

## Genetic variability, heritability and genetic advances in chilli, *Capsicum annuum*

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### ABSTRACT

The present investigation was carried out to find out the Genetic variability, heritability and genetic advance in chilli (*Capsicum annuum* L.) in Central Uttar Pradesh during Rabi season. The experiment was laid out in randomized block design. All the treatments were randomly distributed among the plots and replicate three times. Transplanting of seedlings was done at spacing of 45x60 cm. The observations were recorded on five plants per plots for days to flowering, plant height, number of branches per plant, number of fruits per plant, leaf area, pedicle length, fruit length, fruit width, days to first harvest and fruit yield per plant. The genotypes Azad mirch-1, Sel-16 and 7919 performed better in terms of leaf area had maximum value (116.38), succeeded by fruit yield per plant red ripe (85.40), fruit width (38.23), number of branches per plant (34.43), days to 50% flowering (32.46), days to first harvest (27.83), pedicel length (27.78), fruit yield per plant (17.73), fruit length (16.64) and plant height (12.76).

**KEY WORDS:** CHILLI, GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE.

### INTRODUCTION

Chilli is one of the most important vegetable crops grown throughout India. It belongs to family *Solanaceae* with chromosome number  $2n=24$ . It is grown for export as well as for domestic market. Chilli contributes about 33% of the total spice export from India and share about 16% of the world spice trade (Kadwey *et al.*, 2016). The total area under vegetable cultivation is 6.249 million ha with total production of 93.922 million tonnes. The total cropped area under vegetables come to around 3.2%,

in India, chilli is grown in area of 9, 40,000 ha as it is specially liked for its pungency, aroma and spicy taste. India is the second largest producer of vegetables after China and also maximum numbers of vegetable crops are grown due to great diversity of agro climatic condition. It is widely cultivated during July to December and red ripe fruits fill the market in November to December. A wide range of variability reportedly exists in this crop, (Nandi, 2012).

The genetic information gathered on yield and yield attributing traits would be of utility in formulation of

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an efficient breeding programme for the improvement of chilli crop in order to develop promising genotypes/hybrids. Yield is a determining factor for crop improvement (Addisu, 2012). Chili pepper, as in other crops, yield is a quantitative trait that is influenced by a number of yield contributing parameters. The selection of desirable genotypes is usually based on yield and yield components. It is therefore necessary to study the mutual relationship between yield and yield components for efficient utilization of the genetic stock in crop improvement program of chili pepper. Variability in plants is the first step in understanding how to improve or produce new plants. Heritability is the degree of genetic control associated to some important traits (Nechif *et al.*, 2011).

The present study was under taken to estimate the variability, heritability and correlation section includes for identification of promising genotypes to use in genetic improvement of chilli under hot arid environment. In such a situation it is essential to partition the correlation coefficient in to component of direct and indirect effects in order to provide the relative importance of casual factors. The present investigation was conducted to determine the direction variability, heritability, genetic advance and degree of association among the characters.

## MATERIAL AND METHODS

The present investigation was conducted at the Horticultural Research Farm of the Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University Vidya Vihar Raebareli Road, Lucknow (U.P) during the Rabi season of 2009-2010. Geographically, Lucknow is

situated at an elevation of 111m above the Mean sea Level in the subtropical tract of central U.P. at 26° 56' North Latitude and 80°52' East Longitude. Lucknow is also characterized by subtropical climate with hot dry summer and cold winter. For present investigation 20 germplasm lines of chilli was under taken. Seeds of germplasm were collected from the Department of Vegetables science, Kalyanpur C. S. A University of Agri. and Tech. Kanpur. The experiment was laid out in Randomized Block Design. All the treatments were randomly distributed among the plots and replicate three times. Transplanting of seedlings was done at spacing of 45x60 cm. The observations were recorded on five plants per plots for days to flowering, plant height, number of branches per plant, number of fruits per plant, leaf area, pedicel length, fruit length, fruit width, days to first harvest and fruit yield per plant. The data recorded during observation was used for analysis to test the level of significance as per method given by (Chandel, 1984). The data were analyzed to work out various components coefficient of variation and heritability in broad sense and expected genetic advance as percent of Mean were estimated as suggested by (Johnson *et al*, 1955) respectively.

