



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 252-255

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Received: 21-11-2019

Accepted: 23-12-2019

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## Path coefficient analysis of various quantitative traits of bottle gourd

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### Abstract

A field trial was conducted to weigh up the path coefficient analysis between various morphological traits which directly as well as indirectly associated with yield of various bottle gourd genotypes. The research experiment consists of total 37 genotypes conducted at Research Farm of Vegetable Science department, Chaudhary Charan Singh Haryana Agricultural University, Hisar during summer season. Genotypes were sown with three replications following (RBD) randomized block design. The observed data were taken for further statistical analysis. Substantial amount of variability was found for the sixteen morphological traits which were confirmed by the ANOVA (analysis of variance). The characters having positive direct effect on yield per ha are number of primary branches, leaf width, nodes to first female flower, days to first female flower opening, days to fruit harvest, number of fruits per vine, fruit yield per plant and weight of seeds.

**Keywords:** Bottle gourd, path coefficient analysis, polygenic traits and yield

### 1. Introduction

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is a member of family cucurbitaceae (largest family consisting of 200 genera and 1000 species). It is diploid in nature, having chromosome number  $2n=2x=24$ . The genus consists of six species which show pantropical distribution around Africa, Madagascar, Indo-malaya and neo tropical regions. Among all six species only one is monoecious which is prevalent in India and rest dioecious species are dispersed in Africa. The plant bears chalky white colour both male and female flowers separately on the main stem (Joshi and Gaur, 1971) [10]. Hence, cross pollination is mainly observed and honeybee is the chief pollinator. Bottle gourd has higher nutritive value. It is rich in essential amino acids and several types of micronutrients. Its seeds are also the chief source of protein, lipid and various types of essential fatty acid, and if utilized properly, it can solve the problem of malnutrition and serve as raw material for agro-based industries (Hassan *et al.*, 2008) [7]. Thus, breeders want to focus on development of high yielding genotype. Yield is a polygenic trait which is governed by various major and minor genes with environmental effect. Therefore, for improvement of polygenic traits like yield, study of various morphological traits which are associated with it, is a crucial step. But analysis of correlation coefficient does not depict true association between all the characters which are taken in the experiment for showing their effects towards yield. Hence, estimation of actual role of individual trait towards yield is an indispensable attribute in plant breeding approach. Path coefficient analysis give a well-defined explanation of complex relationship of various minor genes and their effects towards yield and this type of relationship reflect at correlation level. Path analysis also signifies whether association of each individual trait with yield as a result of direct or indirect effect. Thus, it is pre-requisite to recognize the efficacy of selection for instantaneous advancement of those traits. In this study, path analysis was carried out both at genotypic and phenotypic levels by considering total yield as dependent character and other morphological character as independent.

### 2. Materials and methods

A study was conducted for analysis of path coefficient of thirty seven genotypes (Table 1) of bottle gourd by the Vegetable Science Department, Chaudhary Charan Singh Haryana Agricultural University, Hisar during summer season. Phenotypic evaluation of the genotypes was done and best genotypes were found out. The genotypes having good marketable attribute were considered for analysis of various traits which directly or indirectly associated with yield

(quantitative character). The path coefficient analysis was performed as per the formula given by Wright (1921) [23] and adopted by Dewey and Lu (1959) [6]. Both direct and indirect effects of various associated traits were estimated and residual effects were found out. The significance of genotypic correlation was analysed by a comparison of calculated values with tabulated 'r' value at 1 and 5% significance level.

**Table 1:** List of bottle gourd genotypes used in the study

Institutes (sources of the genotype)	Genotype
CCSHAU, Hisar	GH-39, GH-40, GH-41, GH-42, GH-43, GH-44, GH-45, GH-46, GH-47, GH-48, GH-49, GH-50, GH-51, GH-52, GH-53, GH-54, GH-55, GH-56, GH-57, GH-58 and GH-59
PAU, Punjab	Punjab Komal and Punjab Long
ICAR-IARI, New Delhi	Pusa Naveen, Pusa Samridhi, Pusa Santhusti, Pusa Sandesh and P.S.P.L
NDUAT, Faizabad	NDBG-15, NDBG-104 and NDBG-10
ICAR-IIHR, Bangalore	Arka Bahar
RAU, Bihar	Rajendra Chamtkar
GBPUA & T, Uttarakhand	Pant Lauki 3
Local genotypes	Dudhi Long, KBG-16 and RS-1

