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# Correlation and path analysis for quantitative and qualitative traits in bottle gourd [*Lagenaria siceraria* (Molina) standl]

**B Muralidharan, V Kanthaswamy and KG Janaranjani**

**Abstract**
The experiment carried out Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry (U.T), India. The analysis for quantitative and qualitative traits in Bottle gourdall 24 genotypes was used to partition the genotypic correlation into components of direct and indirect effects. The emphasis should be given to improve fruit yield per plant in bottle gourd was found significant and positively correlated with fruit flesh thickness (r = 0.522) and fruit weight (r = 0.644), and the result of path analysis study revealed that the characters like vine length, number of primary branches, number of seeds per fruit and number of pickings were the most important yield determinants, because of their high direct effects and high indirect effects *via.*, many other yield improving characters. This suggests that emphasis must be given on such traits while exercising selection to improve the yield in bottle gourd.

**Keywords:** correlation, path, quantitative, qualitative and bottle gourd

## Introduction
Bottlegourd [*Lagenaria siceraria* (Molina) Standl] is an important member of Cucubitaceae family. It is commercially grown in almost all parts of India during summer as well as rainy season, the fruits are nutritionally rich and used in various culinary purposes. It is highly cross pollinated crop with large amount of variation for many economically important traits. Yield is a complex character and is governed by polygenic system. Moreover, it is highly influenced by environmental fluctuations. Correlation analysis is a biometrical technique to find out the nature and degree of associations among various traits. The study of correlation between plant characters is of great importance to a plant breeder as it provides a measure of the degree of association between yield and other yield attributes. The path coefficient analysis is partitioned the correlation in direct and indirect effects and thus may be useful in choosing the characters that have direct and indirect effects on yield. Hence, study of correlations (genotypic and phenotypic) and path coefficient analysis of yield would be of help in selection of yield component traits in the genetic improvement of quantitative traits, which are positively correlated. Correlation and path coefficient analysis have been studied by several workers to measure the associations between pod yield and other traits Dewey and Lu, (1959) [3]. For a successful planning of breeding improvement program, the analysis of variability among the traits and their association of a particular character in relation to yield and yield attributing traits it would be great importance (Mary and Gopalan, 2006) [10] Ramesh Kumar Jat *et al*. (2014) [7] Kumar *et al*. (2013) [8] and Sharma and Sengupta (2013) [12] in bottle gourd. Keeping in the view of above facts, the objectives of the present investigation was to study the association of yield and its component traits and the direct and indirect effects of yield component traits on fruit yield in bottle gourd genotypes.

## Materials and Methods
The experiment was conducted from January 2011 to April 2011 in the college orchard, Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute (affiliated to the Tamil Nadu Agricultural University), Karaikal. The experiment was laidoutina Randomized Block Design (RBD) with three replications. All the recommended cultural and management practices were followed to raise a healthy crop. Five competitive plants were taken randomly in the observations were recorded on nineteen parameters (Table 1 and 2). The correlations were worked out as per methods suggest edby Johnson *et al*. (1955) [6]. Path coefficient analysis as suggested by Dewey and Lu (1959) [3] was used to partition the genotypic correlation into components of direct and indirect effects.

By keeping yield as dependent variable and the other traits as independent variables, simultaneous equation, which express the basic relationship between path coefficients were solved to estimate the direct and indirect effects. The direct and indirect effects were classified based on the scale given by Lenka and Mishra, (1973) [9].

**Results and Discussion**

The yield per vine was found to be significant and positively correlated with fruit flesh thickness (r = 0.522) and fruit weight (r = 0.644) Characters such as fruit weight and fruit flesh thickness had significant positive correlation among themselves, as well as positive significant correlating with yield. In breeding programme directed towards many traits simultaneously, characters showing positive and significant correlation with yield and among themselves would be considered desirable.

The correlations and inter correlations has highlighted the prominent role of the traits such as fruit weight and fruit flesh thickness. It would therefore be concluded that selection for these traits would bring about an improvement in total fruit yield per vine. It is also suggested that hybridization of genotypes possessing combination of such characters would be most useful in obtaining desirable high yielding segregants and this is in agreement with earlier findings by Tarsem Lal and Sanjay Singh (1997) [13] in muskmelon for flesh thickness and Ashish Kumar *et al*. (2008) [8] in cucumber fruit weight.

