Evaluation of Cucumber Hybrids/Lines for Yield and Quality under Polyhouse

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A B S T R A C T

Keywords Cucumber (*Cucumis sativus* L.), Gynoecious parthenocarpic **Article Info** *Accepted:* 12 May 2019 *Available Online:* 10 June 2019	Fifteen gynoecious parthenocarpic hybrids hybrids/lines of cucumber (*Cucumis sativus* L.) were evaluated under polyhouse (fifty percent shade/naturally ventilated) conditions for yield and quality. The genotypic and phenotypic coefficient of variations were highest for nodal position of first female flower, number fruits, fruit weight and fruit yield per plant which indicates maximum variability is existing in the genotypes. High genetic advance as per cent mean was observed for most of the characters, indicating that these characters are controlled by additive gene action. Correlation studies revealed that at both phenotypic and genotypic level highly significant and positive association of fruit yield per plant with number of fruits per plant and negative association with days to first female flower, nodal position of first female flower and days to fifty percent flowering indicating the possibility of simultaneous selection for these traits to improve the fruit yield. maximum positive direct effects towards fruit yield per plant was contributed by days to fifty percent flowering, number of fruits per plant and fruit weight were the most influencing factors.

Introduction

Cucumber (*Cucumis sativus* L., 2n=2x=14), an economically important member of the gourd family, Cucumber is one of the most preferred vegetables grown under protected conditions in the world. Its demand is throughout the year because of its popular use in salad dish, sandwich, pizza preparations etc. It is believed to be originated in India (De Candolle). India is endowed with enormous variability and genetic divergence for cucumber germplams throughout the country. However, several unique indigenous germplasm that could potentially enhance cucumber productivity and nutritional quality, have not yet been widely utilized in crop improvement programmes due to lack of relevant information. So, there is a great need of screening cucumber germplasm to identify elite genotypes with improved quality and higher yield so that they may be utilized either directly as a selection or as a parent in hybridization programme. Cucumber, being a

high value low volume crop, its exploitation on commercial scale in naturally ventilated polyhouse can improve productivity and generate good income to the growers. These technologies are highly suitable for increasing the socioeconomic status of small farmers through high profitability. For any effective selection programme, the information on the nature and magnitude of variability present in the genotypes, heritability and genetic advance are important. A study of correlation between different quantitative characters provides an idea of association.

It could be effectively exploited to formulate selection strategies for improving yield and quality. The path coefficient technique helps in estimating direct and indirect contribution of various components in building up the correlation towards yield. Hence, the present investigation was carried out to analyze variability and association for yield and quality parameters under polyhouse.

Materials and Methods

The experiment entitled "Evaluation of cucumber hybrids/lines for quality and yield in polyhouse" was conducted at division of vegetable crops, Indian Institute of Horticultural Research, Hessaraghatta, Bengalulru during winter season. The experimental material comprised of 15 accessions of cucumber collected from different parts of the country. The details of genotypes used for the experiment is given in Table 1. The experiment was laid out in a randomized block design with 15 treatments and three replications. The seed sowing of all the genotypes was carried out in the pro trays to get a healthy uniform seedlings. Thirty days old seedlings were transplanted into the poly house with fifty per cent shade net (naturally ventilated polyhouse). Inside the polyhouse raised beds were made and planting was done at a spacing of 60 x 100

cm. The raised beds were covered with black polythene mulch and whole polyhouse was irrigated through drip. The crop received timely management practices as per package of practices recommendations of Indian Institute of Horticultural Research. Growth and yield characters like days to first female flower, nodal position to first female flower, days to 50% flowering, fruit length (cm), fruit weight (g), fruit girth (cm), number of fruits per plant, plant height (cm) and fruit yield per plant (kg).The quality parameters like colour of fruit, spines on fruit surface, bitter taste of fruit, hallow or spliting and ribs on fruit surface. The variance components and coefficients of variation were computed as per Burten (1952). The heritability in broad sense and expected genetic advance were determined by using the formula given by Johnson *et al.,* (1955). The correlation co-efficient among all possible character combinations at phenotypic and genotypic level were estimated employing formula given by Al-Jibouri *et al.,* (1958). Path co-efficient analysis suggested by Wright (1921) Dewey and Lu (1959).

