Original Research Article

Correlation and Path Analysis in Bottle Gourd
[*Lagenaria siceraria* (Mol.) Standl.]

Padmakshi Thakur[1*], J. Singh[1], S.K. Nair[2] and Sasmita Priyadarsini Dash[1]

[1]Department of Vegetable Science, IGKV, Raipur-492012 (C.G.), India
[2]Department of Genetics and Plant Breeding, IGKV, Raipur-492012 (C.G.), India
*Corresponding author

A B S T R A C T

An experiment was carried at Research cum Instructional farm of Horticulture, Department of Vegetable Science, IGKV, Raipur during *kharif* season (2015). Correlation and path analysis among different characters of seventy three bottle gourd genotypes were studied. Observations were recorded for the characters viz., days to first male and female flower appearance, node number at which first male and female flower appears, days to 50% flowering, days to fruit set, number of branches per plant, days to first fruit harvest, fruit length (cm), average fruit weight (g), fruit girth (cm), number of fruits per plant, fruit yield (q per ha) and crop duration. Correlation and path studies revealed that number of fruits per plant and average fruit weight had highest significant positive association with yield q per ha at both phenotypic and genotypic levels and also had significant positive direct effect on fruit yield q per ha.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is one of the most important cucurbit grown throughout the country for its tender fruits. It is also known as white flowered gourd or calabash gourd. It is a fast growing winter seasonal climbing annual, native to Africa. It is grown in both rainy and summer seasons and its fruits are available in the market throughout the year. It is a monoecious and highly cross-pollinated crop known to good potential for yield components.

Yield is a complex character influenced by several genetic factors interacting with environment. Success of any breeding programme for its improvement depends on the existing genetic variability in the base population and on the efficiency of selection. For a successful selection, it is necessary to study the nature of association of the character in question with other relevant traits and also the genetic variability available for them. Path coefficient provides a better index for selection rather than correlation coefficient by separating the correlation coefficient of yield and its components into direct and indirect effects. Therefore, the present study was undertaken with the objective to understand the character association among the various traits and their direct and indirect effects on yield in bottle

gourd. The information on such aspects can be of great help in formulating appropriate breeding strategy for genetic upgradation of this crop.

Materials and Methods

The study was carried out during *kharif* season (2015) at Research cum Instructional farm of horticulture, Department of Vegetable Science, IGKV, Raipur. The experiment comprised of seventy three genotypes of bottle gourd. The experiment was laid out in a Randomized Block Design with three replications at 3.0×0.75 m row to row and plant to plant spacing. All the recommended cultural practices were adopted to raise a healthy crop. Data were recorded on five randomly selected plants with respect to characters viz., days to first male and female flower appearance, node number at which first male and female flower appears, days to 50% flowering, days to fruit set, number of branches per plant, days to first fruit harvest, fruit length (cm), average fruit weight (g), fruit girth (cm), number of fruits per plant, fruit yield (q/ha) and crop duration. The data were subjected to analysis of variance as per the procedure described by Panse and Sukhatme (1985). Correlation and path coefficients were calculated according to method suggested by Miller *et al.,* (1958) and Dewey and Lu (1959) respectively.

Results and Discussion

The analysis of variance (Table 1) showed significant differences for all the characters under study. This analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all characters. Significant mean sum of squares due to fruit yield and attributing characters revealed existence of considerable variability in material studied for improvement for various traits.

The correlation between fruit yield q per ha with different yield attributes are presented in Table 2. Yield (q/ha) expressed a highly significant positive correlation with no. of fruits per plant and fruit weight at both phenotypic and genotypic levels respectively, whereas it showed significant negative correlation with duration of crop at genotypic and phenotypic levels. Prasad *et al.,* (1993), Narayan *et al.,* (1996), Kumar and Singh (1998), Hawlader *et al.,* (1999), Umamaheswarappa *et al.,* (2004) and Raja *et al.,* (2006) reported very high and significant correlation coefficient for fruit weight and no. of fruit per plant with yield. This indicates that fruit yield in bottle gourd can be improved by direct selection of fruit characters like number of fruits per plant and fruit weight. The positive correlation between the desirable characters is favourable to the plant breeder because it helps in simultaneous improvement of all the characters.

