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Correlation and Path Co-efficient in some Cultivars of Bitter Gourd (*Momordica charantia* L.)

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A B S T R A C T

A field trial was conducted at Rajaula Agriculture form of the faculty of Agriculture, M.G.C.G.V. Chitrakoot with 15 cultivars of bitter gourd (*Momordica charantia* L.) during the *kharif* season of 2018-19. To study the variability, correlation and path co-efficient analysis to measure the mutual relationship between various characters and determines the component characters on which selection can be based for improvement in yield. Further path coefficient analysis is an efficient tool to elucidate the direct and indirect effect of each character towards yield. Fruit yield per plant showed highly significant and positive correlation with fruit yield/plot (0.815) at genotypic levels, whereas significant and positive correlation with fruit yield/plot (0.747) at phenotypic level and genotypic level, path coefficient analysis revealed that fruit yield/plant (1.503), as well as phenotypic level, path coefficient analysis revealed that fruit yield/plant (g) (0.743).

Introduction

Bitter gourd (*Momordica charantia* L.) is an important medicinal plant of Cucurbitaceae family. Bitter gourd has remarkable antidiabetic, antiviral, antibacterial and anticancer properties (Samsam-Shariat 1989). It is widely cultivated in India, China (Minraj *et al.,* 1993). Bitter gourd is rich source of carbohydrates 4.32 g, protein 0.84g, vitamin c 33mg, vitamin 0.14mg, calcium 9mg, iron 0.38mg and water 93.95mg. In India, bitter

gourd covers an area of 93 MH with the production of 1063 MT (NHB 2017-18). 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).

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield.

Further path coefficient analysis is an efficient tool to elucidate the direct and indirect effect of each character towards yield. The present study was, for such motives, undertaken with the objective to find out and determine the study on correlation and path coefficient analysis in bitter gourd (*Momordica charantia* L).

Materials and Methods

The experimental material consisted of fifteen genotypes conducted during *kharif* season of 2018 at the main experiment Station, Rajaula agriculture farm of the faculty of agriculture at Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna, Madhya Pradesh, India. The experiment was laid out in RBD (Randomized Block Design) with three replications in individual plot size (3.0 m × 3.0 m). The distance maintained between row to row and plant to plant was 1.0 m and 1.0 m, respectively.

All recommended agronomic practices for the region were adopted to raise a healthy crop. The observation recorded of three plants randomly selected from each ploton twelve characters. Data were recorded on various parameters, viz. no. of branch/plant, days to no. 1st female flower appearance, days to 1st male flower appearance, node no. to 1stfemale flower, node no. to 1stmale flower, days to 1st picking, no. of marketable fruit/vine, average fruit length, average fruit width, average fruit weight (kg), fruit yield/plant and fruit yield/plot (kg).

The path coefficients were obtained by solving the following the simultaneous equations which give the basic relationship between correlations and path coefficients in a system of correlated causes (Dewey and Lu, 1959).

Results and Discussion

Correlation and coefficient

The estimates of genotypic correlation coefficients (Table 3) revealed that yield/vine found to be significantly and positively correlated with vine length, number of laterals/ vine, number of fruits/vine, average fruit weight, fruit length, pulp thickness while significant negative correlations were recorded with sex ratio, node number at 1st female flower, days to 1st male and female flower appeared which confirmed well with the findings of Changyuan *et al.*, (2002), Bhave *et al.*, (2003) and Dey *et al.*, (2005).

Fruit yield per plot showed highly significant and positive correlation with fruit yield/plant (0.815), average fruit weight(g) (0.794), average fruit width (0.652), average fruit length (0.722), and negative and significant correlation with no. of branches/plant (-0.296) at genotypic levels, whereas significant and positive correlation with fruit yield/plant(g) (0.747), average fruit weight (0.493), average fruit width (0.457), average fruit length (0.400).

However, significant and negative correlation with days to first picking (-0.421) with fruit yield per plant at phenotypic level (Table 1 and 2).

