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Character Association Analysis of Yield Traits in Cucumber (*Cucumis sativus* L.)

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A B S T R A C T

Twenty four cucumber genotypes were evaluated at Agricultural College & Research Institute, Killikulam during Rabi 2018. The study was conducted to assess the nature and magnitude of association among yield and its contributing traits in cucumber. The experiment was laid out in RBD with three replications. In this study, genotypic correlation was higher than phenotypic correlations indicating the highly heritable nature of the traits. It was observed that the traits *viz.*, number of primary branches, number of fruits/plant and yield/vine have exhibited highly significant positive association with fruit yield. The genetic improvement of fruit yield thus can be obtained by direct selection of these yield components. The path coefficient analysis revealed that the number of primary branches, number of fruits/plant and yield/vine have direct positive phenotypic and genotypic effect on yield. Hence, direct selection for these traits can be done for improving fruit yield per plant.

Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important cucurbitaceous vegetable crops grown extensively in tropical and subtropical parts of the country, which is thought to be indigenous to India. It is considered as 4th most important vegetable crop after tomato, cabbage and onion. It is grown for its tender fruits, which are consumed either raw as salad, cooked as vegetable or as pickling cucumber in its immature stage (Sharma *et al.*, 2017). It is a rich source of vitamin B and C, carbohydrates, Ca and P (Yawalkar, 1985). India is endowed with the wealth of cucumber germplasm, comprising of both wild and cultivated forms (Sharma *et al.*, 2018). In spite of being native to Indian sub-continent and endowed with enormous variability for different horticultural traits, cucumber remains underutilized in terms of its economic potential and unexploited from breeding point of view. Therefore, there is a need to screen cucumber germplasm for the identification of genotypes with improved quality and yield which may be directly used as varieties after extensive evaluation or as parents in the hybridization programme (Kumar *et al.,* 2011). While selecting for yield, one should take into account the improvement of yield contributing traits, provided that the association of such traits with yield is known. Moreover, correlation and path coefficient analysis have been of immense help in selecting suitable plant type. Although, correlation coefficient indicates the nature of association among the traits, path analysis splits the correlation coefficients into measures of direct and indirect effects, thus providing an understanding on direct and indirect contribution of each character towards yield. Therefore, the present study was undertaken to assess the nature and magnitude of association among yield and its contributing traits for selecting high yielding genotypes of cucumber.

Materials and Methods

The present investigation was carried out during Rabi, 2018 at the Department of Horticulture, Agricultural College & Research Institute, Killikulam, Thoothukudi district, Tamil Nadu Agricultural University, Tamil Nadu. This location is at an elevation of 40 m (131.2 feet) above mean sea level lying between the 8°46 N latitude and 77° 42 E longitudes. The mean annual rainfall of the farm is 736.7 mm which is being received in 40 rainy days. The maximum and minimum temperatures ranged from 39^0C and 20^0C to 22^0C, respectively. The relative humidity during the period of crop growth ranged between 42% to 98.71 %.

The experiment was laid-out under a shade net in a randomized block design replicated thrice. In each replication, each genotype was grown in a single row of 6 m length with a spacing of 75 x 60 cm accommodating 10 plants in a replication. The experimental material (Table 1) comprised of a set of 24 genotypes. These genotypes were collected from different locations as depicted in Table 1. Observations were recorded on plant height (cm), number of primary branches per vine, days to 50% flowering, node at which first female flower appeared, fruit length (cm), fruit circumference (cm), number of fruits per plant, fruit weight (g), yield per plant (kg) and yield per hectare (t) in 10 random plants per treatment. Genotypic and phenotypic correlation coefficients were calculated using the method as suggested by Johnson *et al.,* (1955), by using analysis of variance and covariance matrix in which total variability has been split into replications, genotypes and errors. The genotypic and phenotypic correlation coefficients were used to find out their direct and indirect contributions towards yield per plot. The direct and indirect paths were obtained according to the method given by Dewey and Lu (1959).