Number of primary branches, sex ratio, fruit length, fruit width, fruit cavity, number fruit per vine, number of pickings and number of seeds per fruit recorded positive and non-significant association with fruit yield per vine. This is in agreement with earlier findings by Haribabu (1985) [4] in cucumber for number of fruits per vine, and Pradeep Kumar and Syamal (2010) [7] and Husna *et al*., (2011) [5] in bottle gourd for number of primary branches.

Vine length, Node number at first male flower appearance, node number at first female flower appearance, days to first male flower anthesis, days to first female flower anthesis, days to first harvest, weight of 100 seeds, and total soluble solids showed negative and non-significant association with yield per vine The same negative association on yield was also observed by Borthakur and Baruah (2006) [2] in bitter gourd.

Path co-efficient analysis was carried out on direct and indirect effects of eighteen characters of present study on fruit yield per vine and the results are presented in Table 2. The highest effect on the fruit yield per vine was exerted by fruit weight (1.32970), fruit width (0.72276), number of seeds per fruit (0.69060), days to female flower anthesis (0.44221), number of fruit per vine (0.25197), fruit flesh thickness (0.25088), number of primary branches (0.21182) and number of pickings (0.13025). The positive direct effect of fruit weight on yield was reported by Thakur *et al*. (1980) [14]. Residual effect = 0.3261607implies that total genotypic variability in yield has been explained by the characters associated in the study. The result of plant analysis study revealed that characters like vine length, number of primary branches, number of seeds per fruit and number of pickings were the most important yield determinants, because of their high direct effects and high indirect effects *via.*, many other yield improving characters. The indirect effect also showed that most of the characters influenced the yield through number of fruits per vine, number of seeds per fruit and number of pickings and fruit weight. This suggests that emphasis must be given on such traits while exercising selection to improve yield production in bottle gourd.

**Table 1:** Genotypic correlation coefficients of quantitative and qualititative trait in bottle gourd genotypes.

| | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_9$ | $X_{10}$ | $X_{11}$ | $X_{12}$ | $X_{13}$ | $X_{14}$ | $X_{15}$ | $X_{16}$ | $X_{17}$ | $X_{18}$ | $X_{19}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $X_1$ | 1.000 | 0.245 | 0.638** | 0.342 | 0.026 | -0.044 | 0.206 | 0.375 | 0.017 | 0.040 | 0.164 | 0.198 | 0.212 | -0.289 | -0.111 | 0.003 | 0.029 | 0.036 | -0.073 |
| $X_2$ | | 1.000 | 0.267 | 0.406* | -0.207 | -0.215 | -0.082 | 0.070 | -0.141 | 0.043 | 0.032 | 0.227 | 0.036 | -0.107 | -0.018 | -0.174 | -0.218 | 0.156 | 0.132 |
| $X_3$ | | | 1.000 | 0.662** | 0.148 | 0.075 | 0.002 | 0.428* | 0.031 | -0.201 | -0.099 | -0.174 | -0.030 | -0.403 | -0.206 | 0.154 | 0.127 | 0.175 | -0.365 |
| $X_4$ | | | | 1.000 | 0.067 | -0.175 | 0.222 | 0.319 | 0.117 | 0.018 | -0.002 | -0.140 | -0.163 | -0.206 | -0.169 | 0.399 | -0.015 | 0.325 | -0.247 |
| $X_5$ | | | | | 1.000 | 0.904** | 0.245 | 0.582** | -0.403 | 0.373 | 0.433* | 0.033 | 0.087 | -0.453* | -0.314 | 0.051 | 0.316 | 0.212 | -0.156 |
| $X_6$ | | | | | | 1.000 | 0.093 | 0.273 | -0.571** | 0.470* | 0.436* | -0.082 | -0.054 | -0.271 | -0.146 | -0.285 | 0.552** | 0.052 | -0.296 |
| $X_7$ | | | | | | | 1.000 | 0.258 | -0.068 | 0.308 | 0.497* | 0.319 | 0.474* | -0.299 | -0.208 | 0.293 | 0.028 | 0.140 | 0.282 |
| $X_8$ | | | | | | | | 1.000 | 0.082 | 0.154 | 0.181 | 0.329 | 0.388 | -0.802** | -0.584** | 0.138 | -0.058 | 0.535** | -0.027 |
| $X_9$ | | | | | | | | | 1.000 | -0.592** | -0.521** | -0.066 | 0.257 | -0.304 | -0.490* | 0.261 | -0.357 | 0.167 | 0.102 |
| $X_{10}$ | | | | | | | | | | 1.000 | 0.852** | 0.524** | 0.124 | -0.058 | 0.113 | -0.246 | 0.253 | -0.023 | 0.202 |
| $X_{11}$ | | | | | | | | | | | 1.000 | 0.541** | 0.425* | -0.117 | 0.173 | -0.059 | 0.252 | -0.024 | 0.399 |
| $X_{12}$ | | | | | | | | | | | | 1.000 | 0.637** | -0.395 | -0.193 | -0.262 | -0.084 | 0.219 | 0.552** |
| $X_{13}$ | | | | | | | | | | | | | 1.000 | -0.477* | -0.330 | -0.107 | 0.003 | 0.056 | 0.664** |
| $X_{14}$ | | | | | | | | | | | | | | 1.000 | 0.897** | 0.152 | 0.006 | -0.506* | 0.146 |
| $X_{15}$ | | | | | | | | | | | | | | | 1.000 | 0.127 | 0.149 | -0.375 | 0.161 |
| $X_{16}$ | | | | | | | | | | | | | | | | 1.000 | -0.268 | 0.000 | 0.142 |
| $X_{17}$ | | | | | | | | | | | | | | | | | 1.000 | -0.062 | -0.198 |
| $X_{18}$ | | | | | | | | | | | | | | | | | | 1.000 | -0.260 |
| $X_{19}$ | | | | | | | | | | | | | | | | | | | 1.000 |