Results and Discussion

With a view to understand the extent to which the observed variations are due to genetic factors, the range, mean, PCV, GCV, heritability (h^2), genetic advance (GA) and genetic advance as per cent of mean (GAM) (Table 2). The data revealed the existence of large amount of variability to most of the characters. The estimates of GCV and PCV for days to first female flower were moderate (14.12 and 14.17, respectively). High heritability (99.26 %) was observed along with high genetic advance as per cent of mean (28.98%) and moderate GA (12.93%) for the trait was found. The estimates of GCV and PCV for nodal position to female flower were high (48.44 and 51.04, respectively). High heritability (90.07 %) was observed along

with high genetic advance as per cent of mean (94.71%) and low GA (4.95%).Days to fifty percent flowers were had low GCV and PCV (8.32 and 8.45, respectively) but High heritability (96.87 %) was observed along with moderate genetic advance as per cent of mean (16.86%) and low GA (9.83%). Similar results were reported by Das *et al.,* (2003), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Yogesh *et al.,* (2009) and Kumar *et al.,* (2013).

High GCV and PCV for number of fruits (40.99 and 41.24, respectively) were observed. High heritability (98.98 %) was observed along with high genetic advance as per cent of mean (83.92%) and high GA (24.52%). The estimates of GCV and PCV for fruit weight were high (26.40 and 27.39, respectively). High heritability (92.88 %) was observed along with high genetic advance as per cent of mean (52.41%) and high GA (114.60). The estimates of GCV and PCV for fruit length were moderate (16.91 and 17.50, respectively). High heritability (93.37 %) was observed along with high genetic advance as per cent of mean (33.66%) and low GA (6.11) for the trait was found. The estimates of GCV and PCV for fruit girth were low (5.86 and 6.72, respectively). High heritability (76.05%) was observed along with moderate genetic advance as per cent of mean (10.52%) and low GA (1.49) for the trait was found. Moderate GCV and PCV for plant height (11.73 and 12.15, respectively) were observed. High heritability (93.39 %) was observed along with high genetic advance as per cent of mean (23.38%) and high GA (61.41) for the trait was found. The estimates of GCV and PCV for fruit yield per plant were high (38.22 and 38.93, respectively). High heritability (96.37 %) was observed along with high genetic advance as per cent of mean (77.28%) and low GA (4.75) for the trait was found. Similar results were reported by Das *et al.,* (2003), Munshi *et al.,* (2007),

Hanchinamani *et al.,* (2008), Yogesh *et al.,* (2009), Kumar *et al.,* (2013), Verma *et al.,* (2003), Kumar *et al.,* (2008), Joshi *et al.,* (1981), devmore *et al.,* (2010), Bisht *et al.,* (2010), Eifediyi and Remison (2009), Rakhi and Rajmony (2005) and Singh(2007). The characters which showing high PCV with equally high GCV, high heritability coupled with high genetic advance which indicates maximum variability is existing in the genotypes for these characters and offers good scope for improvement by simple selection through these characters. High heritability coupled with high genetic advance which indicating that these characters are less influenced by environmental factors and are under the control of additive gene effect and selection for improvement of such characters would be rewarding.

The phenotypic and genotypic correlation for different characters is presented in Tables 3 and 4 respectively. In the present study, Fruit yield per plant showed significant positive correlation with number of fruits per plant (0.819), plant height (0.302) and significant negative correlation with days to fifty percent flowering (-0.682), nodal position of first female flower (-0.652) and days to first female flower (-0.373).Nodal position of first female flower showed significant positive correlation with days to first female flower (0.659) whereas days to fifty percent flowering showed significant positive correlation with days to first female flower (0.515) and nodal position of first female flower (0.474).similar results were reported by Verma (2003), Kumar *et al.,* (2008), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Kumar *et al.,* (2013), Soleimani *et al.,* (2009), Singh *et al.,* (2002). Number of fruits per plant showed significant negative correlation with days to first female flower (-0.483), nodal position of first female flower (-0.788) and days to fifty percent flowering (-0.503). Fruit weight showed positive

correlation with days to first female flower (0.238) and nodal position of first female flower (0.265) whereas significant negative correlation was found with number of fruits per plants (-0.356). Fruit length showed significant positive correlation with fruit weight (0.502) whereas only positive correlation with days to first female flower (0.290) and nodal position of first female flower (0.282). It also showed negative correlation with number of fruits (-0.136) whereas fruit girth showed significant positive correlation with fruit weight (0.751) and it has shown significant negative correlation days to

fifty percent flowering (-0.394). Plant height showed significant positive correlation with number of fruits (0.403) and significant negative correlation was found with fruit girth (-0.295). Similar results were reported by Bisht *et al.,* (2010), Sharma *et al.,* (2010), Badgujar and More (2004) and Gulam ud din *et al.,* (2006), Eifediyi and Remison (2009), Shaw *et al.,* (2000), Dijkhuizen and Staub (2002), Singh *et al.,* (2002), Das *et al.,* (2003), Verma (2003), Kumar *et al.,* (2008), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Kumar *et al.,* (2013), Soleimani *et al.,* (2009), Singh *et al.,* (2002).

