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Per se performance and association studies in Cucumber (*Cucumis sativus* L.) genotypes

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Abstract
A comprehensive assessment was conducted on 21 cucumber genotypes gathered from different sources, during which observations were documented for the following traits. *viz*. length of the vine, Branches number per vine, node up to which first female flower appearance, node up to which first male flower appearance, days to first female flower appearance, days to first male flower appearance, days to first harvest, days to last harvest, length of the fruit, diameter of the fruit, average weight of the fruit weight, fruits number per vine, fruit yield per vine, fruit yield per plot, fruit yield per hectare, flesh thickness, TSS. Correlation analysis revealed that fruit yield per vine was significantly and positively correlated with per plot yield, per hectare yield, branches number, fruit length, fruits number per vine, days to first harvest, average fruit weight. However, negative association, was noted for days to the first appearance of the female flower, the node number for the first appearance of the female flower and days to the first harvest. Hence simultaneous selection for these traits would be rewarding for improving the fruit yield per vine.

Keywords: *Per se*, correlation, cucumber

Introduction
Cucumber scientifically known as *Cucumis sativus* L., stands as a highly favoured vegetable among consumers, belongs to the family Cucurbitaceae. It is the second most widely grown cucurbit in the world after watermelon, within this plant family. It is originated in india, all around India, including river banks and plains with greater altitudes, cucumber is cultivated commercially. Cucumber (*Cucumis sativus* L.) holds a significant position in global agriculture, serving as a staple in various culinary traditions and a crucial component of international trade renowned for its versatility and nutritional benefits. Cucumber is a vegetable with more water content and low energy content, it serves as a good source of calcium, phosphate, carbohydrates, vitamin B and C (Yawalkar, 1985) [7]. Typically, cucumber cultivars are divided into two categories based on their intended uses: fresh market (slicing) and pickling types. The fruits are consumed when they are young as a cool salad and are thought to offer cooling properties, help to prevent constipation and benefit those who suffer from jaundice. The fruit is also employed as an antipyretic and astringent. Even though cucumbers are widely cultivated and consumed, little systematic research has been done on them to understand their genetic makeup and crop development in India. It is crucial to choose high-yielding varieties with desired quality attributes to fulfill the increasing demand for both enhanced yield and quality. Achieving this objective can be accomplished through various improvement programs. The initial stage in any improvement program involves the evaluation or screening of germplasm to choose high-yielding types possessing all desirable attributes. The focus of crop development is mostly on yield and yield characters. An association can be determined by looking at the correlation between several quantitative characteristics. The current study aims to identify high-yielding cucumber varieties and assess the inter relationship between quantitative and qualitative traits that contribute to both yield and quality characteristics in cucumbers

Materials and Methods
The inquiry was conducted in the field of Vegetable Science unit of College of Horticulture, Bagalkot, during 2022-23 with 21 genotypes from diverse sources. These plants are being raised in randomized block design (RBD) and it is replicated twice. Ten plants are included in each replication. With followed spacing of 100 cm× 75 cm.

The recommended package of practices of UHSB was followed to grow a successful crop of Cucumber. Observations were documented for the traits like length of the vine, branches number per vine, node to first female flower appearance, node to first male flower appearance, days to first female flower appearance, days to first male flower appearance, days to first harvest, days to last harvest, fruit length, fruit diameter, average fruit weight, number of fruits per vine, fruit yield per vine, fruit yield per plot, fruit yield per hectare in addition to quality traits such as flesh thickness, TSS. The data underwent statistical analysis to extract insights into the average performance and to evaluate the relationship between yield and its components. Correlation analysis was conducted using OPSTAT software, genotypic and phenotypic Correlation was calculated following the procedures recommended by Grafius (1956) [8].

Results and Discussion

Achieving high-yielding crop genotypes necessitates a comprehensive understanding of the inherent variability in the available genotypes. This process relies on a careful and thoughtful evaluation of existing data related to phenotypic characteristics associated with yield. Therefore, a total of 21 cucumber genotypes underwent assessment for their growth and yield attributes. (Table 1).

