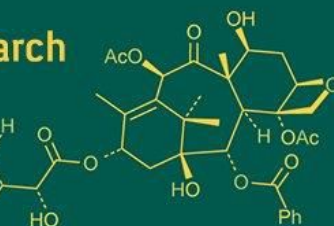
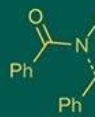
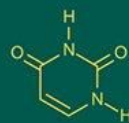


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Study on correlation and path coefficient analysis for certain quantitative traits in cucumber (*Cucumis sativus* L.)

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Abstract

Quantitative trait analysis using correlation and path coefficients in cucumbers (*Cucumis sativus* L.). In order to quantify genetic variation, pinpoint important features influencing yield, and comprehend genetic linkages, a wide range of genotypes of cucumbers was examined. There was significant variation among genotypes, suggesting that there is a great chance for genetic advancement. Fruit length, fruit diameter, and the number of fruits per plant were found to have significant direct influences on yield per plant by path coefficient analysis, making them important candidates for selection. These results show the potential for targeted genetic modification through breeding and offer useful insights for cucumber breeding programs focusing on yield enhancement and other desirable features.

Keywords: Correlation, path coefficient, analysis, quantitative and cucumber

Introduction

Cucumber (*Cucumis sativus* L.) is a significant vegetable crop in the Cucurbitaceae family, with a chromosomal number of $2n=14$. It holds high economic value and is widely cultivated, particularly in India, covering 40,900 hectares with an average yield of 15.63 million tonnes per hectare. In Karnataka, cucumber is grown on 6,903 hectares, producing 1,03,396 M. Tonnes annually with a productivity of 14.98 M. Tonnes per hectare. Known for its culinary versatility and nutritional value, cucumbers are cultivated globally in various climates, both traditionally and in controlled environments such as greenhouses. This plant produces elongated fruits commonly used fresh, pickled, or in diverse culinary dishes. Cucumbers, high in water content, offer hydration and essential nutrients like vitamins K and C, potassium, and antioxidants.

Cucumis, which originated in India, is a genus with 30 species spread over Africa and Asia. *Cucumber sativus* L. var. *hardwickii*, a wild variety, grows in the Himalayan foothills. This species, which varies significantly, is the world's fourth most important vegetable, after onions, tomatoes, and cabbage. Cucumber is a popular summer crop with numerous applications, including salads, pickles, and cooked foods. Its high potassium concentration helps with jaundice, inflammation, and constipation. Cucumber seed oil, which is utilized in Ayurvedic medicines, promotes brain growth and body smoothness. Cucumber extracts are also prized in cosmetics due to their soothing and softening effects.

Despite its significance, cucumber receives limited research attention in India, particularly for crop improvement. Understanding genetic diversity and environmental influences is crucial for successful breeding efforts. Heritability and genetic progress are essential for selecting elite genotypes. Studies indicate that seasonal variations affect yield and attributes, suggesting the need for season-specific varieties. Assessing genetic variability, heritability, and genetic progress helps develop superior genotypes. This research emphasizes exploiting genetic variability to enhance fruit traits and yield, contributing to cucumber breeding and agricultural improvement.

Materials and Method

The experimental study utilized 19 cucumber germplasms, including the national check

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VRCU-23-15-B, sourced from various regions across India and preserved at the Main CRC-3 Turari in the Department of Horticulture at ITM University, Gwalior (M.P). Performed in the summer of 2014 using three replications and a Randomized Block Design, the experiment aimed to evaluate the performance of these germplasms. Each row contained five plants, with the experiment replicated three times. Sowing took place on October 2, 2023, with a gap of 50 cm and 2.5 cm between rows between plants, resulting in a net plot size of 3 x 2.5 meters. Standard agronomic practices and plant protection measures were implemented to ensure a healthy crop five randomly chosen plants per germplasm were used for data collection in each replication. The following characteristics were of particular interest: the number of nodes to the anthesis of the initial staminate bloom, the number of nodes the quantity of pistillate flowers that anthesis before the first days to the first fruit harvest, the average length and diameter of fruits (cm and cm), the number of fruits per plant, the average weight of fruits (g), the total fruit yield per plant (kg), and the length of the vine (m). characteristics' correlations at the phenotypic (p) and genotypic (g) levels were analyzed according to Searle (1961) [9], while path coefficient analysis followed the method of Dewey and Lu (1959) [3].