Table.1 Genotypic correlations matrix

	NO. OF BRANCH/ PLANT	1st FEMALE FLOWER APPERANCE	1st MALE FLOWER APPERANCE	NODE NO. TO 1st FEMALE FLOWER APPERANCE	NODE NO. TO 1st MALE FLOWER APPERANCE	DAYS TO 1st PICKING	NO. OF MARKETABLE FRUITS/VINE	AVERAGE FRUIT LENGTH	AVERAGE FRUIT WIDTH	AVERAGE FRUIT WEIGTH (G)	FRUIT YIELD/ PLANT (GRAM)	FRUIT YIELD/PLOT (KG)
NO. OF BRANCH/PLANT	**1**	-0.277^{NS}	-0.070^{NS}	0.057^{NS}	-0.050^{NS}	-0.253^{NS}	0.703**	0.215^{NS}	0.375*	0.147^{NS}	0.307*	-0.296*
1st FEMALE FLOWER APPERANCE	-0.277^{NS}	**1**	0.789**	-0.272^{NS}	0.542**	0.014^{NS}	-0.445**	-0.469**	-0.198^{NS}	0.036^{NS}	-0.173^{NS}	-0.128^{NS}
1st MALE FLOWER APPERANCE	-0.070^{NS}	0.789**	**1**	0.108^{NS}	0.631**	0.004^{NS}	-0.045^{NS}	-0.101^{NS}	-0.177^{NS}	0.060^{NS}	0.254^{NS}	0.073^{NS}
NODE NO. TO 1st FEMALE FLOWER APPERANCE	0.057^{NS}	-0.272^{NS}	0.108^{NS}	**1**	-0.014^{NS}	-0.005^{NS}	0.315*	0.353*	0.084^{NS}	0.405**	0.244^{NS}	-0.129^{NS}
NODE NO. TO 1st MALE FLOWER APPERANCE	-0.050^{NS}	0.542**	0.631**	-0.014^{NS}	**1**	-0.208^{NS}	0.394**	-0.017^{NS}	-0.051^{NS}	0.367*	0.253^{NS}	0.078^{NS}
DAYS TO 1st PICKING	-0.253^{NS}	0.014^{NS}	0.004^{NS}	-0.005^{NS}	-0.208^{NS}	**1**	-0.146^{NS}	-0.800**	-0.323*	-0.851**	-0.526**	-0.591**
NO. OF MARKETABLE FRUITS/VINE	0.703**	-0.445**	-0.045^{NS}	0.315*	0.394**	-0.146^{NS}	**1**	-0.409**	-0.042^{NS}	0.277^{NS}	0.473**	-0.021^{NS}
AVERAGE FRUIT LENGTH	0.215^{NS}	-0.469**	-0.101^{NS}	0.353*	-0.017^{NS}	-0.800**	-0.409**	**1**	0.727**	0.770**	0.585**	0.722**
AVERAGE FRUIT WIDTH	0.375*	-0.198^{NS}	-0.177^{NS}	0.084^{NS}	-0.051^{NS}	-0.323*	-0.042^{NS}	0.727**	**1**	0.565**	0.665**	0.652**
AVERAGE FRUIT WEIGTH (G)	0.147^{NS}	0.036^{NS}	0.060^{NS}	0.405**	0.367*	-0.851**	0.277^{NS}	0.770**	0.565**	**1**	0.795**	0.794**
FRUIT YIELD/ PLANT (GRAM)	0.307*	-0.173^{NS}	0.254^{NS}	0.244^{NS}	0.253^{NS}	-0.526**	0.473**	0.585**	0.665**	0.795**	**1**	0.815**
FRUIT YIELD/PLOT (KG)	-0.296*	-0.128^{NS}	0.073^{NS}	-0.129^{NS}	0.078^{NS}	-0.591**	-0.021^{NS}	0.722**	0.652**	0.794**	0.815**	**1**