Table.1 Name of the genotypes and quality parameters in cucumber

S. No	Genotype name	Fruit colour	Spines on fruit surface	Bitterness	Hallow	Ribs
1	Polyhouse mix	Light green	Present	Absent	Absent	Absent
2	Parthenocarpic-2	Dark green	Present	Absent	Present	Absent
3	Parthenocarpic	Dark green	Absent	Absent	Absent	Absent
4	Pcu-5039	Green with white stripes	Present	Absent	Absent	Present
5	US-646	Light green with white stripes	Present	Absent	Present	Absent
6	Pcu-2	Green with white stripes	Present	Absent	Absent	Present
7	Pcu-1 X SM12735	Green with white stripes	Present	Absent	Present	Present
8	Sabari	Light green with white stripes	Present	Absent	Present	Present
9	Heera	Green with white stripes	Present	Absent	Present	Present
10	KAU Thrissur	Green with white stripes	Absent	Absent	Absent	Absent
11	US-640	Light green with white stripes	Present	Absent	Present	Absent
12	Valley Star	Dark green	Absent	Absent	Absent	Absent
13	Silyon	Dark green	Absent	Absent	Absent	Absent
14	Pune collection	Dark green	Absent	Absent	Absent	Absent
15	Multi Star	Dark green	Absent	Absent	Absent	Absent

Table.2 Estimates of genetic parameters of variability in cucumber

| Character | Range | | Mean | GCV | PCV | Heritability | Genetic advance at 5% | Genetic advance as % mean |
	Min.	Max.						
Days to first female flower	36.20	54.53	44.61	14.12	14.17	99.26	12.93	28.98
Nodal position to First Female flower	1.83	9.50	5.22	48.44	51.04	90.07	4.95	94.71
Days to 50% flowering	49.27	69.77	58.26	8.32	8.45	96.87	9.83	16.86
No. of fruits per plant	16.87	49.73	29.22	40.99	41.24	98.78	24.52	83.92
Fruit weight (g)	121.0	342.7	218.65	26.40	27.39	92.88	114.60	52.41
Fruit length (cm)	13.02	23.37	18.15	16.91	17.50	93.37	6.11	33.66
Fruit girth (cm)	12.83	16.24	14.14	5.86	6.72	76.05	1.49	10.52
Plant height (cm)	183.13	303.17	262.66	11.73	12.15	93.39	61.41	23.38
Fruit yield per plant (kg)	2.78	9.81	6.15	38.22	38.93	96.37	4.75	77.28

GCV- Genotypic co-efficient of variation; PCV- Phenotypic co-efficient of variation

Table.3 Phenotypic coefficient of correlation of different characters in cucumber

	1	2	3	4	5	6	7	8	9
1	1	0.659**	0.515**	-0.483**	0.238	0.290	0.046	-0.163	-0.373*
2		1	0.474**	-0.788**	0.265	0.282	0.090	-0.052	-0.652**
3			1	-0.503**	-0.269	0.028	-0.394**	-0.176	-0.682**
4				1	-0.356*	-0.136	-0.155	0.403**	0.819**
5					1	0.502**	0.751**	-0.278	0.212
6						1	0.115	0.007	0.215
7							1	-0.295*	0.229
8								1	0.302*
9									1

Table.4 Genotypic coefficient of correlation of different characters in cucumber

	1	2	3	4	5	6	7	8	9
1	1	0.700**	0.527**	-0.487**	0.249	0.305*	0.038	-0.164	-0.379*
2		1	0.510**	-0.833**	0.251	0.291	0.063	-0.087	-0.716**
3			1	-0.519**	-0.277	0.034	-0.453**	-0.195	-0.707**
4				1	-0.373*	-0.139	-0.163	0.412**	0.825**
5					1	0.523**	0.856**	-0.312*	0.186
6						1	0.155	0.003	0.218
7							1	-0.361*	0.278
8								1	0.303*
9									1