$X_1$ – Vine length $X_7$ – Sex ratio $X_{12}$ –Fruit flesh thickness $X_{17}$ – 100 seed weight $X_2$ –Number of primary branches
$X_8$ – Days to first harvest $X_{13}$ –Fruit weight $X_{18}$ –Total soluble solids $X_3$ –Node number at first male flower appears $X_9$ –Fruit length
$X_{14}$– Number fruit per vine $X_{19}$ –Yield per vine $X_4$ – Node number at first female flower appears $X_{10}$ –Fruit width $X_{15}$ – Number of picking
$X_5$ – Days to first male flower anthesis $X_{11}$ –Fruit cavity $X_{16}$ –Number of seeds per fruit

**Table 2:** Direct and indirect effects of yield components on fruit yield in bottle gourd genotypes.

| | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 | X11 | X12 | X13 | X14 | X15 | X16 | X17 | X18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X1 | 0.04186 | 0.05198 | -0.09110 | 0.01903 | -0.00212 | -0.01949 | -0.05059 | -0.15020 | -0.00144 | 0.02879 | -0.14101 | 0.04955 | 0.28231 | -0.07279 | -0.01444 | 0.00224 | -0.00541 | 0.00006 |
| X2 | 0.01027 | 0.21182 | -0.03813 | 0.02264 | 0.01670 | -0.09528 | 0.02017 | -0.02797 | 0.01215 | 0.03076 | -0.02729 | 0.05702 | 0.04808 | -0.02690 | -0.00236 | -0.12041 | 0.04023 | 0.00026 |
| X3 | 0.02670 | 0.05654 | -0.14285 | 0.03685 | -0.01192 | 0.03328 | -0.00043 | -0.17151 | -0.00270 | -0.14517 | 0.08534 | -0.04358 | -0.04051 | -0.10154 | -0.02682 | 0.10658 | -0.02335 | 0.00029 |
| X4 | 0.01431 | 0.08610 | -0.09452 | 0.05569 | -0.00544 | -0.07752 | -0.05466 | -0.12795 | -0.01001 | 0.01272 | 0.00170 | -0.03517 | -0.21723 | -0.05192 | -0.02200 | 0.27554 | 0.00268 | 0.00054 |
| X5 | 0.00110 | -0.04384 | -0.02110 | 0.00375 | -0.08067 | 0.39984 | -0.06012 | -0.23313 | 0.03465 | 0.26949 | -0.37184 | 0.00826 | 0.11530 | -0.11404 | -0.04096 | 0.03549 | -0.05828 | 0.00035 |
| X6 | -0.00184 | -0.04564 | -0.01075 | -0.00976 | -0.07294 | 0.44221 | -0.02280 | -0.10942 | 0.04905 | 0.33958 | -0.37499 | -0.02059 | -0.07172 | -0.06827 | -0.01908 | -0.19705 | -0.10159 | 0.00009 |
| X7 | 0.00861 | -0.01738 | -0.00025 | 0.01238 | -0.01972 | 0.04101 | -0.24588 | -0.10338 | 0.00588 | 0.22266 | -0.42680 | 0.08006 | 0.62966 | -0.07531 | -0.02706 | 0.20244 | -0.00525 | 0.00023 |
| X8 | 0.01569 | 0.01479 | -0.06115 | 0.01778 | -0.04694 | 0.12076 | -0.06344 | -0.40068 | -0.00706 | 0.11115 | -0.15554 | 0.08263 | 0.51608 | -0.20219 | -0.07611 | 0.09536 | 0.01071 | 0.00089 |
| X9 | 0.00070 | -0.02996 | -0.00449 | 0.00649 | 0.03255 | -0.25254 | 0.01682 | -0.03292 | -0.08589 | -0.42774 | 0.44818 | -0.01649 | 0.34161 | -0.07658 | -0.06381 | 0.18012 | 0.06580 | 0.00028 |