Highly significant and positive correlation was shown by node number at which first male flower appears with node number at which first female flower appears, days to first male flower appearance, days to first female flower appearance, days to 50% flowering, days to fruit set, days to first fruit harvest, fruit girth, number of branches per plant and duration of crop at phenotypic and genotypic level, respectively. Node number at which first female flower appears had highly positive and significant correlation with days to first male flower appearance, days to first female flower appearance, days to 50% flowering, days to fruit set, days to first fruit harvest, fruit girth and duration of crop at both genotypic and phenotypic levels.

Days to first male flower appearance had highly positive and significant correlation with days to first female flower appears, days to 50% flowering, days to fruit set, days to first fruit harvest and fruit girth at both

genotypic and phenotypic levels. Days to first female flower appearance had highly positive and significant correlation with days to 50% flowering, days to fruit set, days to first fruit harvest and fruit girth at both genotypic and phenotypic levels and it is also significant and positively correlated with duration of crop only at genotypic level.

Table.1 Analysis of variance for fruit yield and its component characters in bottle gourd

S. No.	Character (df)	Mean sums of square		
		Replication (2)	Treatment (72)	Error (144)
01	Node no. at which 1st male flower appears	16.35	121.09**	0.878
02	Node no. at which 1st female flower appears	0.96	209.44**	1.11
03	Days to 1st male flower appearance	12.02	146.75**	2.15
04	Days to 1st female flower appearance	0.98	142.62**	2.4
05	Days to 50% flowering	0.65	158.41**	0.97
06	Days to fruit set	6.61	146.00**	1.72
07	Days to 1st fruit harvest	64.9	142.06**	3.18
08	Fruit length (cm)	10.69	91.42**	6.41
09	Fruit girth (cm)	4.43	92.29**	13.48
10	Average fruit weight (g)	984.81	148454.9**	6854.18
11	No. of fruits per plant	1.06	15.83**	1.93
12	No. of branches per plant	1.36	9.90**	0.22
13	Duration of crop (sowing to last harvest)	2.75	198.30**	13.73
14	Yield (q/ha)	1004.12	5071.63**	205.26

*: Significant at 5%, **: significant at 1%

Table.2 Genotypic and phenotypic correlation coefficients between fruit yield and its component characters in bottle gourd (*Kharif*, 2015-16)

Characters		01. Node no. at which 1st male flower appears	02. Node no. at which 1st female flower appears	03. Days to 1st male flower appear-ance	04. Days to 1st female flower appear-ance	05. Days to 50% flowering	06. Days to fruit set	07. Days to 1st fruit harvest	08. Fruit length (cm)	09. Fruit girth (cm)	10. Average fruit weight (g)	11. No. of fruits per plant	12. No. of branches per plant	13. Duration of crop (sowing to last harvest)	14. Yield (q /ha)
01.	P	1.000	0.767**	0.644**	0.635**	0.708**	0.667**	0.675**	-0.061	0.292**	0.148*	-0.063	0.240**	0.319**	-0.067
	G	1.000	0.779**	0.665**	0.657**	0.722**	0.684**	0.696**	-0.056	0.362**	0.157*	-0.075	0.248**	0.347**	-0.076
02.	P		1.000	0.589**	0.619**	0.672**	0.645**	0.646**	-0.159*	0.296**	0.088	-0.187**	0.169*	0.333**	-0.169*
	G		1.000	0.606**	0.640**	0.683**	0.661**	0.669**	-0.180**	0.365**	0.102	-0.224**	0.174**	0.376**	-0.183**
03.	P			1.000	0.844**	0.889**	0.859**	0.840**	0.003	0.304**	0.031	-0.103	0.154*	0.111	-0.083
	G			1.000	0.881**	0.923**	0.888**	0.887**	0.002	0.364**	0.039	-0.126	0.162*	0.118	-0.091
04.	P				1.000	0.896**	0.968**	0.911**	-0.072	0.324**	0.042	-0.141*	0.096	0.205**	-0.122
	G				1.000	0.930**	0.982**	0.954**	-0.078	0.408**	0.047	-0.192**	0.108	0.232**	-0.129
05.	P					1.000	0.908**	0.867**	0.001	0.301**	0.031	-0.123	0.117	0.145*	-0.133*
	G					1.000	0.934**	0.907**	-0.01	0.374**	0.025	-0.156*	0.126	0.173*	-0.141*
06.	P						1.000	0.930**	-0.054	0.350**	0.023	-0.164*	0.063	0.186**	-0.141*
	G						1.000	0.964**	-0.061	0.437**	0.027	-0.213**	0.07	0.211**	-0.150*
07.	P							1.000	-0.007	0.346**	0.03	-0.189**	0.131	0.199**	-0.13
	G							1.000	-0.015	0.433**	0.022	-0.207**	0.133*	0.231**	-0.135*
08.	P								1.000	-0.254**	0.042	0.11	-0.048	-0.085	0.076
	G								1.000	-0.376**	0.052	0.154*	-0.062	-0.078	0.067
09.	P									1.000	0.052	0.017	0.191**	0.013	0.057
	G									1.000	0.057	0.025	0.222**	0.031	0.055
10.	P										1.000	0.684**	0.103	-0.115	0.687**
	G										1.000	0.888**	0.12	-0.119	0.777**
11.	P											1.00	0.141*	-0.312**	0.760**
	G											1.00	0.215**	-0.398**	0.956**
12.	P												1.000	0.167*	0.096
	G												1.000	0.181**	0.104
13.	P													1.000	-0.429**
	G													1.000	-0.495**
14.	P														1.000
	G														1.000

