THEORETICAL
BIOLOGY FORUM

TBF : 58–63 (2022)
RESEARCH ARTICLE

Studies on correlation and path coefficient analysis for yield and yield related components in cucumber (*Cucumis sativus* L.)

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ABSTRACT

The present investigation was carried out at the Horticulture Research Centre, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut during summer season 2020-21. Correlation and path coefficient analysis studies were carried out on ninety-five Cucumber genotypes for thirteen characters. The study revealed that fruit yield per plant was positively correlated with fruit weight followed by number fruits per plants, vine length, fruit diameter, fruit length, number seeds per fruit, total soluble solids, and number of primary branches at both genotypic and phenotypic levels. The days to open first female flower was found to have a negative correlation with fruit yield per plant. The positive direct effect on fruit yield per plant was exerted through fruit weight followed by number of fruits per plant number of primary branches, days to open first female flower, number of seeds per fruit, total soluble solids and fruit length at both genotypic and phenotypic levels. Therefore, direct selection of these traits would be beneficial for improvement in Cucumber.

Keywords: *Fruit length, genotypic and phenotypic levels, Cucumber.*

ARTICLE HISTORY:
Received: 23 June 2022
Revised : 04 September 2022
Accepted: 28 October 2022
Available Online: 02 November 2022

DOI:
https://doi.org/10.5281/zenodo.7466219

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INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important cucurbitaceous vegetable crops grown extensively in tropical and sub-tropical parts of India. It belongs to the family Cucurbitaceae, comprising of 118 genera and 825 species [1]. Its primary centre of origin is India [2] and secondary Centre of diversification is China [3]. In the world, India occupies a prime position and is the second largest producer of vegetable next to China and grown in an area of 10,073 million hectare with the production of 18,317 metric tones' which contributes 14% of the total world production of vegetable. Cucumber is the fourth most important vegetable crop of the world after tomato, cabbage and onion, and among the vine crops, it is the most widely grown. Worldwide, it occupies an area of about 3.489 million hectares producing about 158.143 million tonnes annually, with a productivity of 55.68 tonnes per hectare (FAO, 2019). In India however, it is cultivated on an area of about 31776 hectares with an annual production of about 199018 tonnes giving a productivity of 62.63 tonnes per hectare (FAO, 2019). In India it is chiefly cultivated in northern and north eastern states, with Haryana ranking the first. Studies on the correlation coefficients of various attributes are very useful in order to identify the desirable traits that contribute in fruit yield improvement and assist to ascertain the degree to which these traits are associated with the economic productivity. In order to consider the complex relationship among various dependent variables, path coefficient analysis provides an effective mean of chalking out the

direct and indirect effects of yield contributing traits towards the fruit yield with a target to enhance the usefulness of selection for fruit yield improvement. Knowledge of genotypic and phenotypic correlations of yield and its components combined with the path coefficient analysis will be valuable in framing the breeding strategies targeted to develop elite genotypes through selection in advance generation.

MATERIAL AND METHODS

This experiment was conducted at the Horticulture Research Centre of the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, during the summer season of 2021. The Horticulture Research Centre, Meerut is located at 29.010 'N latitude and 77.450 'E by having a distance of around 70 K.M from the national capital, New Delhi, at an altitude of 297 m.a.s.l. The experiment used 95 genotypes (20 parents and 75 hybrids) in a randomised block design with three replications. In the present investigation, crosses were made between 15 lines and 5 testers during summer season 2020 and sufficient F_1 seed was obtained for all the 75 crosses. All the 20 parents and their 75 F_1 were grown during summer season 2021 in randomized block design (RBD) with three replications. Each 75 F_1s were planted in 3.6 meter long 3 row the parents were sown in three rows. The row was spaced 90 cm apart and plant to plant was retained 60 cm. Data for all the characters were recorded on five randomly selected plants of each genotype in both the parental and F_1 generation which observations viz. No of primary branches, Days to open first female flower, Days to open first Male flower, Days to open first fruit set, Days to open last fruit, fruit weight, Fruit length, Fruit diameter, Vine length, Number of fruits per plant, Number of seed per fruits, Total soluble solids, and Yield per plant. The phenotypic, genotypic and environmental coefficients of correlation were computed as per the methods suggested by [4] and the path coefficients were calculated by employing the method suggested by [5].

