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# GENETIC VARIABILITY AND CHARACTER ASSOCIATION OF CHILLI (*Capsicum frutescens* L.)

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## ABSTRACT

Thirty chilli genotypes were studied with a view to find out variability and genetic association for fruit yield and its component characters. All the characters showed significant variation among the genotypes. The phenotypic variance was higher than the corresponding genotypic variance for all the characters. The highest genetic variability was obtained in number of fruits/plant followed by fruit yield, plant height and fruit length. High heritability together with high genetic advance in percentage of mean was observed in fruit number/plant followed by fruit yield and plant height. Genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients for most of the traits. Fruit yield was positively and significantly associated with plant height, days to first flowering, number of primary branches/plant, fruit length, fruit weight and fruits number/plant.


***Key words:*** Variability, character association, heritability, genetic advance, chilli

## INTRODUCTION

Chilli (*Capsicum spp.*) belonging to the family Solanaceae, is a common and widely distributed spices crop throughout the tropics. The hot chilli or cayenne pepper named *Capsicum frutescens* is one of the most important ingredients used in the everyday diet of the people of South and South-east Asia. It is also a cash crop of our country (Ahmed and Haque, 1980). In Bangladesh, the total cultivated area covered by chilli is about 89307.69 ha and its total production is about 109337 M. tons (BBS, 2009). In spite of its much importance, no major break-through has been made and limited numbers of improved varieties are being grown in the country. The yield of land races of chilli is very low. During 1998-1999 to 2005-2006, average yield was 0.89 ton/ha (BBS, 2007) which is much lower than our neighboring country-India. In India, during 2003-2004 to 2007-2008, the average chilli production was 1.6 t/ha (Annon., 2010). Under this situation, the intensive cultivation and increased production of chilli, improved varieties/lines with desirable traits need to be identified. Efforts to improve the crop become difficult due to a lack of adequate information on the genetic control of characteristics of the yield and yield related traits. For achieving a substantial genetic improvement, a high knowledge of variability is essential to improve new varieties of chilli in the country. Selection of better plant type either from local or exotic genotypes can be of immense value to the breeder. Variability and genetic diversity are the fundamentals of plant breeding which is major tool being used in parent selection for efficient hybridization program (Bhatt, 1973). Knowledge of the interrelationship between yield and yield components is desirable to know the magnitude and direction of changes expected during selection.

Yield is a complex trait and highly influenced by many genetic factors and environmental fluctuations. Yield is the result of the expression and association of several plant growth components. Correlation studies provide information about the nature and magnitude of various associations among the traits. It measures the mutual association between two variables but not permit to depict the cause and effect relationship of traits contributing directly or indirectly towards the economic yield. Considering the importance of chilli, the experiment was undertaken aiming to study genetic variability and relationship among different quantitative characters and to identify suitable indirect selection criteria for yield improvement.

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## MATERIALS AND METHODS

In order to evaluate the variability and character association of 30 chilli genotypes, the experiment was carried out during the period of 11 November, 2006 to 31$^{st}$ May, 2007 at the experimental farm of Sher-e-Bangla Agricultural University, Dhaka. Among 30 genotypes, 16 received from Bangladesh Agricultural Research Institute (BARI), Gazipur ; five from BADC office, Muktagacha, Mymensingh ; two from Siddik Bazar, Seed Market, Dhaka ; two from Barisal Nursery, Savar and five from Krishibid Nursery, Dhaka. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was 187.5 sq. m. Row to row and plant to plant distance both were 50 cm and thirty five days old seedlings were transplanted in the main field. Fertilizers were applied at the rate of 275, 200, 200, 20, 10, 10 kg/ha of Urea, TSP, MP, Gypsum, Zinc Oxide, Boric acid and 15ton/ha of cowdung were used as manure respectively. All the fertilizers except urea and well decomposed cowdung were applied to the plots. During final bed preparation, one fourth of both Urea and MP were applied. The rest Urea and MP were top dressed in 3 equal installments after 30, 45 and 60 days of planting. Normal intercultural operations were done as and when necessary.

Genetic variability and correlation were studied by considering eight important yield and yield contributing characters, viz. plant height, days to first flower, number of primary branches per plant, fruit length, fruit circumference, fruit weight, no. of fruits per plant and fruit yield per plant. The data were analyzed to estimate genotypic and phenotypic coefficient of variation according to Burton (1952); genotypic and phenotypic variance, heritability in board sense ($h^2b$) and genetic advance were estimated followed by Jhonson *et al.*(1995) and Allard (1960); genetic advance in percentage of mean was calculated by using the formula of Comstock and Robinson (1952) and simple correlation co-efficient for all possible pair of characters at genotypic and phenotypic levels was estimated following Miller *et al.* (1958) and Singh and Chaudhury (1985).

## RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among the accessions for all the traits. The estimates of coefficient of variation (CV%), genotypic variance ($6^2g$), phenotypic variance ($6^2p$), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (Hb) and genetic advance (GA) in percent of mean for different traits are shown in Table 1. The coefficient of variation indicated the presence of significant variability among the genotypes in respect of different traits studied.

Characters like plant height, days to first flowering, number of primary branches/plant, fruit length, fruit circumference, fruit weight, fruit number/plant and fruit yield exhibited considerable genotypic and phenotypic coefficient of variation. The phenotypic variance was higher than the corresponding genotypic variance for all the traits indicating influence of environment for the expression of these characters. The phenotypic coefficient of variation was higher than the genotypic coefficient of variation for all the traits. The differences between GCV and PCV were high for number of primary branches/plant and fruit circumference indicating exposure of traits to environmental influences. Among all traits, the highest GCV was recorded for number of fruits/plant (56.28) followed by fruit yield (36.51), plant height (28.10), fruit length (26.86) and fruit weight (25.48) indicating higher degree of genetic variability in these traits. The maximum genotypic and phenotypic variances were 47917.55 and 52674.24, respectively in fruit yield per plant.

From this study, high heritability associated with considerable genetic advance in percentage of mean was recorded in number of fruits per plant, fruit yield, plant height, fruit length and fruit weight indicated that these characters are governed by additive gene effects to a greater extent. Higher genetic advance associated with high heritability indicated additive gene effect controlling the characters and had considerable value to the breeder for plant selection (Panse, 1957). The high heritability with low genetic advance in percent of mean indicated non-additive gene action where genotype-environment interaction plays a significant role for expression of the traits as observed in days to first flowering and fruit circumference.

**Table 1. Estimation of genetic parameters for eight characters in 30 chilli genotypes**

| Character | Range | | Mean ± SE | MS | 6²g | 6²e | 6²p | GCV | PCV | Hb | GAPM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PH | 19.610 | 93.200 | 56.223± 2.977 | 797.848** | 249.59 | 49.08 | 298.67 | 28.10 | 30.74 | 83.57 | 52.92 |
| DF | 40.567 | 64.500 | 52.839±1.153 | 119.690** | 35.32 | 13.73 | 49.05 | 11.25 | 13.25 | 72.01 | 19.66 |
| PBN | 4.627 | 9.360 | 6.742±0.192 | 3.324** | 0.85 | 0.76 | 1.62 | 13.71 | 18.85 | 52.89 | 20.54 |
| FL | 1.917 | 8.567 | 5.308±0..272 | 6.658** | 2.03 | 0.56 | 2.59 | 26.86 | 30.34 | 78.33 | 48.96 |
| FC | 1.977 | 4.017 | 3.026±0.065 | 0.386** | 0.09 | 0.11 | 0.20 | 10.04 | 14.83 | 45.86 | 14.01 |
| FW | 1.380 | 4.640 | 2.967±0.143 | 1.844** | 0.57 | 0.13 | 0.70 | 25.48 | 28.22 | 81.54 | 47.39 |
| FN | 22.533 | 98.800 | 75.528±7.851 | 5547.156** | 1806.87 | 126.53 | 1933.40 | 56.28 | 58.22 | 93.46 | 112.08 |
| FY | 62.197 | 890.833 | 599.527±40.621 | 148509.453** | 47917.55 | 4756.69 | 52674.24 | 36.51 | 38.28 | 90.97 | 71.74 |

6²g - Genotypic variance , 6²p - Phenotypic variance, 6²e - Environmental variance, GCV- Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, Hb- Heritability in broad sense, GAPM- Genetic advance in percentage of mean, PH- Plant height, DF- Days to first flowering, PBN - Primary branches/plant, FL- Fruit length, FC- Fruit circumference, FW- Fruit weight, FN-Fruits number/plant, FY-Fruit yield, and *, ** - Significant at 5% and 1 % level of significance, respectively.