Table.2 Phenotypic correlations matrix

	NO. OF BRANCH/ PLANT	1st FEMALE FLOWER APPERANCE	1st MALE FLOWER APPERANCE	NODE NO. TO 1st FEMALE FLOWER APPERANCE	NODE NO. TO 1st MALE FLOWER APPERANCE	DAYS TO 1st PICKING	NO. OF MARKETABLE FRUITS/VINE	AVERAGE FRUIT LENGTH	AVERAGE FRUIT WIDTH	AVERAGE FRUIT WEIGTH (G)	FRUIT YIELD/ PLANT (GRAM)	FRUIT YIELD/PLOT (KG)
NO. OF BRANCH/PLANT	1	-0.140^{NS}	-0.005^{NS}	0.183^{NS}	0.088^{NS}	-0.284^{NS}	0.205^{NS}	0.046^{NS}	0.059^{NS}	-0.041^{NS}	0.195^{NS}	-0.198^{NS}
1st FEMALE FLOWER APPERANCE	-0.140^{NS}	1	0.618**	-0.137^{NS}	0.388**	0.037^{NS}	-0.172^{NS}	-0.144^{NS}	-0.256^{NS}	-0.149^{NS}	-0.110^{NS}	-0.119^{NS}
1st MALE FLOWER APPERANCE	-0.005^{NS}	0.618**	1	0.075^{NS}	0.370*	-0.079^{NS}	0.125^{NS}	-0.015^{NS}	0.013^{NS}	0.050^{NS}	0.264^{NS}	0.065^{NS}
NODE NO. TO 1st FEMALE FLOWER APPERANCE	0.183^{NS}	-0.137^{NS}	0.075^{NS}	1	-0.036^{NS}	-0.014^{NS}	0.206^{NS}	0.060^{NS}	0.077^{NS}	0.157^{NS}	0.116^{NS}	-0.045^{NS}
NODE NO. TO 1st MALE FLOWER APPERANCE	0.088^{NS}	0.388**	0.370*	-0.036^{NS}	1	-0.100^{NS}	0.270^{NS}	0.088^{NS}	-0.041^{NS}	0.120^{NS}	0.186^{NS}	0.049^{NS}
DAYS TO 1st PICKING	-0.284^{NS}	0.037^{NS}	-0.079^{NS}	-0.014^{NS}	-0.100^{NS}	1	-0.127^{NS}	-0.369*	-0.227^{NS}	-0.412**	-0.412**	-0.421**
NO. OF MARKETABLE FRUITS/VINE	0.205^{NS}	-0.172^{NS}	0.125^{NS}	0.206^{NS}	0.270^{NS}	-0.127^{NS}	1	0.004^{NS}	0.200^{NS}	0.084^{NS}	0.270^{NS}	0.063^{NS}
AVERAGE FRUIT LENGTH	0.046^{NS}	-0.144^{NS}	-0.015^{NS}	0.060^{NS}	0.088^{NS}	-0.369*	0.004^{NS}	1	0.305*	0.289^{NS}	0.371*	0.400**
AVERAGE FRUIT WIDTH	0.059^{NS}	-0.256^{NS}	0.013^{NS}	0.077^{NS}	-0.041^{NS}	-0.227^{NS}	0.200^{NS}	0.305*	1	0.449**	0.432**	0.457**
AVERAGE FRUIT WEIGTH (G)	-0.041^{NS}	-0.149^{NS}	0.050^{NS}	0.157^{NS}	0.120^{NS}	-0.412**	0.084^{NS}	0.289^{NS}	0.449**	1	0.486**	0.493**
FRUIT YIELD/ PLANT (GRAM)	0.195^{NS}	-0.110^{NS}	0.264^{NS}	0.116^{NS}	0.186^{NS}	-0.412**	0.270^{NS}	0.371*	0.432**	0.486**	1	0.747**
FRUIT YIELD/PLOT (KG)	-0.198^{NS}	-0.119^{NS}	0.065^{NS}	-0.045^{NS}	0.049^{NS}	-0.421**	0.063^{NS}	0.400**	0.457**	0.493**	0.747**	1

Table.3 Direct and indirect effect for different characters on fruit yield per plant at genotypic level in bitter gourd

	NO. OF BRANCH/ PLANT	1st FEMALE FLOWER APPERANCE	1st MALE FLOWER APPERANCE	NODE NO. TO 1st FEMALE FLOWER APPERANCE	NODE NO. TO 1st MALE FLOWER APPERANCE	DAYS TO 1st PICKING	NO. OF MARKETABLE FRUITS/VINE	AVERAGE FRUIT LENGTH	AVERAGE FRUIT WIDTH	AVERAGE FRUIT WEIGTH (G)	FRUIT YIELD/ PLANT (GRAM)
NO. OF BRANCH/PLANT	**-0.346**	-0.03062	0.03792	-0.0116	-0.00684	0.01471	-0.30387	0.00881	-0.10632	-0.01313	0.46099
1st FEMALE FLOWER APPERANCE	0.096	**0.11**	-0.42945	0.05541	0.07455	-0.00079	0.19226	-0.01923	0.05613	-0.00325	-0.25964
1st MALE FLOWER APPERANCE	0.02414	0.08722	**-0.544**	-0.02196	0.08681	-0.00024	0.01954	-0.00414	0.05014	-0.00538	0.38118
NODE NO. TO 1st FEMALE FLOWER APPERANCE	-0.0197	-0.03	-0.05854	**-0.204**	-0.00195	0.00028	-0.1361	0.01449	-0.02373	-0.03619	0.36673
NODE NO. TO 1st MALE FLOWER APPERANCE	0.01723	0.05986	-0.34323	0.00289	**0.138**	0.01211	-0.17023	-0.0007	0.01456	-0.03279	0.38074
DAYS TO 1st PICKING	0.08755	0.0015	-0.00227	0.00097	-0.02865	**-0.058**	0.06305	-0.0328	0.09148	0.07602	-0.79009
NO. OF MARKETABLE FRUITS/VINE	-0.24349	-0.04915	0.0246	-0.06425	0.05419	0.00849	**-0.432**	-0.01678	0.01184	-0.02475	0.71046
AVERAGE FRUIT LENGTH	-0.07443	-0.05178	0.05485	-0.07209	-0.00233	0.04654	0.17686	**0.041**	-0.20611	-0.0688	0.87864
AVERAGE FRUIT WIDTH	-0.12991	-0.02188	0.09622	-0.01708	-0.00707	0.01878	0.01805	0.02982	**-0.283**	-0.05042	0.99897
AVERAGE FRUIT WEIGTH (G)	-0.0509	0.00403	-0.0328	-0.0827	0.05052	0.04953	-0.11976	0.0316	-0.16003	**-0.089**	1.194
FRUIT YIELD/ PLANT (GRAM)	-0.10624	-0.01909	-0.13798	-0.0498	0.03486	0.03059	-0.20434	0.02398	-0.18843	-0.07096	**1.503**

