*J. Hortl. Sci.*
*Vol. 13(2) : 131-136, 2018*

***Original Research Paper***

# Genetic variability, correlation and path analysis in bottle gourd (*Lagenaria siceraria* (Mol. Standl.) germplasm

**B. Varalakshmi*, M. Pitchaimuthu and E. Sreenivas Rao**
Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research
Hesaraghatta Lake Post, Bengaluru - 560 089, India
*Email : Varalakshmi.B@icar.gov.in

## ABSTRACT

**The present investigation was conducted to determine the variability, heritability, genetic advance and correlation of fruit yield and ten different yield contributing characters in bottle gourd. Wide range of variation was observed for most of the characters like fruit yield/vine, fruit number/vine, fruit weight, fruit yield/ha and node number for first female flower appearance. Phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the traits studied, indicating environmental influence on expression of these characters. However, high heritability (broad sense) along with high genetic advance was recorded by vine length, branch number, fruit length, fruit width, fruit yield/vine and yield/ha indicating the presence of additive gene effects, hence selection can be employed for the improvement of these parameters. Fruit yield/ ha was significantly and positively associated with fruit number/ vine and fruit yield/vine both at genotypic as well as phenotypic levels. Fruit number had maximum direct effect (0.812) on fruit yield/ha followed by fruit weight (0.407), fruit length (0.339), fruit width (0.310), fruit yield/vine (0.249), days taken for first female flower appearance (0.224) and vine length (0.173). Therefore for the yield improvement in bottle gourd, emphasis may be given for indirect selection through fruit parameters like fruit weight, fruit length, fruit number and fruit yield/vine.**

**Key words:** Bottle gourd, genetic variability, heritability, path analysis

## INTRODUCTION

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] commonly known as Lauki or Ghiya in India is one of the most important member of the family *Cucurbitaceae* and believed to be originated in Africa (Whitaker, 1971). It is commercially grown in all the states of India in both rainy and summer seasons. The immature fruits contain good amount of vitamins and have good medicinal values. Yield is a complex trait influenced by genetic factors interacting with environment. Success in any breeding programme for improvement depends on existing genetic variability in the base-population and on efficiency of selection. For successful selection, it is necessary to study the nature of association of the trait of interest with other relevant traits and, also the genetic variability available for these. Path coefficient provides a better index for selection than mere correlation coefficient, thereby separating the correlation coefficient of yield and its components into direct and indirect effects. Therefore, the present study was undertaken to understand the nature and magnitude of variability, heritability, correlation coefficients and path analysis for different quantitative parameters in bottle gourd. The information on such aspects can be of great help in formulating an appropriate breeding strategy for genetic upgradation of this crop.

## MATERIAL AND METHODS

The experiments were carried out at the Vegetable Farm, ICAR-Indian Institute of Horticultural Research, Bengaluru during Rabi-summer seasons of 2012-13 and 2013-14. The experiments were laid out in Randomized Block Design with 35germplasm lines in two replications in both the years. Ten plants per replication were raised. Two weeks old seedlings were planted at 200 x 60 cm spacing and the plants were trained on single trellis. The recommended agronomical practices were adopted to raise the crop. Observations

were recorded on five randomly selected plants from each replication on 11 quantitative traits such as node number for first female flower appearance, days taken for first female flower appearance, vine length (m), branch number, peduncle length (cm), fruit length (cm), fruit girth (cm), fruit number/plant, fruit weight (g), fruit yield/plant (kg) and fruit yield/ha (t).

The pooled data of two years were analyzed as suggested by Panse and Sukhatme (1984) for analysis of variance. The phenotypic and genotypic coefficients of variation (PCV and GCV), heritability in broad sense and genetic advance as percent of mean were calculated as per the procedures given by Burton and De Vane (1953) and Johnson *et al* (1955). The correlation co-efficient among all possible character combinations at genotypic (rg) and phenotypic (rp) level were estimated employing the formula given by Al-Jibouri *et al* (1958) and path coefficient analysis has been done as per Dewey and Lu (1959). GENRES Statistical Software Package (GENRES, 1994) was employed for analysis of variance and estimation of correlation among the traits.