| X10 | 0.00167 | 0.00901 | 0.02869 | 0.00098 | -0.03008 | 0.20776 | -0.07575 | -0.06162 | 0.05083 | 0.72276 | -0.73246 | 0.13143 | 0.16538 | -0.01470 | 0.01471 | -0.17015 | -0.04668 | -0.00004 |
| X11 | 0.00687 | 0.00672 | 0.01418 | -0.00011 | -0.03490 | 0.19291 | -0.12209 | -0.07251 | 0.04478 | 0.61588 | -0.85957 | 0.13567 | 0.56532 | -0.02947 | 0.02258 | -0.04058 | -0.04642 | -0.00004 |
| X12 | 0.00827 | 0.04814 | 0.02482 | -0.00781 | -0.00265 | -0.03630 | -0.07847 | -0.13197 | 0.00565 | 0.37865 | -0.46482 | 0.25088 | 0.84760 | -0.09963 | -0.02511 | -0.18075 | 0.01554 | 0.00037 |
| X13 | 0.00889 | 0.00766 | 0.00435 | -0.00910 | -0.00699 | -0.02385 | -0.11643 | -0.15551 | -0.02207 | 0.08989 | -0.36544 | 0.15992 | 1.32970 | -0.12014 | -0.04301 | -0.07396 | -0.00048 | 0.00009 |
| X14 | -0.01209 | -0.02261 | 0.05757 | -0.01148 | 0.03651 | -0.11981 | 0.07349 | 0.32151 | 0.02610 | -0.04216 | 0.10053 | -0.09919 | -0.63397 | 0.25197 | 0.11680 | 0.10477 | -0.00102 | -0.00085 |
| X15 | -0.00464 | -0.00384 | 0.02941 | -0.00941 | 0.02537 | -0.06478 | 0.05109 | 0.23414 | 0.04207 | 0.08163 | -0.14902 | -0.04837 | -0.43902 | 0.22594 | 0.13025 | 0.08785 | -0.02752 | -0.00063 |
| X16 | 0.00014 | -0.03693 | -0.02205 | 0.02222 | -0.00415 | -0.12618 | -0.07208 | -0.05533 | -0.02240 | -0.17808 | 0.05050 | -0.06566 | -0.14240 | 0.03823 | 0.01657 | 0.69060 | 0.04943 | 0.00000 |
| X17 | 0.00123 | -0.04628 | -0.01811 | -0.00081 | -0.02553 | 0.24394 | -0.00701 | 0.02330 | 0.03069 | 0.18321 | -0.21665 | -0.02117 | 0.00349 | 0.00140 | 0.01946 | -0.18534 | -0.18417 | -0.00010 |
| X18 | 0.00150 | 0.03308 | -0.02493 | 0.01808 | -0.01713 | 0.02287 | -0.03439 | -0.21434 | -0.01433 | -0.01658 | 0.02089 | 0.05490 | 0.07403 | -0.12753 | -0.04887 | 0.00004 | 0.01151 | 0.00167 |

Residual effect = 0.3261607

$X_1$ – Vine length $X_7$ – Sex ratio $X_{12}$ –Fruit flesh thickness $X_{17}$ – 100 seed weight $X_2$ –Number of primary branches $X_8$ – Days to first harvest $X_{13}$ –Fruit weight $X_{18}$ –Total soluble solids $X_3$ –Node number at first male flower appears $X_9$ –Fruit length $X_{14}$– Number fruit per vine $X_4$ – Node number at first female flower appears $X_{10}$ –Fruit width $X_{15}$ – Number of picking $X_5$ – Days to first maleflower anthesis $X_{11}$ –Fruit cavity $X_{16}$ –Number of seeds per fruit $X_6$ – Days to first female flower anthesis

*Bold values indicate direct effects

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