chaudhury, 1985). To this end, residual effect in the present study was 0.413; showing that 58.72% of the variability in grain yield/plant was explained by the component factors. This further elucidated that the choice of yield attributing characters in the study was quite perfect. In the light of results obtained in the present study, it can be suggested that characters such as number of kernels/row, grains/cob, cob length and cob diameter should be used as target characters to improve maize grain yield.

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