## RESULTS AND DISCUSSION

A wide variation in the mean performance of parents was observed for all the characters under study. The analysis of variance showed that all the varieties/strains slightly differed for all the eleven economic characters except days to flowering (Table 1.). The estimate of genetic parameter viz., phenotypic and genotypic coef-

Table 1: Analysis of variance for eleven characters of chilli (*Capsicum annuum* L.) germplasm.

| S. No | Source of variance              | Replication (2) | Treatments (19) | Errors (38) |
|-------|---------------------------------|-----------------|-----------------|-------------|
| 1.    | Days to 50 % Flowering          | 0.35            | 134.74**        | 1.51        |
| 2.    | Plant height (cm)               | 0.309           | 2.17*           | 0.21        |
| 3.    | No. of branches per plant       | 0.10            | 7.98**          | 0.15        |
| 4.    | No. of fruits per plant         | 0.56            | 25.42**         | 0.19        |
| 5.    | Leaf area (cm <sup>2</sup> )    | 0.35            | 101.56**        | 1.22        |
| 6.    | Pedicel length (cm)             | 7.48            | 4.76**          | 8.29        |
| 7.    | Fruit length (cm)               | 0.125           | 4.06**          | 1.85        |
| 8.    | Fruit width (cm)                | 4.99            | 0.651           | 1.89        |
| 9.    | Days to first harvest           | 0.149           | 145.76**        | 2.13        |
| 10.   | Dry fruit yield/ plant (g)      | 2.34            | 7.56**          | 0.73        |
| 11.   | Red ripe fruit yield/ plant (g) | 12.84           | 553.93**        | 17.54       |

\*significant at 5%

\*\*significant at 1%

ficient of variation along with heritability in broad sense and genetic advance as percentage of mean for different characters are given in (Table 2). A wide variation in the mean performance of parents was observed for all the characters under study. The extent of variability with respect to various characters in different genotypes measured in terms of range, general mean, genotypic coefficient of variation, phenotypic coefficient of variation along with heritability and expected genetic advance as percent of mean ((Table 2.).

Days to 50% flowering showed maximum range of variability from 33.92 to 55.33 with a mean of 41.59 followed by plant height from 28.00to 37.43 along with a grand mean of 31.65, number of branches per plant from 3.00 to 6.63 along with a grand mean of 30.46, leaf area from 5.17 to 29.20 along with a grand mean 15.32, Pedicel length from 1.57 to 3.30 along with a grand mean 2.52, fruit length from 5.03 to 8.03 along with a grand mean of 6.67,days of fruit harvest from 72.92 to 95.96 along with a grand mean of 80.74, fruit yield per plant (red ripe ) 85.40 to 320.88 along with a grand mean of 213.12 and fruit yield per plant (dry) (gm.) from 30.15 to 46..87 along with a grand mean of 37.06. The magnitude of phenotypic coefficient of variability was higher than that of genotypic coefficient of variability for all the characters indicating that effect of environment on their genetic expression.

Maximum phenotypic coefficient of variation was obtained for fruit width (181.57), pedicel ; length (105.81),leaf area (38.43), number of branches per plant (34.04), fruit length (24.13), days to 50% flowering (16.29) and moderate to low for remaining traits. The maximum amount of genotypic coefficient of variation was observed for fruit width (121.67), leaf area (37.75), no. of branches per plant (33.10) days to 50% flowering (16.02), fruit length (12.89), no. Of fruit per plant ( 9.52), days to first harvest (8.56), fruit yield per plant (red ripe) (6.27), fruit yield per plant (dry) (4.07gm), plant height 2.55 and minimum coefficient of genotypic variance was observed for pedicel length (- 43.10). This variation indicated the possibility of obtaining very high selection response with respect to these traits.

These results indicated that higher magnitude of genotypic coefficient of variation for the above traits offer a better opportunity for improvement through selection. Similar findings were reported by (Acharya *et al.*, 2007 ), (Maurya *et al.*,2015 ) (Das and Choudhary, 1999) and (Devi *et al.*,1999). The genotypic coefficient of variation provides help to measure the genetic variability in a character and accordingly, it is not possible to partition existing heritable variation in population based solely on this estimate.

According to this the maximum heritability was observed for leaf area 97.00% whereas the lowest herit-

Table 2: Range, mean, genotypic, phenotypic and environmental variance, coefficient of variability, heritability and genetic advance for different characters in chilli (*Capsicum annuum* L.)