Table 1: Name of genotypes and Source of collection

S. No.	Genotypes	Source of collection
Lines		
1	PUSAWHITE CUCUM-BER-1	IARI, New Delhi
2	GUJRAT CUCUMBER-1	IIVR, VANARASI
3	DC-54	IIVR, VANARASI
4	JLG	IIVR, VANARASI
5	PCUC-9	IIVR, VANARASI
6	SWARANA AGETI	IIVR, VANARASI
7	KALYANPUR GREEN	IIVR, VANARASI
8	HIMANGI	IIVR, VANARASI
9	SWARANA POORNA	IARI, New Delhi
10	RUSSION PICKLIES	IARI, New Delhi
11	PUSA LONG GREEN	IARI, New Delhi
12	BORO PATTA	IARI, New Delhi
13	DC-55	IARI, New Delhi
14	DC-306	IARI, New Delhi
15	KTS-07	IIVR, VANARASI
Tester		
16	PUSA UDAY	IARI, New Delhi
17	PANT KHIRA-1	IIVR, VANARASI
18	PUSA BARKHA	IARI, New Delhi
19	PUNJAB NAVEEN	IIVR, VANARASI
20	SWARANA SHEETAL	IIVR, VANARASI

RESULTS AND DISCUSSION

Correlation coefficient analysis

The correlation coefficients have been estimated for all the characters with yield per plant as well as among the characters pairs at both genotypic and phenotypic levels. In general, genotypic correlations were higher than phenotypic correlation in magnitude for all the characters. The character which showed negative correlation at genotypic level also showed negative correlation at phenotypic level. The results of correlation coefficient at genotypic level are presented in table 4.5 and 4.6, respectively and both explained below:

Genotypic Correlation

Yield per plant

At genotypic level, yield per plant had positive and highly significant association with fruit weight (0.943) followed by number fruits per plants (0.717), vine length (0.673), fruit diameter (0.626), fruit length (0.568), number seeds per fruit (0.523), total soluble solids (0.211), and number of primary branches (0.210). Whereas, the highly significant and negative correlation showed by days to open first female flower

Table 2. Estimates of correlation coefficient for genotypic and Phenotypic levels among thirteen characters in cucumber

Characters		No of primary branch-es	Days to open first female flower	Days to open first Male flower	Days to first fruit set	Days to last fruit harvest-	Fruit weight (g)-	Fruit length (cm)	Fruit diam-eter(mm)	Vine length (cm)	Number of fruits per plant-	Number of seeds per fruit-	Total soluble solids (%)-	Yield per plant (kg)
No of prima-ry branches	G	1.000	-0.181**	-0.277**	-0.280**	-0.358**	0.165**	0.468**	0.177**	0.462**	0.130*	0.279**	-0.016	0.210**
	P	1.000	-0.161**	-0.250**	-0.249**	-0.310**	0.146*	0.419**	0.130*	0.366**	0.068	0.170**	0.002	0.184**
Days to open first female flower	G			0.919**	0.860**	0.479**	-0.438**	-0.472**	-0.249**	-0.436**	-0.281**	-0.358**	0.033	-0.461**
	P			0.891**	0.792**	0.418**	-0.356**	-0.432**	-0.202**	-0.365**	-0.153**	-0.191**	0.043	-0.381**
Days to open first Male flower	G				0.857**	0.557**	-0.427**	-0.486**	-0.186**	-0.538**	-0.284**	-0.404**	-0.007	-0.459**
	P				0.785**	0.478**	-0.345**	-0.449**	-0.162**	-0.461**	-0.121*	-0.240**	0.009	-0.383**
Days to first fruit set	G					0.552**	-0.404**	-0.514**	-0.229**	-0.581**	-0.353**	-0.387**	-0.127*	-0.435**
	P					0.460**	-0.332**	-0.447**	-0.187**	-0.471**	-0.220**	-0.199**	-0.099	-0.368**
Days to last fruit harvest	G						-0.344**	-0.506**	-0.332**	-0.527**	-0.386**	-0.599**	-0.101	-0.397**
	P						-0.262**	-0.430**	-0.237**	-0.396**	-0.212**	-0.335**	-0.104	-0.331**
Fruit weight (g)-	G							0.557**	0.701**	0.719**	0.455**	0.534**	0.149*	0.943**
	P							0.450**	0.451**	0.532**	0.215**	0.303**	0.116*	0.819**
Fruit length (cm)	G								0.535**	0.659**	0.431**	0.601**	0.247**	0.568**
	P								0.417**	0.547**	0.245**	0.354**	0.207**	0.475**
Fruit diame-ter(mm)	G									0.419**	0.440**	0.544**	0.318**	0.626**
	P									0.328**	0.273**	0.259**	0.207**	0.463**
Vine length (cm)	G										0.469**	0.680**	0.166**	0.673**
	P										0.240**	0.340**	0.103	0.509**
Number of fruits per plant-	G											0.464**	0.346**	0.717**
	P											0.135*	0.221**	0.525**
Number of seeds per fruit-	G												0.117*	0.523**
	P												0.061	0.319**
Total soluble solids (%)-	G													0.211**
	P													0.181**
Yield per plant (kg)	G													1.000
	P													1.000

(-0.461) followed by days to open first male flower (-0.459), days to first fruit set (-0.435) and days to last fruit harvest (-0.397), respectively.