Results and Discussion

Correlation studies

The correlation coefficients among different characters were calculated both at phenotypic and genotypic levels (Table 2). It was observed that genotypic correlation coefficients were higher than that of phenotypic correlation coefficients for most of the characters studied in the present investigation. This could be interpreted on the basis that there was strong inherent genotypic relation between the characters studied, but the phenotypic expression was impeded by the influence of environmental factors. Fruit yield per vine showed positive and significant correlation, phenotypically and genotypically with the character number of fruits per plant. Number of fruits per plant had significant positive correlation with number of primary branches per plant. While significantly negative correlation with node at which first female flower appear, length of fruit and circumference of fruit. Fruit length had significantly positive correlation with days to first female flower and node at which first female flower occur while negative correlation with vine length. Fruit weight had significantly positive correlation with length of fruit and circumference of fruit. The same results were reported by Chikezie *et al.,* 2016.

Table.1 List of cucumber genotypes along with their sources

Name of the accession	Place of collection
KCS 1	Radhapuram
KCS 2	Vellayani
KCS 3	Assam Agri University
KCS 4	Sattur
KCS 5	Radhapuram
KCS 6	Sivakasi
KCS 7	Kallipatti
KCS 8	Surandai
KCS 9	Mecheri
KCS 10	Vembakottai
KCS 11	Pavoorchatram
KCS 12	Chinakollanpatti
KCS 13	Periyakollanpatti
KCS 14	Erukanpatti
KCS 15	Yelayirampannai
KCS 16	Aalampalayam
KCS 17	Thaiyalpatti
KCS 18	Tenkasi
KCS 19	Nanguneri
KCS 20	Kuruvikulam
KCS 21	Aalantha
KCS 22	Manathi
KCS 23	Villikury
KCS 24	Karungulam

Table.2 Genotypic and phenotypic correlation among yield and yield influencing traits in cucumber

Traits	Correlation	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	G	0.00	0.115	0.234	-0.051	-0.357	0.250	-0.012	-0.130	-0.076	-0.073
	P	0.00	0.110	0.199	-0.055	-0.297	0.201	-0.013	-0.122	-0.070	-0.078
X_2	G		0.00	0.302	-0.193	0.112	0.168	0.226	0.238	0.356	0.359
	P		0.00	0.232	-0.190	0.051	0.136	0.220	0.235	0.343	0.339
X_3	G			0.00	0.058	0.421*	0.247	-0.107	0.221	-0.038	-0.046
	P			0.00	0.042	0.242	0.251	-0.113	0.194	-0.055	-0.044
X_4	G				0.00	0.561**	0.303	-0.980**	0.332	-0.942**	-0.941**
	P				0.00	0.404*	0.238	-0.935**	0.326	-0.897**	-0.898**
X_5	G					0.00	0.498*	-0.628**	0.837**	-0.340	-0.311
	P					0.00	0.197	-0.397	0.579**	-0.198	-0.243
X_6	G						0.00	-0.403*	0.847**	-0.119	-0.146
	P						0.00	-0.362	0.686**	-0.138	-0.096
X_7	G							0.00	-0.430*	0.928**	0.965**
	P							0.00	-0.421*	0.932**	0.866**
X_8	G								0.00	-0.067	-0.071
	P								0.00	-0.069	-0.064
X_9	G									0.00	1.036**
	P									0.00	0.934**
X_{10}	G										0.00
	P										0.00

*0.05% Significant level **0.01 Significant level

X_1 : Vine length (cm) X_6: Circumference of fruit (cm)

X_2: Number of primary branches X_7: Number of fruits/plant

X_3: Days to first female flowerX_8: Fruit weight (g)

X_4: Node at which first female flower appearX_9 : Yield/vine (kg)

X_5: Length of fruit(cm)X_{10}: Yield(t/ha)

Table.3 Path coefficient analysis showing direct and indirect effect of 9 characters on fruit yield in cucumber