## RESULTS AND DISCUSSION

Mean, range and estimates of various genetic parameters of 11 different characters of the 35germplasm lines of bottle gourd are presented in the **Table 1**. The analysis of variance revealed significant differences among the germplasm lines of bottle gourd for all the 11traits studied. Wide range of variation was observed for most of the characters like fruit yield/ vine (1.5-8.5kg), fruit number/vine (1.9-6.1), fruit weight (79.8-300.8g), fruit yield/ha (12.0-70.9 t)and node number for first female flower appearance (4.7-15.2). Presence of such high variability for these parameters will form the basis for effective selection of superior lines in bottle gourd. Such wide variability in this crop has also been reported by Kumar *et al* (2011), Husna *et al* (2011), Anchal Sharma and Sengupta (2013) and Ara *et al* (2014). The degree of variability shown by different parameters can be judged by the magnitude of GCV and PCV. GCV, which gives the picture of extent of genetic variability present in the population ranged from 9.2 (days taken for first female flower appearance) to 31.2 (fruit yield/vine). Similar findings were reported by Yadav*et al* (2008), Husna*et al* (2011) and Ara*et al* (2014) in bottle gourd.A perusal of data in Table 1showed that there is considerable difference between PCV and GCV values for all the characters studied (Singh *et al*, 2008). This indicates the presence of higher environmental influence on the expression of all these parameters

**Table 1. Means, coefficients of variation, heritability and genetic advance for eleven different characters in bottle gourd**

| Sl.No. | Character | Mean | Range | Genotypic Coefficient of Variation (GCV) | Phenotypic Coefficient of Variation (PCV) | Heritability ($h^2$) | G.A.as %mean |
|---|---|---|---|---|---|---|---|
| 1 | Vine length (m) | 4.8 | 2.8-8.9 | 27.1 | 29.7 | 83.3 | 50.9 |
| 2 | Branch number | 12.5 | 7.3-20.8 | 20.9 | 26.9 | 60.5 | 33.5 |
| 3 | NFF | 7.2 | 4.7-15.2 | 23.3 | 31.6 | 54.2 | 35.3 |
| 4 | DFF | 56.1 | 45.5-71.7 | 9.2 | 11.5 | 64.1 | 15.2 |
| 5 | Peduncle length (cm) | 10.6 | 6.8-14.1 | 11.0 | 22.2 | 24.7 | 11.3 |
| 6 | Fruit length (cm) | 31.8 | 11.2-48.5 | 24.9 | 28.4 | 77.2 | 45.2 |
| 7 | Fruit width (cm) | 9.0 | 6.9-13.2 | 19.8 | 23.4 | 71.6 | 34.6 |
| 8 | Fruit weight (g) | 1.3 | 0.5-2.6 | 22.5 | 31.9 | 49.7 | 32.7 |
| 9 | Fruit number/vine | 3.7 | 1.9-6.1 | 26.1 | 33.8 | 59.7 | 41.6 |
| 10 | Fruit yield/vine (kg) | 4.2 | 1.5-8.5 | 31.2 | 36.5 | 73.3 | 55.1 |
| 11 | Fruit yield/ha (t) | 36.2 | 12.0-70.9 | 29.7 | 33.0 | 80.8 | 54.9 |

NFF- Node number for first female flower appearance, DFF- Days taken for first female flower appearance

and selection as such may not be effective for the improvement of bottle gourd. Further, the GCV values were low in magnitude compared to PCV values for all the characters studied. This also indicates that the direct selection is not effective for these characters and heterosis breeding can be resorted for further improvement. However, contrary to this Anchal Sharma and Sengupta (2013) reported that the GCV and PCV values were in close proximity for all the traits studied in bottle gourd.