Phenotypic Correlation

Yield per plant

At phenotypic level, yield per plant had positive and highly significant association with fruit weight (0.819) followed number of fruits per plant (0.525), vine length (0.509), fruit length (0.475), fruit diameter (0.463), number of seeds per fruit (0.319), number of primary (0.184), and total soluble solids (0.181). Whereas, negative and highly significant correlation was recorded with days to open first male flower (-0.383) followed by days to open first female flower (-0.381), days to first fruit set (-0.368) and days to last fruit harvest (-0.331), respectively. These results are in close harmony with the findings of [6-10] and [11] have also reported the same effects of component traits on yield.

Path coefficient analysis

For the better understanding of association, the genotypic correlation co-efficient of grain yield per plant and their contributing traits were partitioned into direct and indirect effects through path co-efficient analysis as suggested by Wright (1921). The results on path coefficient analysis have been presented in table 4.7 (at genotypic level) and table 4.8 (at phenotypic level).

Genotypic path coefficient

The direct and indirect effects of various characters toward yield per plant at genotypic level are presented in table 4.7. At genotypic level highest positive direct effect towards yield

Table:3. Estimates of genotypic and phenotypic direct and indirect effects for thirteen characters studied towards fruit yield in cucumber

Characters		No of primary branch-es	Days to open first female flower	Days to open first Male flower	Days to first fruit set	Days to last fruit harvest-	Fruit weight (g)-	Fruit length (cm)	Fruit diame-ter(mm)	Vine length (cm)	Number of fruits per plant-	Num-ber of seeds per fruit-	Total soluble solids (%)-	Yield per plant (kg)
No of primary branches	G	**0.1440**	-0.0133	0.0208	0.0063	0.0075	0.1869	0.0121	-0.0486	-0.1718	0.0548	0.0114	-0.0005	0.210**
	P	**0.0291**	-0.0031	0.0359	-0.0153	0.0053	0.1013	0.0057	0.0037	-0.0077	0.0244	0.0044	0.0001	0.184**
Days to open first female flower	G	-0.0261	**0.0733**	-0.0690	-0.0195	-0.0101	-0.4951	-0.0122	0.0685	0.1620	-0.1189	-0.0146	0.0010	-0.461**
	P	-0.0047	**0.0195**	-0.1280	0.0486	-0.0072	-0.2467	-0.0059	-0.0058	0.0076	-0.0545	-0.0049	0.0008	-0.381**
Days to open first Male flower	G	-0.0399	0.0674	**-0.0751**	-0.0194	-0.0117	-0.4820	-0.0125	0.0511	0.1998	-0.1203	-0.0165	-0.0002	-0.459**
	P	-0.0073	0.0174	**-0.1436**	0.0481	-0.0082	-0.2395	-0.0061	-0.0047	0.0097	-0.0431	-0.0062	0.0002	-0.383**
Days to first fruit set	G	-0.0403	0.0631	-0.0644	**-0.0226**	-0.0116	-0.4562	-0.0133	0.0630	0.2161	-0.1492	-0.0158	-0.0036	-0.435**
	P	-0.0072	0.0154	-0.1127	**0.0613**	-0.0079	-0.2303	-0.0061	-0.0054	0.0099	-0.0781	-0.0051	-0.0018	-0.368**
Days to last fruit harvest	G	-0.0515	0.0351	-0.0418	-0.0125	**-0.0211**	-0.3889	-0.0131	0.0913	0.1958	-0.1634	-0.0244	-0.0029	-0.397**
	P	-0.0090	0.0082	-0.0686	0.0282	**-0.0172**	-0.1818	-0.0058	-0.0068	0.0083	-0.0755	-0.0086	-0.0019	-0.331**
Fruit weight (g)-	G	0.0238	-0.0321	0.0320	0.0091	0.0073	**1.1302**	0.0144	-0.1929	-0.2671	0.1924	0.0217	0.0043	0.943**
	P	0.0042	-0.0069	0.0496	-0.0204	0.0045	**0.6934**	0.0061	0.0130	-0.0111	0.0766	0.0078	0.0022	0.819**
Fruit length (cm)	G	0.0674	-0.0346	0.0365	0.0116	0.0107	0.6291	**0.0258**	-0.1472	-0.2449	0.1822	0.0245	0.0071	0.568**
	P	0.0122	-0.0084	0.0645	-0.0274	0.0074	0.3121	**0.0136**	0.0120	-0.0114	0.0872	0.0091	0.0039	0.475**
Fruit diam-eter(mm)	G	0.0255	-0.0183	0.0140	0.0052	0.0070	0.7927	0.0138	**-0.2750**	-0.1558	0.1861	0.0222	0.0091	0.626**
	P	0.0038	-0.0039	0.0233	-0.0114	0.0041	0.3127	0.0057	**0.0288**	-0.0069	0.0970	0.0066	0.0038	0.463**
Vine length (cm)	G	0.0666	-0.0320	0.0404	0.0132	0.0111	0.8123	0.0170	-0.1153	**-0.3716**	0.1985	0.0277	0.0047	0.673**
	P	0.0106	-0.0071	0.0662	-0.0289	0.0068	0.3692	0.0074	0.0094	**-0.0209**	0.0855	0.0087	0.0019	0.509**
Number of fruits per plant-	G	0.0187	-0.0206	0.0214	0.0080	0.0081	0.5143	0.0111	-0.1211	-0.1745	**0.4227**	0.0189	0.0099	0.717**
	P	0.0020	-0.0030	0.0174	-0.0135	0.0037	0.1492	0.0033	0.0078	-0.0050	**0.3559**	0.0035	0.0041	0.525**
Number of seeds per fruit	G	0.0402	-0.0262	0.0303	0.0088	0.0126	0.6034	0.0155	-0.1496	-0.2526	0.1962	**0.0407**	0.0034	0.523**
	P	0.0050	-0.0037	0.0345	-0.0122	0.0058	0.2101	0.0048	0.0075	-0.0071	0.0482	**0.0256**	0.0011	0.319**
Total sol-uble solids (%)-	G	-0.0023	0.0024	0.0006	0.0029	0.0021	0.1680	0.0064	-0.0875	-0.0617	0.1464	0.0048	**0.0286**	0.211**
	P	0.0001	0.0009	-0.0013	-0.0061	0.0018	0.0806	0.0028	0.0059	-0.0022	0.0785	0.0016	**0.0186**	0.181**