| Sr. No. | Characters                    | Range |        | General mean 1 | Genotypic variance | Environmental variance | Phenotypic variance | GCV    | PCV    | Heritability (%) (B.S) | Genetic advance | Genetic advance as % of mean |
|---------|-------------------------------|-------|--------|----------------|--------------------|------------------------|---------------------|--------|--------|------------------------|-----------------|------------------------------|
|         |                               | Min.  | Max.   |                |                    |                        |                     |        |        |                        |                 |                              |
| 1       | Days to 50% Flowering         | 33.92 | 55.33  | 41.59          | 44.41              | 1.51                   | 45.93               | 16.02  | 16.29  | 96.70                  | 13.50           | 32.46                        |
| 2       | Plant height (cm)             | 28.00 | 37.43  | 31.65          | 0.65               | 0.21                   | 0.86                | 2.02   | 2.93   | 67.50                  | 4.04            | 12.76                        |
| 3       | No. of branches per plant     | 3.00  | 6.67   | 4.88           | 2.61               | 0.15                   | 2.76                | 33.10  | 34.02  | 63.60                  | 1.68            | 34.43                        |
| 4       | No. of fruits per plant       | 26.67 | 39.67  | 30.46          | 8.41               | 0.19                   | 8.60                | 9.52   | 9.63   | 81.90                  | 5.40            | 17.73                        |
| 5       | Leaf area (cm <sup>2</sup> )  | 5.17  | 29.20  | 15.32          | 33.44              | 1.22                   | 34.66               | 37.75  | 38.43  | 97.00                  | 17.83           | 116.38                       |
| 6       | Pedicel length (cm)           | 1.57  | 3.30   | 2.52           | -1.18              | 8.30                   | 7.11                | -43.10 | 105.81 | 73.60                  | 0.70            | 27.78                        |
| 7       | Fruit length (cm)             | 5.03  | 8.03   | 6.67           | 0.74               | 1.85                   | 2.59                | 12.89  | 24.13  | 68.20                  | 1.11            | 16.64                        |
| 8       | Fruit width (cm)              | 0.70  | 1.60   | 1.02           | 1.54               | 1.90                   | 3.43                | 121.66 | 181.57 | 72.50                  | 0.39            | 38.23                        |
| 9       | Days to first harvest         | 72.92 | 95.96  | 80.74          | 47.82              | 2.31                   | 50.13               | 8.56   | 8.77   | 96.80                  | 22.47           | 28.83                        |
| 10      | Dry fruit yield/plant(g)      | 30.15 | 46.87  | 37.06          | 2.28               | 0.73                   | 3.01                | 4.07   | 4.68   | 71.30                  | 8.58            | 23.15                        |
| 11      | Red ripe fruit yield/plant(g) | 85.40 | 320.88 | 213.12         | 178.79             | 17.54                  | 196.33              | 6.27   | 6.57   | 92.10                  | 182.01          | 85.40                        |

ability was hovered by number of branches per plant 63.60%. High heritability for days to flower, number of branches per plant, no. of fruit per plant, leaf area, pedicel length, length of fruits, width of fruits, days to first harvest, yield of fruit per plant (dry) and yield of fruits per plant (red ripe), whereas remaining characters showed lower heritability except these characters showed high heritability (Table 2).

These findings are in accordance with the observations made by (Tembhurne, *et al.*, 2008), (Mishra, *et al.*, 2002) and (Sreelathakumary, *et al.*, 2002). High heritability in broad sense indicated that large proportion of phenotypic variance was attributable to the genotypic variance and were less influenced by environment. Hence, selection can bring worthwhile improvement in these traits.

Genetic advance is still a more useful estimate because heritability value by itself does have much significance as it fails to account for the magnitude of absolute variability. It is therefore, necessary to utilize heritability in conjunction with selection differential which would then indicate the expected genetic gain resulting from selection. The leaf area had maximum value (116.38), succeeded by fruit yield per plant red ripe (85.40), fruit width (38.23), number of branches per plant (34.43), days to 50% flowering (32.46), days to first harvest (27.83), pedicel length (27.78), fruit yield per plant (17.73), fruit length (16.64) and plant height (12.76). The consequence of heritability coupled with genetic advance pointed out that two attributes leaf area and fruit yield per plant observed with high heritability as well as moderate genetic gain (Table-2).

Rest the characters exhibited high or moderate heritability with low genetic gain. When the traits exhibit high heritability with moderate to low genetic advance as percent of mean these can be improved through multiple crosses. The results of present investigation are also in agreement with the findings reported by (Ukkund *et al.*, 2007), (Gupta, *et al.*, 2009), (Addissu *et al.*, 2012) and (Vani *et al.*, 2007). High estimates of heritability along with high genetic advance provide good scope for further improvement in advance generation if characters subject mass progeny or family selection

## CONCLUSION

Genetic variability in onion was studied during Rabi season involving 20 genotypes showing wider variation for all traits. Result revealed that the genotypes Azad mirch-1, Sel-16 and 7919 performed better in terms of yield and yield contributing traits and these lines may be used for the breeding programme. The highest genotypic and phenotypic coefficients of variation were noted for

fruit width, leaf area and number of branches per plant. The highest phenotypic coefficient of variation were observed for fruit width, pedicel length and leaf area. The highest genotypic and phenotypic coefficients of variation were noted for fruit width, leaf area and number of branches per plant. The highest phenotypic coefficient of variation were observed for fruit width, pedicel length and leaf area. The highest heritability was recorded for plant height. High heritability with high genetic advance were obtained for leaf area, days to first harvest, days to 50% flowering, red ripe fruit yield per plant, number of fruits per plant, pedicel length, dry fruit width, fruit yield per plant, fruit length, plant height and number of branches per plant which indicated additive gene action for these traits.

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