With the help of GCV alone, it is not possible to determine the extent of variation that is heritable. Thus the estimates of heritability indicate the effectiveness with which selection can be expected to exploit the existing genetic variability. The broad sense heritability was high (>60%) for almost all the traits except node number for first female flower appearance, peduncle length, fruit weight and fruit number. Similar findings were reported by Kumar *et al* (2011), *Husna et al* (2011) and Anchal Sharma and Sengupta (2013) in bottle gourd. Moderate heritability (40-60%) was observed for node number for first female flower appearance, fruit weight and fruit number (Table 1). Johnson *et al*. (1955) reported that the heritability along with genetic advance is more useful than the heritability alone in predicting the resultant effect of selecting best individual genotype as it suggests the presence of additive gene effects. In the present study, high heritability along with high genetic advance was recorded by vine length, branch number, fruit length, fruit width, fruit yield/vine and yield/ha indicating the presence of additive gene effects, hence selection can be employed for the improvement of these parameters in bottle gourd. Similar findings were reported by Singh *et al* (2008), Yadav *et al* (2008), Husna *et al* (2011),Kumar *et al* (2011), Anchal Sharma and Sengupta (2013) in bottle gourd. Days taken for the first female flower appearance, peduncle length and fruit weight have recorded moderate heritability and genetic advance. This suggests that the environmental effects constitute major portion of total phenotypic variation and hence direct selection for these characters will be less effective.

All possible correlation coefficients between fruit yield/ha and its component characters were estimated at genotypic (G) and phenotypic (P) levels and have been presented in **Table 2**. From these associations, it appeared that higher fruit yield/ ha was significantly and positively associated with fruit number/ vine and fruit yield/vine both at genotypic as well as phenotypic levels. In the present investigation, the interrelation between these two yield contributing parameters was also positive and significant. Vine length had significantly positive correlation with branch number, node number and days taken for first female flower appearance and positive but non-significant association with fruit width. Branch number was also positively correlated with node number and days taken for first female flower appearance and fruit width, but negatively and significantly correlated with fruit weight indicating that the increased branch number reduces fruit weight in bottle gourd. Important fruit traits, fruit length and fruit width are significantly negatively correlated. Indirect selection for fruit number and fruit yield/vine will improve the fruit yield in bottle gourd. These results are in conformity with the findings of Yadav *et al* (2007), Wani *et al* (2008), Husna *et al* (2011) and Ara *et al* (2014) in bottle gourd.

Though the correlation analysis can quantify the degree of association between two characters, it does not provide reasons for such association. The simple linear correlation coefficient is designed to detect the presence of linear association between two variables. It cannot be taken to imply the absence of any functional relationship between the two variables. Path coefficient analysis reveals this mystery by breaking the total correlation into components of direct and indirect effects. Thus path analysis was performed to assess the direct and indirect effects of different characters on fruit yield/ha (**Table 3**). Fruit number had maximum direct effect (0.812) on fruit yield/ha followed by fruit weight (0.407), fruit length (0.339), fruit width (0.310), fruit yield/vine (0.249), days taken for first female flower appearance (0.224) and vine length (0.173). The indirect effects of most other parameters through these parameters were also positive as well as negative, but the higher magnitude of positive direct effects nullified the negative indirect effects resulting in the positive direct effect on fruit yield/ha. The positive direct and indirect effects of fruit number and fruit yield/vine have lead to the significant and positive correlation with fruit yield/ha. Similarly, Wani *et al* (2008) and Husna *et al* (2011) also reported that fruit traits had maximum direct effect on fruit yield

