J. Sher-e-Bangla Agric. Univ., 3(2): 36-39, July 2009 ISSN 1997-6038

# VARIABILITY AND INTERRELATIONSHIP OF YIELD AND YIELD COMPONENTS IN MAIZE

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## ABSTRACT

Genetic variability, correlation and path coefficient analyses were carried out for grain yield and its component characters in maize. Comparatively higher genotypic coefficient of variability was found for plant height, number of tassel branches and 1000-kernel weight. Plant height, tassel length and shelling percentage showed high heritability coupled with high genetic gain. Grain yield was significantly and positively associated with days to maturity, number of tassel branches and kernel weight. Path coefficient analysis revealed the highest contribution of ear diameter and length to grain yield and these were followed by tassel length and days to silking.

**Key words:** Path analysis, character association, maize, genetic variability

## INTRODUCTION

Maize (*Zea mays*) as a cereal crop ranks third in Bangladesh although in world cereal production, it ranks second to wheat. For long, the country is suffering from food deficit. In Bangladesh the cultivation of maize is limited, though its prospect is bright. Maize having high yield potentiality can play an important role in reducing the food deficit in Bangladesh. It is an important cereal crop, which is used as a staple human food, as feed for livestock, as a raw materials for many industrial products (plastic & fabrics), as source of carbon whiskey, as a source of biofuels, as a fermented beverage, as a corn syrup and as source of alcohol. To fight hunger and starvation by achieving self-sufficiency in food production is a must for Bangladesh. Maize crop furnished huge quantities of green fodder for cattle. In order to fulfill the demand of additional food and to maintain self-sufficiency in food especially maize can be considered as a supplementary food to rice. However, our cultivated land is limited and we require increased production. Genetic variability is a prerequisite for effective selections of any crop varieties and a critical survey of genetic variability is essential aiming at developing high yielding varieties. The success of breeding programs also depends upon the amount of genetic association present in the population and the extent to which the desirable characters are heritable. Therefore, the present study was undertaken to analyze variability and interrelationship of yield and yield components in maize.

## MATERIALS AND METHODS

The experimental materials consisted of eleven inbreds of maize such as, 1139-9, CML326, CML-322, 1139-15, CML164, CML226, CML P45, CML295, CML173, 6000-46 and CML329. These eleven inbreds of maize were sown in a randomized block design with two replications at the Botanical Research Garden of Botany Department, Rajshahi University, Rajshahi-6205, Bangladesh in 2000. A replication having a size of 16.5 m × 5 m was made up of 22 rows. The distance was 75 cm from row to row and 25 cm from plant to plant (one plant/hill). The recommended practices were provided to raise a good crop. Irrigation, weeding and other intercultural operation were done as and when necessary. Data on days to 50% silking (DS), days to maturity (DM), plant height (PH), ear length

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(EL), ear diameter (ED), length of tassel (LT), number of tassel branches (NTB), shelling percentage (SP), 1000-kernel weight (TKW) and grain yield/plant (GYP) were recorded from five randomly selected plants from each row. Genotypic ($\sigma^2$g) and phenotypic ($\sigma^2$p) variance, genotypic (GCV) and phenotypic (PCV) coefficient of variability, heritability in broad sense ($h^2$b), genetic advance (GA), genetic advance as percentage of mean (GA%), correlation coefficient and path coefficient analysis were done according to the method of Singh and Chowdhury (1985).

## RESULTS AND DISCUSSION

Estimation of genotypic and phenotypic variance, genotypic and phenotypic coefficient of variability, heritability in broad sense, genetic advance and genetic advanced as percentage of mean for ten characters of maize under study are presented in Table 1. The highest genotypic variance (209.35) was observed in plant height followed by shelling percentage (93.978) and days to maturity showed the lowest genotypic variance. Maximum and minimum phenotypic variation was found in plant height and ear diameter, respectively. The big differences between genotypic and phenotypic variance for the characters studied indicate that phenotypic variability might be considered as a reliable measure of genotypic variability.