1. Days to first female flower
2. Nodal position to first female flower
3. Days to 50% flowering
4. Number of fruits per plant
5. Fruit weight (g)
6. Fruit length (cm)
7. Fruit girth (cm)
8. Plant height (cm)
9. Fruit yield per plant (kg)

** Significant at 1% level of significance; * Significant at 5% level of significance

Table.5 Estimation of direct and indirect effects of different traits in cucumber

Traits	1	2	3	4	5	6	7	8	rG
1	**-0.3557**	0.5077	0.0537	-0.8852	0.4039	-0.10774	-0.0310	0.0347	-0.379*
2	-0.2489	**0.7253**	0.0519	-1.5147	0.4071	-0.1027	-0.052	0.0183	-0.716**
3	-0.1873	0.3697	**0.1019**	-0.9427	-0.4493	-0.0118	0.3714	0.0413	-0.707**
4	0.1732	-0.6044	-0.0528	**0.8176**	-0.6047	0.0493	0.1339	-0.0873	0.825**
5	-0.0887	0.1823	-0.0282	-0.6786	**0.6198**	-0.1848	-0.7020	0.0660	0.186
6	-0.1084	0.2108	0.0034	-0.2535	0.8468	**-0.3535**	-0.1270	-0.00056	0.218
7	-0.0134	0.046	-0.0461	-0.2968	1.3867	-0.0547	**-0.8201**	0.0766	0.278
8	0.0584	-0.0628	-0.0198	0.7493	-0.5052	-0.0009	0.2964	**-0.2119**	0.303*

rG. Genotypic correlation with fruit yield per plant
** Significant at 1% level of significance
* Significant at 5% level of significance
1.   Days to first female flower
2.   Nodal position to first female flower
3.   Days to 50% flowering
4.   Number of fruits per plant
5.   Fruit weight (g)
6.   Fruit length (cm)
7.   Fruit girth (cm)
8.   Plant height (cm)

In genotypic correlation coefficients, fruit yield per plant showed significant positive correlation with number of fruits per plant (0.825), plant height (0.303) and significant negative correlation with days to fifty percent flowering (-0.707), nodal position of first female flower (-0.716) and days to first female flower (-0.379). Nodal position of first female flower showed significant positive correlation with days to first female flower (0.700) whereas days to fifty percent flowering showed significant positive correlation with days to first female flower (0.527) and nodal position of first female flower (0.510). Similar results were reported by Verma (2003), Kumar *et al.,* (2008), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Soleimani *et al.,* (2009), Singh *et al.,* (2002), Rakhi and Rajmony (2005), Kumar *et al.,* (2013) and Singh (2007). Number of fruits per plant showed significant negative correlation with days to first female flower (-0.487), nodal position of first female flower (-0.833) and days to fifty percent flowering (-0.519). Fruits weight showed positive correlation with days to first female flower

(0.249) and nodal position of first female flower (0.251) whereas significant negative correlation was found with number of fruits per plants (-0.373).Fruit length showed significant positive correlation with fruit weight (0.523) and days to first female flower (0.305). It also showed negative correlation with number of fruits (-0.139) whereas fruit girth showed significant positive correlation with fruit weight (0.856) and it has shown significant negative correlation with days to fifty percent flowering (-0.453). Plant height showed significant positive correlation with number of fruits (0.412) whereas significant negative correlation was found with fruit girth (-0.361) and fruit weight (-0.312). Similar results were reported by Bisht *et al.,* (2010), Sharma *et al.,* (2010), Badgujar and More (2004) and Gulam ud din *et al.,* (2006), Eifediyi and Remison (2009), Shaw *et al.,* (2000), Dijkhuizen and Staub (2002),Singh *et al.,* (2002), Das *et al.,* (2003), Verma (2003), Kumar*et al.,* (2008), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Kumar *et al.,* (2013), Soleimani *et al.,* (2009), Singh *et al.,* (2002). Positive correlation makes

simultaneous improvement in two or more attributes possible, whereas, negative association indicates the need to compromise between desirable characters. So, when the breeder applies selection for a particular character, not only it improves that trait, but also those characters provide a reliable measure of genetic association between them, which is useful in the breeding programmes.