Typically, the concept of earliness in cucurbits is quantified as the number of days it takes for the first appearance of a female flower, days taken for the first male flower appearance and node number for first female flower appearance, node for first male flower appearance are considered as desirable traits in any hybrid development programme. In the present study, minimum number of days taken for first female flower appearance was observed in Belgaum Local (22.10), The genotype IC276589 took the fewest days (16.80) for the first male flower to bloom. The least number of nodes up to first male flowering belonged to genotype IC538137 (3.00) and EC538145 (6.50) observed to have least number of nodes up to which the first female flower appearance. The genotype Swarna Ageti took the fewest days for the first harvest (28.25).

The information regarding growth parameters suggested that among the 21 accesions. For vine length the longest vines were measured in IC410682 (4.75m) and for number of branches per vine the genotype Hassan Local had the more number of branches per vine (7.05).

For yield and yield attributing parameters like fruit length, Belgaum Local had the longest average fruit length (17.33 cm), Arka Veera had the largest fruit diameter (40.80 mm), It is observed that the highest fruit number per vine observed in IC276589 (16.60), for average fruit weight the line IC538137 had the heaviest fruit on average (143.66 g), the highest total fruit production per plant was observed in the genotype IC276589 (2.34 Kg), fruit yield per plot was highest in IC276589 (13.60 kg), The maximum fruit yield per hectare was achieved in IC276589(18.13 tonnes/ha).

For quality traits like flesh thickness and TSS, Maximum mean flesh thickness was found in Puna Local (15.95 mm) and TSS content was maximum in IC538126 (4.42 ˚B).

Correlation analysis

Yield, being a intricate trait is affected by numerous components contributing to its complexity. Understanding the influence of different components on yield is crucial prior to the selection of desirable genotypes. In this context, conducting correlation analysis will reveal potential associations between the overall yield and its specific attributes of cucumber genotypes. The estimation of correlation serves as a simple tool for making selection of the cucumber genotypes appropriate for advancing crop improvement programme. The genotypic correlation coefficients for cucumber yield and its attributes are presented in Tables 3 and 4.

Doku (1970) [2] recommended the estimation of correlations among yield components, emphasizing that such estimation is crucial as one component can significantly influence other interconnected components. The results of the correlation analysis showed that among the examined traits the fruit yield per vine is positive and significant correlation with per plot yield (0.3495) per hectare yield (0.415) length of the fruit (0.4125), and branches number per vine (0.2235). It exhibited negative and significant correlation with days to which the first female flower appearnce (-0.2095) node to first female flowering (-0.1214) days to first harvest (-0.3861). It indicates simultaneous selection for these traits would be rewarding for improving the fruit yield per vine

For growth and earliness parameters like Vine length is positively significant (at p=0.01) association with branches number per vine (r_g=0.2368), node to which the first male flower appearance (r_g=0.2414), average weight of the fruit (rg=0.2809). and it shows negative and significant correlation for node to which the first female flower appearance (r_g=0.5811) and average weight of the fruit (r_g=0.5126). Node to first male flowering was positively significant association with average fruit weight (r_g=0.7444). Node to first female flowering is positively significant association with days to last harvest (r_g=0.134), average fruit weight (r_g=0.484). and it shows negative and significant (at p=0.01) days to first fruit harvest (r_g=0.4912). Days to first male flowering was positively significant association with number of branches (r_g=0.3792), days to first harvest (r_g=0.22). Additionally, it had a negative and significant correlation with the days to first female flower (r_g=-0.4917), days to first male flower (r_g=-0.6145), node at first female flowering (r_g=-0.0945). days to first female flowering was positively significant association with number of branches (r_g=0.1931), days to first harvest (r_g=0.481), average fruit weight (r_g=0.2809).