Table.3 Direct and indirect effect of component character on fruit yield in bottle gourd (*kharif*, 2015-16)

Characters	Node no. at which 1st male flower appears	Node no. at which 1st female flower appears	Days to 1st male flower appearance	Days to 1st female flower appearance	Days to 50% flowering	Days to fruit set	Days to 1st fruit harvest	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	No. of fruits per plant	No. of branches per plant	Duration of crop (sowing to last harvest)	Yield (q/ha)
Node no. at which 1st male flower appears	**0.060**	0.008	0.219	-0.329	-0.124	-0.043	0.144	0.013	-0.121	0.010	0.071	0.016	-0.006	-0.083
Node no. at which 1st female flower appears	0.047	**0.011**	0.200	-0.320	-0.118	-0.042	0.138	0.033	-0.117	0.008	-0.054	0.013	-0.007	-0.209
Days to 1st male flower appearance	0.040	0.006	**0.329**	-0.441	-0.160	-0.056	0.183	0.001	-0.121	0.017	0.090	0.011	-0.002	-0.101
Days to 1st female flower appearance	0.040	0.007	0.290	**-0.500**	-0.162	-0.062	0.197	0.015	-0.126	0.001	0.117	0.007	-0.004	-0.181
Days to 50% flowering	0.043	0.007	0.304	-0.467	**-0.174**	-0.059	0.187	0.004	-0.126	0.004	0.150	0.008	-0.003	-0.120
Days to fruit set	0.041	0.007	0.293	-0.491	-0.163	**-0.063**	0.199	0.012	-0.140	-0.001	0.115	0.005	-0.004	-0.191
Days to 1st fruit harvest	0.042	0.007	0.292	-0.477	-0.158	-0.061	**0.206**	0.005	-0.140	-0.009	0.098	0.009	-0.004	-0.189
Fruit length (cm)	-0.005	-0.002	-0.003	0.045	0.005	0.005	-0.006	**-0.164**	0.106	0.033	0.029	-0.004	0.001	0.040
Fruit girth (cm)	0.022	0.004	0.119	-0.188	-0.066	-0.027	0.086	0.052	**-0.334**	-0.042	0.238	0.007	-0.001	-0.130
Average fruit weight (g)	-0.002	0.000	-0.018	0.002	0.002	0.000	0.006	0.018	-0.045	**0.310**	0.075	-0.004	0.002	0.346*
No. of fruits per plant	0.008	-0.001	0.054	-0.106	-0.047	-0.013	0.037	-0.009	-0.144	-0.042	**0.552**	0.010	0.005	0.302**
No. of branches per plant	0.015	0.002	0.054	-0.053	-0.022	-0.004	0.029	0.010	-0.034	0.020	0.083	**0.065**	-0.003	0.160
Duration of crop (sowing to last harvest)	0.021	0.004	0.039	-0.116	-0.029	-0.013	0.048	0.013	-0.025	0.038	-0.165	0.013	**-0.018**	-0.191