Genotypic and phenotypic correlation co-efficient among different pairs of characters of chilli are presented in Table 2. Character association analysis among yield and yield contributing characters revealed that genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients in most of the cases indicating that character association had not been largely influenced by environment at phenotypic level in these cases. Higher genotypic correlation than their phenotypic ones were reported in many crops including chilli (Singh *et al.*, 2007; Abdullah *et al.*, 2006;

**Table 2. Genotypic (G) and phenotypic (P) correlation coefficients among eight yield contributing characters for 30 chilli genotypes**

| Characters | | DF | PBN | FL | FC | FW | FN | FY |
|---|---|---|---|---|---|---|---|---|
| PH | G | 0.369** | 0.717** | 0.355** | 0.183ns | 0.263* | 0.416** | 0.588** |
| | P | 0.315** | 0.527** | 0.333** | 0.171ns | 0.194ns | 0.373** | 0.506** |
| DF | G | | 0.432** | 0.425** | 0.633** | 0.608** | -0.037ns | 0.332** |
| | P | | 0.273** | 0.372** | 0.356** | 0.492** | -0.047ns | 0.297** |
| PBN | G | | | 0.667** | 0.130ns | 0.478** | 0.606** | 0.933** |
| | P | | | 0.443** | 0.051ns | 0.323** | 0.448** | 0.629** |
| FL | G | | | | 0.306** | 0.648** | 0.198ns | 0.561** |
| | P | | | | 0.229* | 0.493** | 0.162ns | 0.460** |
| FC | G | | | | | 0.655** | -0.125ns | 0.216* |
| | P | | | | | 0.360** | -0.098ns | 0.105ns |
| FW | G | | | | | | 0.362** | 0.550** |
| | P | | | | | | 0.332** | 0.460** |
| FN | G | | | | | | | 0.606** |
| | P | | | | | | | 0.562** |

*and ** indicates significant at 5% and 1% level of significance respectively

Kumar *et al.*, 2003; Rathod *et al.*, 2002). Considering both genotypic and phenotypic correlation co-efficient among eight yield contributing characters of 30 chilli genotypes, fruit yield was significantly and positively correlated with plant height, days to first flowering, number of primary branches per plant, fruit length, fruit weight, and fruit number per plant. Similar results were obtained by Hasanuzzaman and Faruq (2011), Acharyya *et al.* (2007), Rathod *et al.* (2002) and Munshi *et al.* (2000) who reported that fruit yield had a significant positive association with number of fruits per plant, both at the genotypic and phenotypic levels. Bharadwaj *et al.*, 2007, Kumar *et al.*, 2003 and Khurana *et al.*, 2003 also reported that fruit yield was positively associated with number of fruits/plant. Singh *et al.*, 2007 reported that total yield had positive and significant phenotypic and genetic correlations with fruit length, fruit breadth and fruits per plant.

Highly significant and positive correlation was existed between plant height and primary branches/plant at both level while it showed non-significant positive correlation with fruit circumference and fruit weight. Days to first flowering exhibited significant positive association with fruit circumference and fruit weight. Primary branches/plant was significantly and positively correlated with fruit length and fruits number/plant but non-significant positive correlation with fruit circumference was observed for these traits. Significant positive correlation was observed for fruit length with fruit circumference and fruit weight while it showed non-significant positive association with fruit number/plant. Hasanuzzaman and Faruq (2011) and Munshi *et al.* (2000) reported that fruit weight showed significant positive correlation with fruit length. Fruit circumference exhibited significant positive genotypic and phenotypic association with fruit weight but non-significant positive correlation with fruit yield and non-significant negative correlation with fruits number were observed. Hasanuzzaman and Faruq (2011) and Kumar *et al.* (2003) also reported that fruit length and width showed positive correlation with fruit weight. Fruit weight had significant positive correlation with fruits number/plant. Number of fruits/plant showed significant positive correlation with fruit yield.

From overall genetic studies, it is emphasized that in any selection and breeding program, characters least affected by the environment and characters closely related together must be considered (Singh and Singh, 1979). Higher magnitude of genotypic correlation than phenotypic correlation was noticed for almost combinations indicating inherent association between characters that might be due to masking or modifying effect of environment (Shukla and Khanna, 1987; Singh *et al.*, 2003).

The results of the present study indicated that high heritability together with high genetic advance in percentage of mean for fruits number/plant, fruit yield, plant height, fruit length and fruit weight were remarkable. The study of correlation suggested that plant height, days to first flowering, primary branches/plant, fruit length, fruit weight and fruits number/plant were the important characters to be considered in the selection for improving high yielding chilli cultivars. Therefore, variability and correlation coefficient analysis suggested that during selection more emphasis should he given on the above characters, since these characters have high positive correlation on fruit yield of chilli.

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