Table 1: *Per se* performance of cucumber genotypes for growth and earliness parameters

Sl. No.	Genotypes	Vine length (m)	Numbers of branches per vine	Number of Node at first female flower	Number of Node at first male flower	Days to first male flowering	Days to first female flowering	Days to first harvest	Days to last harvest
1	Puna Local	1.95	5.23	6.65	3.01	19.30	23.80	28.90	80.20
2	Swarna Ageti	1.38	5.67	6.90	3.50	18.90	25.90	28.25	78.40
3	EC-888549	1.43	5.42	6.35	3.70	22.90	26.70	29.35	79.80
4	IC-538126	2.25	5.00	7.30	4.10	21.40	22.20	29.75	77.90
5	IC-572024	1.37	4.33	6.80	3.90	21.05	24.80	28.88	77.50
6	IC-276589	1.88	4.70	7.00	3.21	16.80	23.50	28.76	76.60
7	Mysore Local	2.70	5.95	6.35	4.20	17.00	26.90	29.74	81.00
8	Belgaum Local	2.33	5.83	6.20	4.00	18.50	22.10	28.59	79.30
9	IC-410682	4.75	4.00	5.80	4.10	20.80	23.60	28.70	78.20
10	IC-527400	1.83	3.83	6.40	3.50	20.75	25.60	29.50	78.50
11	Hassan Local	2.97	7.05	6.30	3.40	17.40	22.90	32.13	77.00
12	Arka Veera	1.87	5.58	6.20	3.60	21.70	24.95	29.89	81.40
13	Pusa Barkha	2.22	6.17	7.10	4.00	21.10	26.60	30.40	78.60
14	Pusa Uday	2.81	5.42	6.25	3.80	22.10	28.50	31.30	78.90
15	IC-7418	3.38	5.58	6.15	4.00	20.55	25.10	30.63	76.30
16	IC-410638	2.15	5.95	6.10	3.60	18.90	24.00	32.59	77.00
17	EC-1041467	1.31	6.00	6.15	3.20	17.30	24.00	32.40	77.30
18	EC-1041463	2.23	4.00	6.40	3.60	18.90	25.80	30.90	77.80
19	IC-527994	2.98	6.33	5.81	3.90	21.90	28.30	33.99	76.90
20	IC-538137	1.87	3.67	6.05	3.00	22.30	23.85	31.05	79.90
21	EC-538145	2.20	4.67	6.50	5.00	22.20	27.15	32.60	77.20
	Mean	2.63	5.26	6.42	3.73	22.08	25.06	30.39	78.37
	S.Em±	0.21	0.39	0.23	0.22	0.78	0.89	0.77	0.69
	CD at 5%	0.60	1.15	0.68	0.66	2.32	2.62	2.27	2.048

Table 2: *Per se* performance of cucumber genotypes for yield and quality parameters

Sl. No.	Genotypes	Fruit length (cm)	Fruit diameter (mm)	Number of fruits per vine	Average fruit weight (g)	Fruit yield per vine (kg)	Yield per plot (kg)	Yield per hectare (t)	Flesh thickness (mm)	TSS (°B)
1	Puna Local	16.34	39.76	15.04	114.35	1.82	12.75	17.00	15.95	2.85
2	Swarna Ageti	16.07	39.80	14.65	107.40	1.59	12.62	16.82	13.46	3.99
3	EC-888549	14.46	38.20	11.27	126.20	1.10	10.61	14.14	14.54	4.06
4	IC-538126	13.20	37.34	14.39	107.70	1.49	12.37	16.49	12.12	4.42
5	IC-572024	13.99	39.85	11.89	132.78	1.36	11.61	15.48	14.10	3.55
6	IC-276589	14.48	39.35	16.60	134.08	2.34	13.60	18.13	13.27	3.46
7	Mysore Local	16.27	38.14	13.39	131.40	1.41	12.15	16.20	11.36	3.35
8	Belgaum Local	17.33	36.35	13.99	126.69	1.73	12.52	16.69	10.90	3.41
9	IC-410682	15.95	39.79	10.99	106.50	1.02	10.32	13.76	13.04	3.63
10	IC-527400	14.48	40.16	15.08	128.45	2.00	13.08	17.44	13.21	3.99
11	Hassan Local	14.16	39.90	10.69	130.48	1.29	11.41	15.15	13.31	3.99
12	Arka Veera	14.05	40.80	11.67	121.20	1.46	11.75	15.47	13.08	4.25
13	Pusa Barkha	13.30	40.22	10.69	139.60	1.21	10.54	14.05	14.47	4.01
14	Pusa Uday	14.53	37.75	9.67	132.78	1.00	9.44	13.11	12.31	3.38
15	IC-7418	14.82	37.30	10.01	132.70	1.05	10.10	13.46	12.73	3.48
16	IC-410638	15.65	40.42	11.38	122.03	1.33	10.65	14.20	12.27	3.33
17	EC-1041467	14.07	40.48	15.01	140.00	2.17	13.10	17.46	11.52	3.29
18	EC-1041463	14.12	40.02	8.56	131.30	0.98	9.11	12.14	11.98	3.60
19	IC-527994	15.27	39.96	9.39	121.38	1.02	9.77	13.02	13.36	4.14
20	IC-538137	16.09	37.40	12.00	143.66	1.18	11.09	14.78	12.43	4.06
21	EC-538145	14.23	40.46	7.58	128.59	0.84	6.50	8.66	13.09	4.01
	Mean	14.90	39.21	12.09	126.63	1.40	11.20	13.42	12.97	3.73
	S.Em±	0.43	0.71	0.24	4.88	0.08	0.50	0.61	0.52	0.21
	CD at 5%	1.29	2.09	0.7	14.41	0.11	1.48	1.75	1.53	0.63