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

| Character | | Vine Length (m) | Branch Number | NFF | DFF | Peduncle length (cm) | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Fruit number/ vine | Fruit Yield/vine (kg) | Fruit Yield/ha (t) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vine length (m) | ($r_g$) | 1.000 | 0.587** | 0.682** | 0.711** | -0.323 | -0.181 | 0.288 | -0.238 | -0.019 | -0.083 | -0.096 |
| | ($r_p$) | 1.000 | 0.403* | 0.458** | 0.532** | -0.122 | -0.156 | 0.242 | -0.090 | -0.017 | -0.057 | -0.053 |
| Branch number | ($r_g$) | | 1.000 | 0.195 | 0.274 | -0.333 | -0.110 | 0.166 | -0.449** | 0.240 | 0.051 | -0.052 |
| | ($r_p$) | | 1.000 | 0.158 | 0.246 | -0.148 | -0.065 | 0.109 | -0.218 | -0.023 | -0.044 | -0.110 |
| NFF | ($r_g$) | | | 1.000 | 0.769** | -0.188 | -0.266 | 0.429* | -0.051 | -0.236 | -0.279 | -0.283 |
| | ($r_p$) | | | 1.000 | 0.542** | -0.082 | -0.063 | 0.300 | 0.030 | -0.234 | -0.203 | -0.192 |
| DFF | ($r_g$) | | | | 1.000 | -0.182 | -0.288 | 0.312 | -0.238 | -0.201 | -0.229 | -0.252 |
| | ($r_p$) | | | | 1.000 | -0.057 | -0.172 | 0.283 | -0.144 | -0.112 | -0.168 | -0.180 |
| Peduncle length (cm) | ($r_g$) | | | | | 1.000 | 0.195 | -0.400* | 0.497** | -0.222 | 0.058 | 0.092 |
| | ($r_p$) | | | | | 1.000 | 0.113 | -0.140 | 0.182 | -0.063 | 0.029 | 0.038 |
| Fruit length (cm) | ($r_g$) | | | | | | 1.000 | -0.877** | 0.233 | -0.155 | 0.016 | 0.057 |
| | ($r_p$) | | | | | | 1.000 | -0.629** | 0.234 | -0.106 | 0.034 | 0.085 |
| Fruit width (cm) | ($r_g$) | | | | | | | 1.000 | -0.003 | -0.063 | -0.097 | -0.134 |
| | ($r_p$) | | | | | | | 1.000 | 0.018 | -0.044 | -0.129 | -0.106 |
| Fruit weight (g) | ($r_g$) | | | | | | | | 1.000 | -0.304 | 0.130 | 0.315 |
| | ($r_p$) | | | | | | | | 1.000 | -0.279 | 0.038 | 0.214 |
| Fruit number/vine | ($r_g$) | | | | | | | | | 1.000 | 0.881** | 0.792** |
| | ($r_p$) | | | | | | | | | 1.000 | 0.722** | 0.689** |
| Fruit yield/vine (kg) | ($r_g$) | | | | | | | | | | 1.000 | 1.003** |
| | ($r_p$) | | | | | | | | | | 1.000 | 0.876** |

** Significant at *P=0.01*, * Significant at *P=0.05*

NFF- Node number for first female flower appearance, DFF- Days taken for first female flower appearance

**Table 3. Direct and indirect effects of different characters on fruit yield/ha at genotypic levels in bottle gourd**

| Character | Vine length (m) | Branch number | NFF | DFF | Peduncle length (cm) | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Fruit number/ vine | Fruit yield/vine (kg) | Genotypic correlation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vine length (m) | 0.173 | -0.096 | -0.193 | 0.159 | -0.033 | -0.061 | 0.089 | -0.097 | -0.016 | -0.021 | -0.096 |
| Branch number | 0.102 | -0.164 | -0.055 | 0.061 | -0.034 | -0.037 | 0.051 | -0.183 | 0.194 | 0.013 | -0.052 |
| NFF | 0.118 | -0.032 | -0.284 | 0.172 | -0.019 | -0.090 | 0.133 | -0.021 | -0.192 | -0.069 | -0.283 |
| DFF | 0.123 | -0.045 | -0.218 | 0.224 | -0.019 | -0.098 | 0.097 | -0.097 | -0.163 | -0.057 | -0.252 |
| Peduncle length (cm) | -0.056 | 0.055 | 0.053 | -0.041 | 0.102 | 0.066 | -0.124 | 0.202 | -0.180 | 0.014 | 0.092 |
| Fruit length (cm) | -0.031 | 0.018 | 0.075 | -0.065 | 0.020 | 0.339 | -0.272 | 0.095 | -0.126 | 0.004 | 0.057 |
| Fruit width (cm) | 0.050 | -0.027 | -0.122 | 0.070 | -0.041 | -0.297 | 0.310 | -0.001 | -0.051 | -0.024 | -0.134 |
| Fruit weight (g) | -0.041 | 0.074 | 0.014 | -0.053 | 0.051 | 0.079 | -0.001 | 0.407 | -0.247 | 0.032 | 0.315 |
| Fruit number/vine | -0.003 | -0.039 | 0.067 | -0.045 | -0.023 | -0.053 | -0.019 | -0.124 | 0.812 | 0.219 | 0.792** |
| Fruit yield/vine (kg) | -0.014 | -0.008 | 0.079 | -0.051 | 0.006 | 0.005 | -0.030 | 0.053 | 0.715 | 0.249 | 1.003** |

** Significant at *P=0.01*, * Significant at *P=0.05*

Direct effects are in bold figures on main diagonal.