Results and Discussion

The correlation coefficient, which expresses the extent to which association between two characteristics or variables, was helpful in this case in determining the kind and strength of the relationship that exists between fruit production and its constituent parts (Tables 1 & 2). For most traits, the phenotypic correlation coefficients were sign and nature reflected by the corresponding genotypic correlation coefficients. In contrast to their phenotypic counterparts,

genotypic associations were typically stronger in magnitude. This study found a phenotypic association that is both extremely significant and positive between the quantity of fruits and fruit output per plant produced, with average fruit weight, days to first fruit harvest, days to the first pistillate flower anthesis, node number to the first pistillate flower anthesis, and average fruit diameter following. Important and the quantity of nodes leading to the anthesis of the first staminate flower showed the strongest positive relationships. These were followed by the average fruit length and the duration until the anthesis of the first staminate bloom. Similar results with sponge gourd and pumpkin have been reported by Singh (2006) [12] and Kumaran *et al.* (1998) [4], respectively. Route coefficient and correlation analysis in cucumber germplasm showed that the average fruit weight, fruit output was significantly positively influenced by the number of fruits per plant, the number of days till the first fruit harvest, and other factors. plant, while it exhibits a straight negative relationship between the number of nodes and average fruit length to the anthesis of the initial staminate bloom. Mohanty (2001) [6] provides support for the current findings in pumpkin. The immediate consequences of the residual component qualities could be inconsistent in how they present themselves when the environment changes and could be heavily impacted by environmental factors. In the case of bitter melon, Rajput *et al.* (1996) [8], Sharma and Bhutani (2001) [11], and Shah and Kale (2002) [10] in the case of ridge gourd all corroborate the current findings. Days to the first fruit harvest had an indirect beneficial impact on fruit yield. Despite this, the number of nodes and the amount of days until the first staminate flower anthesis had a beneficial indirect effect. The average fruit weight and the number of fruits that each plant yields.

Table 1: Cucumber genotypes: phenotypic path of coefficient analysis among several characters.

	DTFSFA	NNTFSFA	DTFPFA	NNTFPFA	IL	PH	DTFFH	FL	FD	NOFPP	AFW	FYPP
DTFSFA	1 **	-0.0262	0.2898 *	0.3062 *	0.273 *	0.2379	0.5324 **	0.1437	-0.3275 *	-0.3807 **	0.148	-0.4139 **
NNTFSFA	-0.0262	1 **	-0.1047	0.1634	0.0012	0.1019	-0.0992	0.2001	0.0407	-0.0294	0.1233	0.0259
DTFPFA	0.2898 *	-0.1047	1 **	0.2641 *	0.2715 *	0.3057 *	0.2114	0.2081	-0.061	-0.5447 **	0.3527 **	-0.5115 **
NNTFPFA	0.3062 *	0.1634	0.2641 *	1 **	0.5855 **	0.2155	0.089	0.2655 *	-0.1221	-0.4899 **	0.253	-0.4611 **
IL	0.273 *	0.0012	0.2715 *	0.5855 **	1 **	0.0583	-0.0482	0.5644 **	-0.0165	-0.4756 **	0.2443	-0.4103 **
PH	0.2379	0.1019	0.3057 *	0.2155	0.0583	1 **	0.0497	0.0544	-0.222	-0.0821	0.1776	-0.1182
DTFFH	0.5324 **	-0.0992	0.2114	0.089	-0.0482	0.0497	1 **	0.0777	-0.1987	-0.1871	0.0792	-0.473 **
FL	0.1437	0.2001	0.2081	0.2655 *	0.5644 **	0.0544	0.0777	1 **	-0.0323	-0.3476 **	0.1816	-0.2746 *
FD	-0.3275 *	0.0407	-0.061	-0.1221	-0.0165	-0.222	-0.1987	-0.0323	1 **	0.0823	-0.079	0.0628 NS
NOFPP	-0.3807 **	-0.0294	-0.5447 **	-0.4899 **	-0.4756 **	-0.0821	-0.1871	-0.3476 **	0.0823	1 **	-0.4266 **	0.6832 **
AFW	0.148	0.1233	0.3527 **	0.253	0.2443	0.1776	0.0792	0.1816	-0.079	-0.4266 **	1 **	-0.3524 **
FYPP	-0.4139 **	0.0259	-0.5115 **	-0.4611	-0.4103 **	-0.1182	-0.473 **	-0.2746 *	0.0628 NS	0.6832 **	-0.3524 **	1 **

IL stands for internodal length, PH for plant height, DTFSFA for days till first staminate flower anthesis, and NNTFSFA for node number to first staminate flower appearance and node number to first pistillate flower appearance. Fruit diameter (FD), fruit length (FL), fruit harvest days (DTFFH), fruit yield per plant (FYPP), number of fruits per plant (NOFPP), and average fruit weight (AFW) are all represented.