### 3. Results and discussion

The sixteen characters were taken in the investigation were: days to 50% germination, number of primary branches, days to first male flower opening, days to first female flower opening, nodes to first male flower, nodes to first female flower, leaf length (cm), leaf width (cm), days to first fruit harvest, length of fruit (cm), diameter of fruit (cm), vine length at the time of final harvest (m), weight of 100 seeds (g), number of fruits per vine, fruit yield per vine (kg), yield per hectare (t) and residual factor (represented by 'x'). The genotypic path diagram (Fig. 1) truly depicts the nature of cause and effect system. All the characters had directly or indirectly association with yield and inter-related among themselves except residual factor. The path analysis of genotypic correlations of yield per hectare with its other characters presented diagonally showed direct effects of the characters towards their correlation with yield per vine, while all other off diagonal estimates revealed indirect effects of the characters towards their correlation with yield per vine.

#### 3.1 Direct effect

Out of sixteen characters, eight characters showed positive direct effect on fruit yield per vine at genotypic level, nodes to first female flower (0.534), number of primary branches (0.380), days to leaf width (0.907), fruit yield per plant (0.226), first female flower opening (0.078), days to fruit harvest (1.639), number of fruits per vine (0.125) and weight of seeds (0.110). The days to first male flower (-1.268) had highest negative direct effect on yield per vine, followed by days to 50% germination (-0.826), nodes to first male flower (-0.813), leaf length (-0.258), diameter of fruit (-0.162), length of fruit (-0.072) and vine length (-0.045) (Table 2).

#### 3.2 Indirect effect

The number of primary branches, days to first female flower opening, leaf width nodes to first female flower, days to first fruit harvest, number of fruits per vine, fruit yield per plant, and weight of seeds were found significantly and positively associated with fruit yield per hectare at genotypic level (Table 2). So, these traits can be taken into consideration during selection process. Among indirect contributions of component traits through each other, days to 50% germination showed highest positive indirect effect *via* fruit yield per plant (0.437) and nodes to first male flower (0.170), while it had negative effect through leaf width (-0.252). Diameter of fruit

### 2.1 Germplasm lines and standard released varieties included under study

In total 37 genotypes of bottle gourd were included and analysed in the study. A list of genotypes and their source is given in the Table 1.

showed maximum positive indirect effect through length of fruit (0.065) and negative through number of primary branches (-0.051). Leaf length had indirect positive effect through days to first fruit harvest (0.030) and negatively associated with leaf width (-0.135). Length of fruit had the highest positive direct effect via diameter of fruit (0.029), nodes to first female flower (0.007). Nodes to first male flower had indirect positive effects on days to 50% germination (0.167). Vine length had high positive indirect effect on diameter of fruit (0.156), and negatively correlated with fruit yield per vine (-0.102) and length of fruit (-0.074). The eight characters showed highly positive direct effect on yield per hectare *viz.*, days to first female flower opening, number of primary branches, leaf width, days to fruit harvest, nodes to first female flower, fruit yield per plant, number of fruits per vine and weight of seeds.

The days to first male flower had highest negative direct effect on yield per vine, followed by days to 50% germination, nodes to first male flower, leaf length, diameter of fruit, length of fruit and vine length. Similar trends of findings was also obtained by Rajput *et al.* (1996) [16], Kumaran *et al.* (2000) [13], Husna *et al.* (2011) [8], Kumar *et al.* (2012) [11], Singh *et al.* (2013) [19], Deepthi *et al.* (2014) [5], Varpe *et al.* (2014) [21], Janaranjani and Kanthaswamy (2015) [9] and Mandal *et al.* (2015) [15]. The number of primary branches, days to first female flower opening, leaf width, nodes to first female flower, days to first fruit harvest, number of fruits per vine, fruit yield per plant, and weight of seeds were found significantly and positively associated with fruit yield per hectare at genotypic level. Among indirect contributions of component traits through each other, days to 50% germination showed highest positive indirect effect *via* fruit yield per plant and nodes to first male flower, while it had negative effect through leaf width. Diameter of fruit showed maximum positive indirect effect through length of fruit and negative through number of primary branches. Similar results were found by Choudhary and Mandal (1987) [4] in cucumber, Singh and Prasad (1997) [20] in pointed gourd, Rolania *et al.* (2003) [18] in watermelon, Ahmed *et al.* (2005) [1] in bottle gourd and Borthakur and Baruah (2006) [3] in bitter gourd.