NFF- Node number for first female flower appearance, DFF- Days taken for first female flower appearance

in bottle gourd. Whereas node number for first female flower appearance and branch number had negative direct effect on fruit yield/ha. The positive direct and indirect effects of fruit length, fruit weight, fruit yield/ plant, fruit number have lead to the significant and positive correlation with fruit yield/ha. This indicates that the positive selection for these parameters is going to contribute to higher fruit yields in bottle gourd.

Therefore for the yield improvement in bottle gourd, emphasis may be given for indirect selection through fruit parameters like fruit length, fruit weight, fruit number and fruit yield/plant.

## REFERENCES


Al-Jibouri, H.H., Miller, P.A. and Robinson, H.F. 1958.Genotypic and environmental variances and covariances in upland cotton crosses of interspecific origin.*Agron. J.*, **50**: 633-37.

Anchal Sharma and S.K. Sengupta.2013. Genetic Diversity, Heritability and Morphological Characterization in Bottle Gourd (*Lagenariasiceraria* (Mol.) Stand). *The Bioscan*.**8**(4): 1461-1465.

Ara Z.G., Zakaria, M., Uddin, M.Z., Rahman, M.M., Rasul, M.G. and Kabir, A.F.M.R. 2014. Correlation matrix among different parameters of bottle gourd genotypes *Int. J Nat. Soc Sci*.**1**:48-51. ISSN: 2313-4461

Burton, G.W. and De Vane, E.W. 1953. Estimating heritability in tall fescue (*Festucaarundinacea*) from replicated clonal material. *Agron. J.*, **45**:478-81.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.*,**51**:515-18.

GENRES. 1994. Data entrymodule for genres statistical software Pascal Int'l. Software Solution, Version 3.11

Husna, A., Mahmud, F., Islam, M.R., Mahmud,M.A.A. and Ratna,M. 2011.Genetic variability, correlation and path co - efficient analysis in bottle gourd (*Lagenariasicereria*(Mol.) stand).*Ad.Bio. Res.* **5**(6): 323-327.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybean.*Agron. J.,* **47**:314-18.

Kumar, A., Singh, B., Kumar,M. and Naresh,R.K. 2011.Genetic variability, heritability, genetic advance for yield and its components in bottle gourd (*Lageneriasicereria*(Mol.) stand).*Ann. of Horti*.**4**(1): 101-103

Panse, V.G. and Sukhatme, P.V. 1984. Statistical Methods for Agricultural Workers.Indian Council of Agricultural Research, New Delhi.

Singh,K.P., Choudhury,D.N., Mandal,G. and Saha,B.C. 2008.Genetic variability in bottle gourd (*Lagenaria siceraria* (Molina) Standl.).*J. Interacademicia*. **12**(2): 159-163

Wani, K.P., Ahmed, N., Hussain, K., Mehfuza-Habib and Kant, R.H. 2008.Correlation and path coefficient analysis in bottle gourd (*Lagenariasiceraria* L.) under temperate conditions of Kashmir valley.*Environment and Ecology*.**26**(2A): 822-824

Whitaker, T.W. 1971.Men across the sea. Kelley JC, Pennigton CW and Rauds RL (Eds.) pp. 320-27.

Yadav, A., Srivastava, J.P., Yadav, J.R., Shukla, I.N., Mishra, G., Kumar,S. and Parihar,N.S. 2007.Correlation and path coefficient analysis in bottle gourd [*Lagenariasiceraria* (Molina) Standl.].*Prog. Res.***2**(1/2): 165-166

Yadav, J.R., Yadav, A., Srivastava, J.P., Mishra, G., Parihar, N.S. and Singh,P.B. 2008. Study on variability heritability and genetic advance in bottle gourd [*Lagenariasiceraria* (Molina) Standl.]. *Prog. Res.***3**(1): 70-72


(*MS Received 22 June 2017, Revised 15 November 2018, Accepted 20 December 2018*)