Residual value: 0.0654, Diagonal and bold underline figures shows direct effect on fruit yield

Days to 50% flowering exhibited highly significant and positive correlation with days to fruit set, days to first fruit harvest and fruit girth at both phenotypic and genotypic level. It also showed significant and positive correlation with no. of fruits per plant at genotypic level only.

Days to fruit set had highly positive and significant correlation with days to first fruit harvest and fruit girth at both genotypic and phenotypic level. Days to first fruit harvest showed highly positive and significant correlation with fruit girth at both phenotypic and genotypic level and with duration of crop only at genotypic level. Highly significant and negative correlation of days to fruit length was observed with fruit girth at phenotypic and genotypic levels. Fruit girth showed significant and positive correlation with no. of fruits per plant at both phenotypic and genotypic levels.

The findings clearly indicated that genotypic correlations were of higher magnitude to the corresponding phenotypic ones, thereby establishing strong inherent relationship among the characters studied. The low phenotypic value might be due to appreciable interaction of the genotypes with the environments. An overall observation of correlation coefficient analysis revealed that number of fruits per plant and fruit weight exhibited the significant positive correlation with yield quintal per ha. Hence, direct selection for these traits may lead to the development of high yielding genotypes of bottle gourd. The present findings are in conformity with Ahmed *et al.,* (2005) who reported that fruit yield q per ha had strong positive association with number of fruits per vine, fruit weight, fruit length and fruit girth. Similar results were also reported by Wani *et al.,* (2008), Kumar *et al.,* (2012), Singh *et al.,* (2012), Bhardwaj *et al.,* (2013) and Mandal *et al.,* (2015).

Path coefficient analysis depicts the effects of different independent characters individually and in combination with other character on fruit yield. The data on path coefficient analysis at genotypic level showing direct and indirect effects of significant characters over yield q per ha is tabulated in Table 3. The data revealed that no. of fruits per plant showed the highest positive direct effect (0.552) on fruit yield followed by days to first male flower appearance (0.329), average fruit weight (0.310), days to first fruit harvest (0.206), number of branches per plant (0.065), node number at which first male flower appears (0.060) and node no. at which first female flower appears (0.011) whereas, days to first female flower appearance (-0.500), fruit girth (-0.334), days to 50% flowering (-0.174), fruit length (-0.164), days to fruit set (-0.063) and duration of crop (-0.018) showed negative direct effects on fruit yield q per ha.

In present investigation number of fruits per plant and average fruit weight showed significant positive and direct effect on fruit yield q per ha. Therefore, plant having more number of fruits with average fruit weight should be considered in selection criteria for increasing fruit yield. Directly or indirectly all characters showed positive effect on fruit yield, which is in confirmation to the finding of Umamaheswarappa *et al.,* (2004), Husna *et al.,* (2011) and Janaranjani and Kanthaswamy (2015) reported that number of fruits vine[-1] had maximum direct effect on fruit yield followed by fruit weight. Similar results were obtained by Singh *et al.,* (2006), Muralidharan *et al.,* (2013) and Thakur *et al.,* (2015). Positive direct effect of various characters on total fruit yield observed in the present study are according to the findings of Narayan *et al.,* (1996) and Kumar and Singh (1998) for days to the first harvest and number of fruits per plant, Hawlader *et al.,* (1999) for number of female flowers per plant, Ahmed *et al.,* (2005) for average fruit

weight, number of fruits per plant and fruit length, Singh *et al.,* (2006) for female flower per vine, average fruit weight, number of fruits per vine, Gayen and Hossain (2007) for average fruit weight and fruit length.

The results of the study indicated that the characters with positive correlation have shown high direct effects. Thus, number of fruits per plant had high direct and correlation values. The effect of residual factor (0.0654) on fruit yield (q/ha) was negligible, thereby, suggested that no other major yield component is left over.

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