Leaf length had indirect positive effect through days to first fruit harvest and negatively associated with leaf width. Length of fruit had the highest positive direct effect via diameter of fruit, nodes to first female flower. Nodes to first male flower

had indirect positive effects on days to 50% germination. The above findings were similar with the findings of Lal and Singh (1997) [14] in muskmelon, Kumaran *et al.* (2000) [13] in pumpkin, Bharathi *et al.* (2005) [2] in spine gourd and Verghese *et al.* (2005) [22] in ivy gourd. Vine length had high positive indirect effect on diameter of fruit, length of fruit and

nodes to first female flower, negatively correlated with fruit yield per vine. These results corroborate the findings of Kumar and Singh (1998) [12] in bottle gourd, Raju *et al.* (1998) [17] in summer squash and Kumar *et al.* (2012) [11] in bottle gourd. All the given values are presented in Table 2.

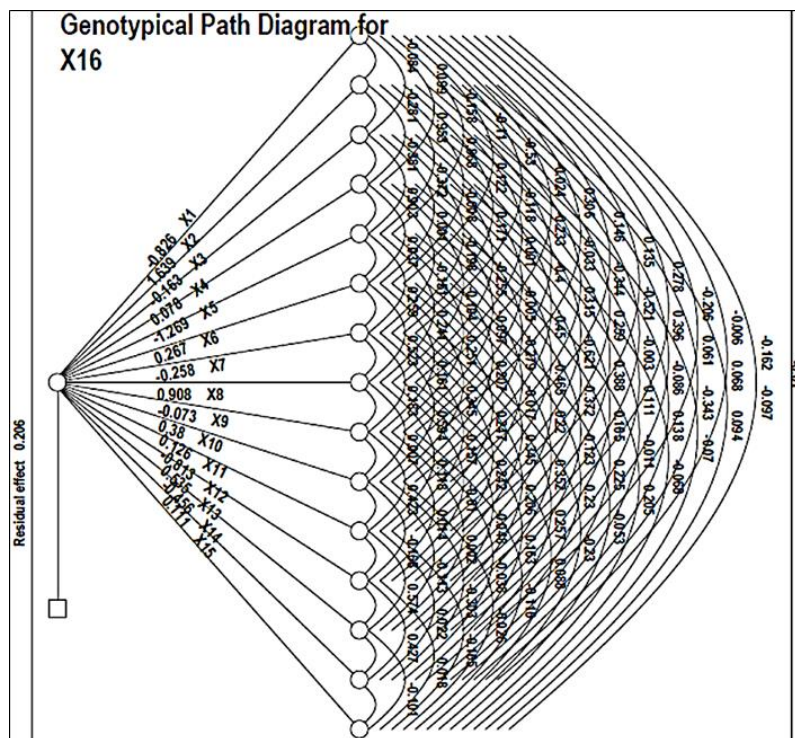


Fig 1: Genotypical diagram and coefficient of factors influencing fruit yield per hectare.

Where, X 1 to X 16 stands for the sixteen traits used in the study:

X 1: Days to 50% germination

X 2: Days to first fruit harvest

X 3: Diameter of fruit (cm)

X 4: Days to first female flower opening

X 5: Days to first male flower opening

X 6: Fruit yield per vine (kg)

X 7: Leaf length (cm)

X 8: Leaf width (cm)

X 9: Length of fruit (cm)

X 10: Number of primary branches

X 11: Number of fruits per vine

X 12: Nodes to first male flower

X 13: Nodes to first female flower

X 14: Vine length at final harvest (m)

X 15: Weight of 100 seeds (g)

X 16: Yield per hectare (t)

Table 2: Direct (diagonal) and indirect genotypic path coefficient values of different characters on yield of bottle gourd.