*, ** significant at 5% and 1% level, respectively
Where, G= Genotypic Residual effect, P= Phenotypic Residual effect

per plant throw fruit weight (1.1302) followed by number of fruits per plant (0.4227), number of primary branches (0.1440), days to open first female flower (0.0733), number of seed per fruit (0.0407), total soluble solid (0.0286) and fruit length (0.0258). Whereas, the negative direct effect was toward the yield per plant throw vine length (-0.3716) followed by fruit diameter (-0.2750), days to open first male flower (0.0751), days to first fruit set (-0.0226) and Days to last fruit harvest (-0.0233).

Phenotypic Path Coefficient

Direct effect

The direct and indirect effects of various characters toward yield per plant at phenotypic level are presented in table 4.7. At phenotypic level highest positive direct effect towards yield per plant through fruit weight (0.6934) followed by number of fruits per plant (0.3559), days to first fruit set (0.0613), number of primary branches (0.0291), fruit diameter (0.0288), number of

seeds per fruit (0.0256), days to open first female flower (0.0195), total soluble solid (0.0186) and fruit length (0.0136). Whereas, the negative direct effect was toward the yield per plant through days to open first male flower (-0.1436) followed by vine length (-0.0209) and days to last fruit harvest (-0.0172). [12-15] have also reported the same effects of component traits on yield.

CONCLUSION

The correlation coefficient studies revealed that yield per plant had positive and highly significant association with fruit weight followed by number fruits per plants, vine length, fruit diameter, fruit length, number seeds per fruit, total soluble solids, and number of primary branches at both genotypic and phenotypic levels. The path coefficient analysis on direct and indirect effects of various characters toward yield per plant are presented in highest positive towards fruit weight followed by number of fruits per plant, Number of primary branches, days to open first female flower, Number of seed per fruit, total soluble solid and fruit length at both genotypic and phenotypic levels, indicating that these traits will be considered as main component of selection in a breeding programme for fruit yield per plant.

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