Residual are -0.12848; Direct effects on main diagonal (bold figures)

Table.4 Direct and indirect effect for different characters on fruit yield per plant at Phenotypic level in bitter gourd

	NO. OF BRANCH/ PLANT	1st FEMALE FLOWER APPERANCE	1st MALE FLOWER APPERANCE	NODE NO. TO 1st FEMALE FLOWER APPERANCE	NODE NO. TO 1st MALE FLOWER APPERANCE	DAYS TO 1st PICKING	NO. OF MARKETABLE FRUITS/VINE	AVERAGE FRUIT LENGTH	AVERAGE FRUIT WIDTH	AVERAGE FRUIT WEIGTH (G)	FRUIT YIELD/ PLANT (GRAM)
NO. OF BRANCH/PLANT	**-0.386**	-0.00516	0.00086	-0.00759	-0.00081	0.06014	-0.01535	0.00148	0.0082	0.00066	0.14473
1st FEMALE FLOWER APPERANCE	0.05387	**0.037**	-0.09714	0.00566	-0.00354	-0.00788	0.01293	-0.00462	-0.03546	0.00238	-0.08165
1st MALE FLOWER APPERANCE	0.0021	0.02281	**-0.157**	-0.00312	-0.00338	0.01675	-0.00934	-0.0005	0.00181	-0.00079	0.19609
NODE NO. TO 1st FEMALE FLOWER APPERANCE	-0.07074	-0.00505	-0.01184	**-0.041**	0.00033	0.003	-0.01549	0.00194	0.01071	-0.0025	0.08582
NODE NO. TO 1st MALE FLOWER APPERANCE	-0.03404	0.01433	-0.05815	0.00147	**-0.009**	0.02112	-0.02024	0.00282	-0.00572	-0.00192	0.13796
DAYS TO 1st PICKING	0.10933	0.00137	0.01242	0.00059	0.00091	**-0.212**	0.00951	-0.01188	-0.03137	0.00657	-0.3063
NO. OF MARKETABLE FRUITS/VINE	-0.07888	-0.00636	-0.01957	-0.00854	-0.00246	0.02687	**-0.075**	0.00012	0.02767	-0.00133	0.20045
AVERAGE FRUIT LENGTH	-0.01772	-0.0053	0.00244	-0.00249	-0.0008	0.07826	-0.00027	**0.032**	0.04216	-0.00461	0.27584
AVERAGE FRUIT WIDTH	-0.02284	-0.00946	-0.00206	-0.0032	0.00038	0.04808	-0.015	0.00981	**0.138**	-0.00717	0.32054
AVERAGE FRUIT WEIGTH (G)	0.01594	-0.00551	-0.00778	-0.00649	-0.0011	0.08728	-0.00627	0.00929	0.06218	**-0.016**	0.36105
FRUIT YIELD/ PLANT (GRAM)	-0.07514	-0.00406	-0.0415	-0.00478	-0.0017	0.08747	-0.02025	0.01195	0.05973	-0.00776	**0.743**

Residual are 0.22933; Direct effects on main diagonal (bold figures)

Path coefficient analysis

At genotypic level, path coefficient analysis revealed that fruit yield/plant (1.503), node no to first male flower appearance (0.138), first female flower appearance (0.11), average fruit length (0.041) had exerted positive direct effect on fruit yield per plot. Days to first male

flowering appearance (-0.544), no of marketable fruit/vine (-0.432), no of branches/plant (-0.346), average fruit width (-0.283), node no to first female flower appearance (-0.204), average fruit weight (-0.089), days to first picking (-0.058) exhibited negative direct effect on fruit yield per plot (Table 4).

At phenotypic level, path coefficient analysis revealed that fruit yield/plant (g) (0.743), average fruit width (0.138), days to first female flowering appearance (0.037), average fruit length (0.032) had exerted positive direct effect on fruit yield per plot. number of branch/plant (-0.386), days to first picking (-0.212), Days to first male flowering appearance (-0.157), number of marketable fruit /vine (-0.075), node no to which 1st female flower appearance (-0.041), average fruit weight{gram} (-0.016), node no to which 1st male flower appearance (0.009), exhibited negative direct effect on fruit yield per plot.

The characters, that is, fruit yield/plant (g), days to first female flowering appearance, average fruit length was positively correlated with total yield per vine (Rajput *et al.*, 1996).

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