**Table 1. Estimation of genetic parameters of ten characters in maize**

| Characters | $\sigma^2$g | $\sigma^2$p | GCV | PCV | $h^2$b | GA | GA% |
|---|---|---|---|---|---|---|---|
| DS | 9.909 | 36.636 | 0.798 | 8.991 | 0.788 | 0.112 | 0.146 |
| DM | 7.064 | 22.145 | 2.211 | 4.145 | 28.448 | 2.758 | 2.429 |
| PH | 209.350 | 303.100 | 13.162 | 15.861 | 68.866 | 24.735 | 22.500 |
| EL | 5.301 | 8.273 | 10.239 | 12.798 | 64.002 | 3.792 | 16.874 |
| EB | 0.433 | 1.466 | 3.930 | 7.235 | 29.502 | 0.736 | 4397 |
| LT | 8.408 | 11.882 | 9.051 | 10.759 | 70.773 | 5.025 | 15.686 |
| NTB | 24.042 | 26.038 | 48.613 | 50.591 | 92.333 | 9.706 | 96.226 |
| SP | 93.978 | 187.617 | 20.572 | 29.067 | 50.090 | 14.134 | 29.993 |
| TKW | 6.349 | 18.418 | 1824.425 | 3009.477 | 34.471 | 3.046 | 875.287 |
| GY/P | 0.343 | 0.612 | 765.625 | 1366.071 | 56.045 | 4.952 | 11053.57 |

DS=Days to 50% silking, DM=days to maturity, PH=plant height, EL=ear length, ED=ear diameter, LT=length of tassel, NTB=number of tassel branches, SP=shelling percentage, TKW=1000-kernel weight and GYP= grain yield/plant, $\sigma^2$g = genotypic variance, $\sigma^2$p = phenotypic variance, GCV= genotypic co-efficient of variability, PCV = phenotypic co-efficient of variability, $h^2$b = heritability inbroad sense, GA = genetic advance, GA(%) = genetic advance as percentage of mean

The highest genotypic and phenotypic coefficients of variabilities were recorded in 1000-kernel weight (1824.425 and 3009.477, respectively) followed by grain weight and number of tassel branches. But little differences between GCV and PCV were found for plant height, ear length and tassel length indicating that environment had less influence on the expression of these characters. Very little GCV was found in days to 50% silking indicating lack of inherent variability and limited scope for improvement through selection for these characters. Rahman (2001) reported that higher GCV and higher $h^2$b with genetic advance as percentage of mean for number of tassel branches and grain yield in maize. Higher heritability in broad sense coupled with genetic advance as percentage of mean was observed for plant height, tassel length and number of tassel branches indicating the presence of additive gene effects (Panse, 1957). Presence of additive gene effects indicated that these characters would be fixable and improvement of characters could be made through selection. In the present investigation, plant height, number of tassel branches and ear length had higher GCV, PCV, higher $h^2$b values and higher genetic advance as percentage of mean which made these three characters most vital in the selection for grain yield improvement.

Genotypic and phenotypic correlation coefficients between different pairs of characters are presented in Table 2. In most of the cases, genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients, indicating that the association of characters was not appreciably influenced by environmental factors. Correlation between yield and yield contributing characters is very important because this association helps to select a suitable character for the breeding experiment.

**Table 2. Genotypic ($r_g$) and phenotypic ($r_p$) correlation coefficients among different characters**

| Characters | | DM | PH | LT | NTB | EL | EB | SP | TKW | GY/P |
|---|---|---|---|---|---|---|---|---|---|---|
| DS | G | -0.325 | 0.365 | 0.119 | 0.563* | 0.856** | -0.689** | 0.123 | -0.452 | 0.523 |
| | P | 0.199 | -0.054 | -0.066 | 0.033 | 0.281 | -0.001 | -0.189 | -0.088 | -0.123 |
| DM | G | | 0.234 | 0.386 | -0.034 | -0.103 | 0.614* | 0.986** | -0.241 | 0.619* |
| | P | | -0.162 | 0.024 | -0.041 | 0.042 | 0.129 | -0.065 | -0.225 | -0.160 |
| PH | G | | | 0.323 | 0.512* | 0.215 | 0.148 | 0.181 | -0.092 | -0.012 |
| | P | | | 0.292 | 0.425 | 0.242 | 0.287 | 0.282 | -0.042 | 0.158 |
| LT | G | | | | -0.213 | 0.529* | -0.208 | 0.103 | 0.542* | -0.009 |
| | P | | | | -0.275 | 0.219 | -0.100 | 0.005 | 0.285 | 0.046 |
| NTB | G | | | | | 0.076 | 0.392 | 0.649** | 0.167 | 0.714* |
| | P | | | | | 0.130 | 0.132 | 0.557* | 0.077 | 0.503* |
| EL | G | | | | | | -0.953** | -0.395 | 0.062 | 0.156 |
| | P | | | | | | -0.179 | -0.179 | -0.149 | 0.033 |
| EB | G | | | | | | | 0.563* | 0.007 | 0.455 |
| | P | | | | | | | 0.444 | 0.164 | 0.439 |
| SP | G | | | | | | | | 0.442 | 0.790** |
| | P | | | | | | | | 0.281 | 0.648** |
| TKW | G | | | | | | | | | 0.674** |
| | P | | | | | | | | | 0.665** |

