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Evaluation and assessment of genetic variability of cucumber (*Cucumis sativus* L.) genotypes

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Abstract

The present experiment was carried out thirty six cucumber genotypes under Randomized Block Design with two replications to assess the PCV, GCV, heritability and genetic gain for various horticultural traits. In this study phenotypic coefficient of variation (PCV) were higher than the corresponding values of genotypic coefficient of variation (GCV) while the difference between PCV and GCV was very less for length of vine, number of primary branches, number of nodes per vine, node number bearing first male flower, node number bearing first female flower, days for first male flower, days for first female flower, days for first harvest, number of male flower, number of female flower, number of fruits per plant, fruit length, fruit diameter, fruit weight and yield per plant and these traits are less influenced by environment. High phenotypic and genotypic coefficient of variation were observed number of primary branches, node number bearing first male flower, number of male flower, number of female flower, number of fruits per plant, fruit length, fruit weight and yield per plant. In this experiment all the studied traits had high heritability coupled with high to moderate genetic advance except days for first male and female flower appearance.

Keywords: Cucumber, variability, heritability, genetic advance

Introduction

Cucumber is (*Cucumis sativus* L.) one of the important vegetable crop around the world and belongs to Cucurbitaceae with chromosome number of $2n=14$. It is grown for its edible tender fruits preferred as salad and also as cooked and pickled forms. It is useful for preventing constipation and beneficial for people suffering from jaundice and allied diseases. Cucurbits are composed of 118 genera and 825 species. Members of this family are distributed primarily in tropical and subtropical regions of the world (Wang *et al.* 2007). The cultivated species *Cucumis sativus* L. originated from the wild progenitor *Cucumis hardwickii* in the Himalayan belt of Indo Chinese region. Now, it is extensively cultivated in diverse agroclimatic conditions ranging from tropical to subtropical regions of the world. India being the primary centre of origin has accumulated a wide range of variability which can be exploited for crop improvement.

Further, cucumber being monoecious, cross pollinated crop with numerous seeds per fruit and practically no inbreeding depression, offers an excellent opportunity for exploitation of heterosis. In spite of these advantages, the availability of very few commercial varieties / F_1 hybrids reveals that no systematic efforts have been made for the genetic amelioration of this crop in India. Crop improvement to a large extent depends on the existing genetic variability. Considering the importance of a wide genetic base in plant breeding, identification and characterization of available germplasm is a pre-requisite for estimation of diversity, determination of genetic relatedness, documentation and management of germplasm. This also assumes a greater relevance in the context of intellectual property rights and trade agreements. Evaluation of various genotypes is the basic step for breeding programmes, which will help us to find out the growth and yield difference among various genotypes in field itself. Morphological evaluation is the best way to predicting the performance of hybrid combination (Cruz and Regazzi 1997) [4]. The problem of evaluation is expressions of phenotypic characters greatly influenced by environment influence which will regret the prediction of quantitative characters. This problem can be overcome by continuous evaluation; moreover repeated evaluation of genotypes is a step of the process for acclimatizing the non-cultivated to cultivated forms (Ivandro *et al.* 2003) [9]. Assessment of genetic variability is needful and essential pre requisite for plant breeders to improve the yield traits in further developing hybrids. Estimation of genotypic and phenotypic coefficients of variability are efficient tool to

identify the nature of variability in the group of diverse population, whereas, estimates of heritability provide us the characters which are all inherited from parents to off springs (Deepa *et al.* 2018) [6]. Information about genetic diversity will help us to select the promising diverse genotypes, which may be used in future breeding programme. Keeping this in

view, the present study is planned to evaluate 36 cucumber genotypes to describe the level of diversity present among them with respect to agro-morphological traits.

Materials and Methods

The experimental materials comprised thirty six cucumber genotypes and the sources of the genotypes are mentioned below.

Sl. No	Genotypes	Source of Collection
1.	IC 613470, IC 613472, IC 613473, IC 613474, IC 613476, IC 613477, IC 613479, IC 613481, IC 613482, IC 613483, IC 613484, IC 613485, IC 539818, IC 366034, IC 469517, IC 595514, IC 595515, IC 595504, IC 595505, IC 277030, Swarna Ageti, IC 392530, IC 429930, IC 527400	NBPGR, New Delhi
2.	Pant Khira-1	G B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand
3.	Peramangalam, Thillailampur, Musiri, Namana Samuthiram, Amaravathi	Local types of around Tamil Nadu
4.	AVCU 1302, AVCU 1202, AVCU 1203, AVCU 1205, AVCU 1303, AVCU 1206	AVRDC. Taiwan.