CHR	DFG	DFH	DF	DFH	DMF	FYP	LL	LW	LF	NOP	NFV	NFM	NFF	VL	WS	Genotypic correlation with yield
DFG	-0.826	0.069	-0.081	0.130	0.090	0.437	0.019	-0.252	-0.120	-0.111	-0.229	0.170	0.004	0.133	0.007	-0.397*
DFH	-0.137	1.639	-0.460	1.562	1.423	0.199	-0.193	-0.382	-0.053	-0.563	-0.854	0.649	0.100	0.112	-0.158	0.053**
DF	-0.016	0.045	-0.162	0.061	0.060	0.001	-0.027	-0.000	0.065	-0.051	-0.042	0.006	0.013	0.055	-0.015	-0.002*
DFH	-0.012	0.074	-0.029	0.078	0.070	0.000	-0.015	-0.019	-0.000	-0.035	-0.048	0.030	0.008	0.010	-0.005	-0.685*
DMF	0.139	-141	0.471	-1.146	-1.268	-0.047	0.191	0.132	0.123	0.354	0.590	-0.472	-0.209	0.014	0.086	-0.043*
FYP	-0.141	0.006	-0.002	0.000	0.009	0.266	0.069	0.064	0.066	0.055	-0.004	0.058	0.032	0.060	0.054	0.876**
LL	0.006	0.277	-0.044	0.051	0.039	-0.066	-0.258	-0.135	-0.041	-0.089	-0.063	-0.089	-0.090	-0.059	0.013	0.207**
LW	0.277	-0.010	-0.001	-0.231	-0.094	0.218	0.474	0.907	0.163	0.539	0.412	0.219	0.187	0.233	-0.208	0.316**
LF	-0.010	0.051	0.029	0.000	0.007	-0.018	-0.011	-0.013	-0.072	-0.000	-0.008	0.007	0.003	-0.011	-0.006	0.068**
NOP	0.051	0.034	0.119	-0.171	-0.106	0.078	0.131	0.005	0.002	0.380	0.160	0.005	0.000	-0.014	-0.044	0.525**
NFV	0.034	0.167	0.032	-0.078	-0.058	-0.002	0.031	0.019	0.014	0.053	0.125	-0.021	-0.014	-0.038	-0.003	-0.019*
NFM	0.167	-0.322	0.002	-0.316	-0.302	-0.178	-0.280	-0.196	0.007	-0.011	0.136	-0.813	-0.466	-0.017	0.134	0.017**
NFF	-0.003	0.032	-0.045	0.059	0.088	0.065	0.188	0.110	-0.025	-0.001	-0.060	0.306	0.534	0.228	0.009	0.086*
VL	0.073	-0.031	0.156	-0.062	0.005	-0.102	-0.102	-0.117	-0.074	0.017	0.138	-0.009	-0.194	-0.045	0.046	0.240**
WS	-0.001	-0.010	0.010	-0.007	-0.007	-0.022	0.022	-0.025	0.009	-0.012	-0.002	-0.018	0.002	-0.011	0.110	0.002*

Residual effect -0.2056

\*Significant at 5% level \*\*Significant at 1% level

DFG: Days to 50% germination; DFH: Days to first fruit harvest; DF: Diameter of fruit (cm); DFH: Days to first female flower opening ; DMF: Days to first male flower opening; FYP: Fruit yield per plant; LL :leaf length (cm); LW : leaf width (cm) ; LF: Length of fruit (cm) ; NOP: Number of primary branches; NFV: Number of fruits per vine; NFM: Nodes to first male flower; NFF: Nodes to first female flower harvest; VL: Vine length at the time of final harvest (m); WS: Weight of 100 seeds (g)

#### 4. Conclusion

The result of this experiment showed direct and indirect association of various characters with yield. The characters having positive direct effect on yield per ha are number of primary branches, leaf width, nodes to first female flower, days to first female flower opening, days to fruit harvest, number of fruits per vine, fruit yield per plant and weight of seeds. The trait such as days to first male flower had highest negative direct effect on yield per vine, followed by days to 50% germination, nodes to first male flower, leaf length, diameter of fruit, length of fruit and vine length. Those traits which have direct positive effects on yield can be utilized in crop improvement programme. Subsequently those traits which have negative impacts towards yield also can be taken in various breeding programme by imposing a negative selection pressure.

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