Table 3: Genotypic correlation coefficients of different characters in cucumber

	NFV	YPP	YPH	DMF	DFF	VL	NOB	NFM	NFF	DFH	DLH	FL	FD	AFW	FT	TSS	YPV
NFV	1**	0.5174**	0.2173**	-0.3925	-0.2465**	0.2747	0.2061**	0.1092	0.0347	-0.5686**	0.3406	0.4549*	0.2743	0.2077	0.0682	0.0607	0.3987
YPP		1**	0.7637	-0.63**	-0.5795**	-.4093	-0.1342*	0.7863**	0.3707*	-0.5968	0.2289	0.3735	0.1944	0.2421**	0.0641	0.3098	0.3495**
YPH			1**	-0.5053	-0.6145	0.3413	0.0276	-0.3699	-0.1278	-0.55	0.3346	0.1365	-0.0263	0.1089	0.0853	-0.1974	0.415**
DMF				1**	-0.4197**	0.0369	0.3792**	0.03621	-0.0945**	0.22**	0.2123	0.003	-0.2151	-0.3216	0.514*5	0.6097**	0.2676
DFF					1**	0.0067	0.1931**	0.3198	-0.2778	0.4481**	0.1679	-0.2846	0.4002	0.2809**	0.2137	0.2358	-0.2095**
VL						1**	0.2368**	0.2441**	-0.58111**	0.1656	-0.2159	-0.238	-0.186	-0.5126**	-0.1125	-0.1076	-0.3747
NOB							1**	0.0622	-0.078	0.3803	-0.0073	-0.0539	0.0022	0.2285	0.0129	-0.0393	0.2235**
NFM								1**	0.0471	-0.267	0.1268	0.0746	-0.1916	0.7444**	0.3515	0.2641	0.3781
NFF									1**	-0.4912**	0.134**	0.0537	0.1932	-0.2478**	0.484	0.0341	-0.1214**
DFH										1**	0.5533**	-0.5491	0.4092	-0.3795	-0.4028	-0.3076	-0.3861**
DLH											1**	0.4583	-0.3249	-0.0662	-0.0995	0.0217	-0.306
FL												1**	-0.5083**	-0.4321	0.1846	-0.011	0.4215**
FD													1**	0.543	0.1783	-0.0236	0.1352
AFW														1**	0.0817	-0.4237	00.3228
FT															1**	0.6375**	0.1235
TSS																1**	0.0093
YPV																	1**

*indicates significant at P = 0.05 ** indicates significant at P= 0.01 Critical 'r_g' value at 5 percent = 0.185 Critical 'r_g' value at 1percent = 0.242