The present investigation was carried out at the College Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during late *kharif* 2018 which is situated at 11° N latitude and 77° E longitude and at an elevation of 426.6 m above mean sea level. A total of 36 genotypes of cucumber were raised in a Randomized Block Design (RBD) with two replications. All recommended package of practices were followed during the crop production. Five plants at random were taken from each plot for recording the observations on length of vine (cm), number of primary branches, number of nodes per vine, node number bearing first male flower, node number bearing first female flower, days for first male flower, days for first female flower, days for first harvest, number of male flower, number of female flower, number of fruits per plant, fruit length (cm), fruit diameter (cm), fruit weight (g) and yield per plant (kg). The mean over replications for each character was subjected to statistical analysis by using the principles of 'Analysis of Variance' techniques as described by Panse and Sukhatme (1978) [18]. The phenotypic and genotypic coefficients of variations (PCV, GCV) were analysed by using the formulae

suggested by Burton, 1952. Heritability in broad sense was estimated by using the formulae suggested by Lush, 1940 and expected genetic advance as percent mean was computed by using formulae suggested by Johnson *et al.*, 1955 [10].

Results and Discussion

Wide variations between thirty six cucumber genotypes for various horticultural traits are presented in Table 1. The estimates of variability on the basis of phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance as per cent of mean are presented in Table 2. The breeder should have the knowledge of distinguishing the genetic and non-genetic components of variation occurring in a population. In the present investigation, a similar analysis of variability was carried out. Usually the phenotypic variance and phenotypic coefficient of variation are always higher than the genotypic variance and genotypic coefficient of variation, respectively. In this study scope of selection through heritability and genetic advance estimates were analysed and the results obtained are discussed below. The analysis of variance revealed significant differences among the 36 genotypes for all the traits studied.

Table 1: Mean performance of cucumber genotypes for various horticultural traits

Geonotypes	vl	pb	nn	nnmf	nnff	dfmf	dff	dfh	nmf	nff	nfp	fl	fd	fw	yp
IC 613470	259.80	3.51	18.10	3.95	6.60	30.70	33.51	42.51	153.47	31.41	8.61	13.93	6.33	254.00	1.98
IC 613472	248.90	4.00	17.51	5.20	7.35	35.51	37.51	45.03	140.31	26.85	8.61	16.21	6.23	202.48	1.55
IC 613473	295.00	6.20	20.80	6.40	8.95	32.51	34.30	42.00	150.43	34.95	12.16	15.19	6.08	323.42	3.73
IC 613474	319.30	5.40	18.00	6.79	9.14	27.60	32.70	38.96	141.31	23.30	7.60	16.97	4.81	239.33	1.42
IC 613476	274.90	5.70	16.00	5.60	8.90	32.10	39.20	46.06	157.02	24.31	12.16	18.49	5.32	209.28	2.52
IC 613477	284.30	5.40	21.30	5.60	7.80	34.90	34.00	42.00	172.73	29.88	12.66	14.94	5.32	254.90	2.84
IC 613479	271.60	6.10	19.40	5.80	8.00	33.30	39.20	45.03	150.94	30.39	10.64	15.95	5.83	211.60	1.96
IC 613481	242.80	4.60	21.70	6.85	9.10	32.60	36.00	42.00	155.49	25.84	8.61	18.49	6.33	184.80	1.42
IC 613482	300.00	3.70	15.10	7.25	9.80	31.80	34.00	45.03	162.08	24.82	7.60	17.37	5.47	254.63	1.62
IC 613483	240.30	4.51	26.60	6.20	8.75	34.90	37.90	46.05	150.44	24.82	9.12	13.93	6.84	192.47	1.66
IC 613484	232.10	3.00	17.50	6.76	9.26	35.40	39.50	46.55	134.73	31.41	9.12	15.95	5.47	220.87	1.54
IC 613485	288.80	3.20	19.51	4.91	7.55	33.91	37.20	51.11	167.65	22.29	8.11	20.26	6.84	182.67	1.20
IC 539818	332.51	4.90	21.10	2.80	4.60	27.20	30.30	33.40	140.31	35.96	16.72	22.03	7.35	293.79	4.45
IC 366034	284.10	3.80	17.10	5.40	7.60	32.90	36.10	43.01	143.34	19.76	8.61	18.49	5.82	245.27	1.96
IC 469517	274.92	3.30	18.40	5.65	7.50	31.60	33.80	39.97	136.25	23.81	9.62	20.01	5.57	266.64	2.28
IC 595514	199.30	3.90	19.20	5.30	7.45	30.80	32.70	40.48	146.89	21.78	9.12	18.74	5.83	246.05	2.05
IC 595515	224.51	3.90	17.20	4.70	7.25	32.40	35.00	42.51	150.44	21.78	10.64	16.97	6.33	211.21	1.86
IC 595504	378.40	6.50	27.90	4.50	6.35	35.00	39.10	45.54	143.35	34.44	17.73	24.82	7.34	403.18	6.46
IC 595505	281.00	3.20	19.20	4.25	6.30	32.40	35.30	40.48	139.80	24.83	8.10	17.98	5.88	194.33	1.37
IC 277030	233.40	3.20	18.51	4.74	6.36	33.80	36.50	39.47	147.90	25.33	7.60	6.94	6.08	102.90	0.75
Swarna Ageti	261.91	2.90	16.30	4.68	6.90	32.10	36.30	46.55	149.93	23.30	13.68	18.23	6.33	313.55	3.80
IC 392530	222.00	3.20	16.20	4.75	7.15	31.00	36.51	41.49	153.48	21.78	7.60	13.93	6.08	249.47	1.55