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	**-1.174**	0.021	0.118	0.182	0.342	0.445	0.331	1.297	-1.636	**-0.073**
X_2	-0.135	**0.182**	0.153	0.685	-0.107	0.299	-6.033	-2.375	7.690	**0.359**
X_3	-0.275	0.055	**0.506**	-0.205	-0.404	0.440	2.860	-2.202	-0.820	**-0.046**
X_4	0.060	-0.035	0.029	**-3.553**	-0.538	0.539	26.195	-3.303	-20.335	**-0.941**
X_5	0.419	0.020	0.213	-1.994	**-0.959**	0.887	16.776	-8.338	-7.336	**-0.311**
X_6	-0.293	0.031	0.125	-1.076	-0.477	**1.781**	10.769	-8.437	-2.568	**-0.146**
X_7	0.015	0.041	-0.054	3.482	0.602	-0.718	**-26.731**	4.281	20.047	**0.965**
X_8	0.153	0.044	0.112	-1.178	-0.802	1.509	11.490	**-9.960**	-1.437	**-0.071**
X_9	0.089	0.065	-0.019	3.346	0.326	-0.212	-24.815	0.663	**21.594**	**1.036**

X_1 : Vine length (cm) X_6: Circumference of fruit (cm)
X_2: Number of primary branchesX_7: Number of fruits/plant
X_3: Days to first female flowerX_8: Fruit weight (grams)
X_4: Node at which first female flower appearX_9 : Yield/vine (kg)
X_5: Length of fruit(cm)X_{10}: Yield/t

Path coefficient analysis

Path coefficient analysis furnishes a means of measuring the direct and indirect effects of a variable through other variables on the end product. Yield being a complex and polygenic character, direct selection for yield may not be reliable approach because it is highly influenced by environmental factors. Therefore, it becomes essential to identify the component characters, through which yield improvement could be identified. Though correlation gives information about the components of complex character like yield, it will not provide an exact picture of relative importance of the direct and indirect contribution of the component characters to yield. The technique of path coefficient analysis involves a method of partitioning the total correlation between the dependent variable and the independent component variable *i.e.*, direct effect of independent variable and its indirect effect via third variable on the dependent variable. Hence, path analysis is an important tool for partitioning the correlation coefficients into direct and indirect effects of independent variable and dependent variables. Thus, correlations in combination with path analysis would give a better insight into cause and effect relationship between different pairs of characters.

Direct and Indirect effect on yield

Table 3 revealed that number of fruits per plant and number of primary branches per plant have direct positive phenotypic and genotypic effect on yield. The results are in line with the findings of Chikezie *et al.*, 2016. The traits *viz.*, vine length, days to first female flower, node at which first female flower appears, fruit length, fruit circumference and fruit weight have negative direct effect on yield. The same results were proved by Arunkumar *et al.*, 2011 and Sandeep *et al.*, 2011 in cucumber. Node at which first female flower appeared had positive indirect effect on vine length, number of primary branches and yield per vine. These results were in agreement with the findings of Sharma *et al.*, 2018. Fruit weight had positive indirect effect on yield through vine length, number of fruits per plant and yield per plant. The fruit weight exhibited negative indirect effect on number of primary branches, days to first female flower, node at which first female flower appear, length of fruit and circumference of fruit. Similar findings were also reported by Kumar *et al.*, 2008 in cucumber.

In this study, genotypic correlation was higher than phenotypic correlations indicating the highly heritable nature of the traits. It was observed that number of fruits per plant has exhibited highly significant positive association with fruit yield per plant followed by fruit weight, number of primary branches per plant, fruit length and vine length. Direct selection based on these traits would improve yield. The path coefficient analysis revealed that the number of fruits per plant, fruit weight, number of primary branches per plant and fruit length have direct positive phenotypic and genotypic effect on yield. These findings showed that direct selection on the basis of above characters will be rewarding for crop improvement in cucumber.

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