NFV- Number of fruits per vine
NFF- Node to first female flower
DFH- Days to first harvest
DFF- Days to first female flower
FD- Fruit diameter
YPP- Yield per plot
NFM- Node to first male flower
TSS- Total Soluble Solid
DMF- Days to first male flower
FL- Fruit length
NOB- Number of branches
FT- Flesh thickness
YPH- Yield per hectare
DLH- Days to last harvest
VL- Vine length
AFW- Average fruit weight

Table 4: Phenotypic correlation coefficients of different characters in cucumber

	NFV	YPP	YPH	DMF	DFF	VL	NOB	NFM	NFF	DFH	DLH	FL	FD	AFW	FT	TSS	YPV
NFV	1**	0.4325**	0.2907	0.2502	0.1284	0.2371	0.2541**	0.061	-0.1277**	-0.3488**	0.0744	0.2541	0.0466	0.2673*	0.0202	0.0283	0.4093**
YPP		1**	0.6492**	-0.4485*	-0.5912	0.3148	0.0508	-0.5145**	0.2518	-0.4918**	0.2205	0.3409**	0.0389	0.2125**	0.1437	0.0283	0.5789**
YPH			1**	-0.4394**	-0.4096**	0.2956	0.092	0.1989	0.1211	0.3355**	0.105**	0.1575*	0.0153	0.2194**	0.0094	0.0854	0.2874*
DMF				1**	0.4006**	0.0599	0.2829	0.2999	0.1113	0.0468	0.147	0.0999	0.0358	0.1982	0.3638**	0.4887**	0.2074**
DFF					1**	0.3452	0.0807	0.309**	0.367**	0.247**	0.0351	0.194**	0.0663	0.2533	0.174	0.0545	-0.4019**
VL						1**	0.1465**	0.3267**	-0.3888**	0.0881	0.153	0.0052	0.1433	-0.3168**	0.1408	0.0335	0.3432
NOB							1**	-0.1758**	0.0383	0.336**	0.107**	0.172	0.061	0.281**	0.0514	0.0419	0.2531**
NFM								1**	0.0407	0.1486	0.1011	0.02299	0.0255	0.2175	0.012	0.1681	-0.0299
NFF									1**	-0.4065**	0.26414**	0.1877	0.0945	0.2695*	0.1107	0.22	-0.6023**
DFH										1**	0.3184	0.3599	0.1878	0.2182**	0.1191**	0.03388	0.5356**
DLH											1**	0.3788**	0.1111	0.0561	0.1043	0.0173	0.2008
FL												1**	-0.3417**	-0.3668**	0.1699	0.002	0.7904**
FD													1**	0.0441	0.1979	0.1009	0.35
AFW														1**	0.085	0.3086**	0.4179**
FT															1**	0.3314**	-0.3194
TSS																1**	0.8126
YPV																	1**

*indicates significant at P = 0.05 ** indicates significant at P= 0.01 Critical 'r_p' value at 5 percent = 0.185 Critical 'r_p' value at 1percent = 0.242 = 0.185

Critical 'r_p' value at 1 per cent = 0.242

NFV- Number of fruits per vine
YPP- Yield per plot
YPH- Yield per hectare
DLH -Days to last harvest
FL -Fruit length
NFM -Node to first male flower
NFF -Node to first female flower
DFH -Days to first harvest
AFW -Average fruit weight
VL -Vine length
FT -Flesh thickness
TSS -Total Soluble Solid
FD -Fruit diameter
DFF- Days to first female flower
NOB -Number of branches
YPV-yield per vine
DMF- Days to first male flower

Conclusion

The primary goal in any hybrid development program is to select parents with the highest fruit yield. According to the current investigation, among the 21 cucumber genotypes it is observed that the highest number of fruits was seen in IC276589 (16.60), the highest total fruit production per plant was observed in the genotype IC276589 (2.34 Kg), fruit yield per plot was highest in IC276589 (13.60 kg), total fruit yield per hectare was maximum in IC276589 (18.13 tonnes/ha). The traits which are significant association with the yield per vine can be simultaneous selected for improving the fruit yield per vine.

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