Table 2: In cucumber genotypes, the genotypic path of coefficient analysis among several features

	DTFSA	NNTFSA	DTFPFA	NNTFPFA	IL	PH	DTFH	FL	FD	NOFP	AFW	FYPP
DTFSA	1 **	-0.3116 NS	2.0563 **	0.5973 **	1.0261 **	1.6003 **	1.5994 **	0.5002 *	-2.8973 **	-1.1782 **	0.6966 **	-1.472 **
NNTFSA	-0.3116 NS	1 **	-0.5783 **	0.4582 *	1.0535 **	0.0238 NS	-0.8502 **	0.6143 **	-0.9593 **	0.1246 NS	0.2573 NS	0.1728 NS
DTFPFA	2.0563 **	-0.5783 **	1 **	0.5609 *	1.0055 **	0.5277 *	1.0607 **	0.5576 *	-1.9059 **	-0.81 **	0.4799 *	-0.7941 **
NNTFPFA	0.5973 **	0.4582 *	0.5609 *	1 **	0.9773 **	0.2862 NS	0.6108 **	0.7767 **	0.5769 **	-0.8008 **	0.5173 *	-0.6576 **
IL	1.0261 **	1.0535 **	1.0055 **	0.9773 **	1 **	-0.3336 NS	0.6265 **	0.6342 **	0.8247 **	-1.269 **	0.9435 **	-1.1077 **
PH	1.6003 **	0.0238 NS	0.5277 *	0.2862 NS	-0.3336 NS	1 **	1.2205 **	0.1737 NS	-2.9806 **	-0.0609 NS	0.0956 NS	-0.2475 NS
DTFH	1.5994 **	-0.8502 **	1.0607 **	0.6108 **	0.6265 **	1.2205 **	1 **	-0.0573 NS	-2.8318 **	-0.6554 **	0.5072 *	-1.0431 **
FL	0.5002 *	0.6143 **	0.5576 *	0.7767 **	0.6342 **	0.1737 NS	-0.0573 NS	1 **	-1.0995 **	-0.6831 **	0.8294 **	-0.6562 **
FD	-2.8973 **	-0.9593 **	-1.9059 **	0.5769 **	0.8247 **	-2.9806 **	-2.8318 **	-1.0995 **	1 **	0.205 NS	-0.3735 NS	0.4521 NS
NOFP	-1.1782 **	0.1246 NS	-0.81 **	-0.8008 **	-1.269 **	-0.0609 NS	-0.6554 **	-0.6831 **	0.205 NS	1 **	-0.5314 *	0.801 **
AFW	0.6966 **	0.2573 NS	0.4799 *	0.5173 *	0.9435 **	0.0956 NS	0.5072 *	0.8294 **	-0.3735 NS	-0.5314 *	1 **	-0.4742 *
FYPP	-1.472 **	0.1728 NS	-0.7941 **	-0.6576 **	-1.1077 **	-0.2475 NS	-1.0431 **	-0.6562 **	0.4521 NS	0.801 **	-0.4742 *	1 **

The acronyms for fruit length, fruit diameter, number of fruits per plant, average fruit weight, and fruit yield per plant are FL, FD, NOFP, and DTFH, respectively. The node number to the first staminate and pistillate flower appearance is NNTFSA, while the days to the first staminate and pistillate flower anthesis are DTFSA and DTFPFA, respectively.

Table 3: Analysis of variance for 12 characters in Cucumber 19 genotypes.

Source of Variation	d.f	Mean sum of squares											
		Days to first staminate flower anthesis	Days to first pistillate flower anthesis	Node number to first staminate flower appearance	Node number to first pistillate flower appearance	Internodal length (cm))	Plant height (cm)	Days till the first harvest of fruits	length of fruit (cm)	Fruit size in centimeters	Fruits per plant in number	Fruit weight on average (gram)	Fruit production (kg) per plant
Replications	2	7.148	1.000	5.205	0.156	2.762	290.480	12.178	3.992	1.900	0.540	992.690	0.010
Genotypes	18	7.705	0.516	9.584	1.522	1.042	241.280	16.935	1.514	0.524	5.883	440.510	0.344
Error	36	5.839	0.254	2.611	0.343	0.604	127.720	10.722	0.751	0.483	0.474	55.780	0.016