The path analysis reveals, whether the association of the component characters with yield is due to their direct effect on yield, or is a consequence of their indirect effect via some other trait(s). The direct and indirect effects of yield components on marketable yield are presented in Table 5. In the present study, days to first female flower showed negative direct effect (-0.3557) on fruit yield per plant (-0.379). However, its strong positive association with fruit yield was mainly of its positive indirect effect through nodal position of first female flower (0.5077) and fruit weight (0.4039). Nodal position of first female flower showed positive direct effect (0.7253) on fruit yield per plant (-0.716). However, its strong positive association with fruit yield was mainly of its positive indirect effect through fruit weight (0.4072) whereas its strong negative association with fruit yield was via days to first female flower (-0.2489), number of fruits (-1.5148) and fruit length (-0.1028). Days to fifty percent flowering showed positive direct effect (0.1019) on fruit yield per plant (-0.707). However, its strong positive association with fruit yield was mainly of its positive indirect effect through nodal position of first female flower (0.3698) and fruit girth (0.3715) whereas its strong negative association with fruit yield was via number of fruits (-0.9427), fruit weight (-0.4493) and days to first female flower (-0.1873).Number of fruits per plant showed positive direct effect (0.8176) on fruit yield per plant (0.825). However, its strong positive

association with fruit yield was mainly of its positive indirect effect through days to first female flower (0.1732) and fruit girth (0.1339) whereas its strong negative association with fruit yield was via nodal position of first female flower (-0.6045) and fruit weight (-0.6048). Fruit weight showed positive direct effect (0.6198) on fruit yield per plant (0.186). However, its strong positive association with fruit yield was due its positive indirect effect through nodal position of first female flower (0.1823) whereas its strong negative association with fruit yield was via fruit girth (-0.7020),number of fruits per plant (-0.6786) and fruit length (-0.1848).Fruit length showed negative direct effect (-0.3535) on fruit yield per plant (0.218). However, its strong positive association with fruit yield was mainly of its positive indirect effect through fruit weight (0.8468) and nodal position of first female flower (0.2109) and whereas its negative association with fruit yield was via number of fruits per plant (-0.2536) and fruit girth (-0.1270) and days to first female flower (-0.1084).Fruit girth showed negative direct effect (-0.8021) on fruit yield per plant (0.278). However, its strong positive association with fruit yield was due to its positive indirect effect through fruit weight (0.3868) whereas its negative association with fruit yield was via number of fruits per plant (-0.2968). Plant height showed negative direct effect (-0.2119) on fruit yield per plant (0.303). However, its strong positive association with fruit yield was due to its positive indirect effect through number of fruits per plant (0.7494) and fruit girth (0.2964) whereas its negative association with fruit yield was via fruit weight (-0.5052). The path coefficient analysis revealed that maximum positive direct effects towards fruit yield per plant was contributed by days to fifty percent flowering, number of fruits per plant and fruit weight were the most influencing factors. Thus, these characters

deserve greater weightage during selection for yield. The direct selection in these traits would be rewarding for improvement in the fruit yield per plant. These are agreement with earlier reports given by Verma (2003), Kumar*et al.,* (2008), Munshi *et al.,* (2007), Hanchinamani *et al.,* (2008), Soleimani *et al.,* (2009), Singh *et al.,* (2002), Rakhi and Rajmony (2005), Kumar *et al.,* (2013) and Singh (2007).

However in the present study the gynoecious parthenocarpic hybrids namely Vally Star, Multi Star, Silyon and Pune collection were the best with respect to earliness as well as maximum yield. These genotypes having quality parameters (Table 1) like good taste, absence of spines (smooth fruit surface), there is no no splitting or hallow and absence of ribs or warts. Hence, these hybrids on commercial scale in naturally ventilated polyhouse can improve productivity and generate good income to the growers. These technologies are highly suitable for increasing the socioeconomic status of small farmers through high profitability.

In conclusions, the characters which showing high PCV with equally high GCV, high heritability coupled with high genetic advance which indicates maximum variability is existing in the genotypes for these characters and offers good scope for improvement by simple selection through these characters. Correlation studies revealed that at both phenotypic and genotypic level highly significant and positive association of fruit yield per plant with number of fruits per plant and negative association with days to first female flower, nodal position of first female flower and days to fifty percent flowering indicating the possibility of simultaneous selection for these traits to improve the fruit yield. maximum positive direct effects towards fruit yield per plant was contributed by days to fifty percent flowering, number of

fruits per plant and fruit weight were the most influencing factors. The hybrids namely Vally Star, Multi Star, Silyon and Pune collection were the best with respect to earliness, superior quality as well as maximum yield.

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