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

DS=Days to 50% silking, DM=days to maturity, PH=plant height, EL=ear length, EB=ear breath, LT=length of tassel, NTB=number of tassel branches, SP=shelling percentage, TKW=1000-kernel weight and GYP= grain yield/plant

Correlation analysis between grain yield and yield contributing characters revealed that the genotypic correlation coefficients in most of the cases were higher than their phenotypic correlation coefficients. The correlation of grain yield/plant with days to maturity, number of tassel branches, shelling percentage and 1000 kernel weight both at genotypic and phenotypic levels were significant and positive. Positive genotypic correlation of grain yield /plant with days to 50% silking and number of tassel branches and kernel weight were reported by Rahman (2001).

Path coefficient analysis based on genotypic correlation is presented in Table 3. The results reveal that ear diameter had the highest positive direct effect on grain yield and it was followed by tassel length, ear length and days to 50% silking suggesting that direct selection for grain yield of these characters would be effective. Similar effect of ear height, 1000 grain weight and ear length on grain yield has also been observed by Khatun *et al.* (1999), Qadir and Saleem (1991) and Parth *et al.* (1986). The residual effect of the present study was 0.5130 which indicated that only 48.05% of the variability observed for grain yield was represented by yield related characters studied. The genetic variability, character associations and path coefficient analysis revealed that ear length, ear diameter, days to 50% silking, length of tassel and number of tassel branches had high direct effect and highly significant positive correlation with grain yield, moderate to high genotypic and phenotypic coefficient of variability, high heritability and high genetic advances as percentage of mean.

**Table 3. Direct (Bold) and indirect effects of yield components of maize**

| Characters | DS | DM | PH | EL | EB | LT | NTB | SP | T KW | $r_g$ with GYP |
|---|---|---|---|---|---|---|---|---|---|---|
| DS | **1.0541** | -0.1768 | -0.3344 | 0.1381 | 0.9782 | 1.1880 | -0.0352 | 0.0054 | 0.0858 | 0.523* |
| DM | -0.3425 | **0.5443** | -0.2144 | 0.4481 | -0.0590 | -0.1429 | 0.0313 | 0.0436 | 0.0457 | 0.619** |
| PH | 0.3847 | 0.1273 | **-0.9164** | 0.3750 | 0.8896 | 0.2983 | 0.0075 | 0.0080 | 0.0194 | -0.012 |
| EL | 0.1254 | 0.2100 | 0.2959 | **1.1611** | -0.3700 | 0.7341 | -0.0106 | 0.0045 | -0.1029 | -0.009 |
| EB | 0.5934 | -0.0185 | 0.4691 | 0.2473 | **1.7375** | 0.1054 | 0.0200 | 0.0287 | -0.0317 | 0.714** |
| LT | 0.9023 | -0.0560 | 0.1970 | 0.6142 | 0.1320 | **1.3879** | -0.0486 | 0.0174 | -0.0117 | 0.156 |
| NTB | -0.7262 | 0.3342 | 0.1356 | -0.2415 | 0.6811 | -1.3226 | **0.0511** | 0.0249 | -0.0839 | 0.455 |
| SP | 0.1296 | 0.5366 | 0.1658 | 0.1195 | 1.1276 | -0.5482 | 0.0287 | **0.0443** | -0.0839 | 0.790** |
| TKW | -0.4764 | -0.1311 | -0.0843 | 0.6293 | 0.2902 | 0.0860 | 0.0003 | 0.0195 | **-0.1900** | 0.674** |

Residual effect= 0.5130, * and ** Significant at 5% and 1% level, respectively.

Therefore, 51.30% variability represented by other yield related characters that was not included in this study might also have major role in determination of grain yield of maize. For grain yield improvement in maize, selection can be made based mainly on plant height, ear length, ear diameter and number of tassel branches.

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