*, **=significant at 5% & 1% level respectively

Table 4: Phenotypic path of coefficient analysis among different characters in genotypes of cucumber

	DTFSA	NNTFSA	DTFPFA	NNTFPFA	IL	PH	DTFH	FL	FD	NOFP	AFW	FYPP
DTFSA	1 **	-0.0262 NS	0.2898 *	0.3062 *	0.273 *	0.2379 NS	0.5324 **	0.1437 NS	-0.3275 *	-0.3807 **	0.148 NS	-0.4139 **
NNTFSA	-0.0262 NS	1 **	-0.1047 NS	0.1634 NS	0.0012 NS	0.1019 NS	-0.0992 NS	0.2001 NS	0.0407 NS	-0.0294 NS	0.1233 NS	0.0259 NS
DTFPFA	0.2898 *	-0.1047 NS	1 **	0.2641 *	0.2715 *	0.3057 *	0.2114 NS	0.2081 NS	-0.061 NS	-0.5447 **	0.3527 **	-0.5115 **
NNTFPFA	0.3062 *	0.1634 NS	0.2641 *	1 **	0.5855 **	0.2155 NS	0.089 NS	0.2655 *	-0.1221 NS	-0.4899 **	0.253 NS	-0.4611 **
IL	0.273 *	0.0012 NS	0.2715 *	0.5855 **	1 **	0.0583 NS	-0.0482 NS	0.5644 **	-0.0165 NS	-0.4756 **	0.2443 NS	-0.4103 **
PH	0.2379 NS	0.1019 NS	0.3057 *	0.2155 NS	0.0583 NS	1 **	0.0497 NS	0.0544 NS	-0.222 NS	-0.0821 NS	0.1776 NS	-0.1182 NS
DTFH	0.5324 **	-0.0992 NS	0.2114 NS	0.089 NS	-0.0482 NS	0.0497 NS	1 **	0.0777 NS	-0.1987 NS	-0.1871 NS	0.0792 NS	-0.473 **
FL	0.1437 NS	0.2001 NS	0.2081 NS	0.2655 *	0.5644 **	0.0544 NS	0.0777 NS	1 **	-0.0323 NS	-0.3476 **	0.1816 NS	-0.2746 *
FD	-0.3275 *	0.0407 NS	-0.061 NS	-0.1221 NS	-0.0165 NS	-0.222 NS	-0.1987 NS	-0.0323 NS	1 **	0.0823 NS	-0.079 NS	0.0628 NS
NOFP	-0.3807 **	-0.0294 NS	-0.5447 **	-0.4899 **	-0.4756 **	-0.0821 NS	-0.1871 NS	-0.3476 **	0.0823 NS	1 **	-0.4266 **	0.6832 **
AFW	0.148 NS	0.1233 NS	0.3527 **	0.253 NS	0.2443 NS	0.1776 NS	0.0792 NS	0.1816 NS	-0.079 NS	-0.4266 **	1 **	-0.3524 **
FYPP	-0.4139 **	0.0259 NS	-0.5115 **	-0.4611	-0.4103 **	-0.1182 NS	-0.473 **	-0.2746 *	0.0628 NS	0.6832 **	-0.3524 **	1 **

Day counts for staminate and pistillate flowers, respectively, are as follows: DTFSA is the number of nodes that appear first in staminate flowers, DTFPFA is the number of nodes that appear first in pistillate flowers, Plant Height (PH), Internodal Length (IL) FL = fruit length; FD = fruit diameter; DTFH = days to first fruit harvest; FYPP is for fruit yield per plant; NOFP stands for number of fruits per plant; and AFW for average fruit weight.

Conclusion

Top genotypes V6, V7, V11, V12, V13, V15, and V16, demonstrate significant differences in The number of nodes at which the first pistillate bloom appears, the number of staminate flower anthesis days, and the number of staminate flower anthesis nodes Plant height (cm), internodal length (cm), fruit production per plant (kg), average fruit weight (Grammes), number of fruits per plant, days till first fruit harvest, fruit length (cm), fruit diameter (mm), and days till first fruit harvest.

As an outcome, larger yields can be obtained through heterosis breeding or recurrent SCA selection. The same investigation must be carried out for one or two seasons utilizing promising genotypes to determine the stable expression of the features and the future hybridization programmer. The genetically diverse genotypes can be utilized as mapping populations to detect molecular diversity and to find molecular markers associated with desirable features for marker assisted selection (MAS).

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