IC 429930	244.80	3.00	16.51	4.33	6.95	37.10	40.10	45.54	144.87	26.34	9.12	14.94	5.72	281.53	2.26
IC 527400	238.31	3.31	17.40	5.83	8.51	36.80	39.60	42.51	164.63	24.32	7.60	17.98	6.69	165.96	1.08
Peramangalam	330.00	5.70	27.30	5.55	8.15	33.10	37.10	45.54	129.15	32.93	11.65	20.51	7.09	267.13	2.73
Thillailampur	347.50	6.30	23.90	6.20	8.45	33.20	35.80	46.55	135.75	31.41	12.66	29.12	8.10	293.92	3.35
Musiri	316.20	6.51	26.70	5.51	7.70	35.00	39.40	47.56	122.57	32.42	11.14	15.70	5.07	121.68	1.29
Namana Samuthiram	281.90	6.30	21.60	5.25	7.51	33.60	37.40	50.60	132.20	31.41	12.66	21.02	6.38	167.26	1.99
Amaravathi	339.70	6.00	23.70	5.30	7.50	34.90	38.60	34.41	132.71	28.37	13.68	22.79	5.07	307.27	3.71
Pant Khira-1	283.10	5.20	29.60	4.65	6.50	32.70	35.80	43.52	125.11	34.45	14.69	19.76	6.33	256.37	3.39
AVCU 1302	217.52	2.80	15.29	5.07	8.22	39.58	41.64	53.35	3.48	33.25	9.94	12.55	7.18	254.10	2.21
AVCU 1202	209.07	2.69	16.93	6.73	5.89	31.84	33.00	37.95	9.21	44.25	14.80	14.58	6.53	253.17	3.28
AVCU 1203	242.23	2.53	17.26	12.62	9.09	31.63	33.82	38.11	13.20	51.87	16.82	15.94	6.27	244.58	3.81
AVCU 1205	297.67	3.23	19.05	7.99	4.08	33.81	36.74	40.99	12.25	55.25	17.78	13.98	6.26	192.10	3.06
AVCU 1303	327.25	4.37	21.25	7.34	5.24	28.81	30.56	34.51	11.39	47.70	16.66	12.63	6.83	202.28	3.20
AVCU 1206	269.84	3.70	18.75	6.22	3.99	34.30	29.54	38.28	13.85	64.64	22.00	17.56	6.67	227.25	4.71
G Mean	274.86	4.33	19.94	5.74	7.40	33.08	35.99	42.91	123.29	31.15	11.54	17.36	6.21	235.87	2.50
S.E (d)	11.62	0.20	0.82	0.26	0.31	1.33	1.47	1.75	5.70	1.44	0.52	0.73	0.26	9.83	0.14
C.D.(5%)	33.03	0.55	2.33	0.75	0.89	3.77	4.18	4.96	16.20	4.09	1.47	2.07	0.73	27.94	0.40

Length of vine (VL), N.P Branches(pb), No. of nodes /vine(nn), Node Number bearing first male flower (nmmf), Node Number bearing first female flower (nnff), Days for first male flower(dfmf), Days for first female flower(dfff), Days for first harvest(dfh), Number of male flower (nmf), Number of female flower (nff), Number of fruits per plant (nfp), fruit length (fl), Fruit diameter (fd), Fruit weight (fwt), Yield per plant (ypp)

Table 2: Estimation of genetic parameters for various traits in cucumber

Characters	Mean	Range	PCV	GCV	h ²	GAM
Length of vine (cm)	274.86	199.30 -378.40	16.11	14.96	86.23	28.62
Number of primary Branches	4.33	2.53-6.51	30.21	29.52	95.54	59.45
Number of nodes per vine	19.94	15.10-29.60	19.53	18.65	91.11	36.66
Node number bearing first male flower	5.74	2.80-12.62	28.00	27.23	94.57	54.54
Node number bearing first female flower	7.40	3.99-9.80	19.78	18.85	90.77	36.99
Days for first male flower	33.08	27.20-39.58	8.47	6.30	55.19	9.64
Days for first female flower	35.99	29.54-41.64	9.07	6.98	59.32	11.08
Days for first harvest	42.91	33.40-53.35	11.26	9.68	73.86	17.13
Number of male flower	123.29	3.48-172.73	42.71	42.20	97.66	85.91
Number of female flower	31.15	19.76-64.64	32.98	32.32	96.07	65.27
Number of fruits per plant	11.54	7.60-22.00	32.02	31.38	96.10	63.38
fruit length (cm)	17.36	6.94-29.12	22.86	22.08	93.24	43.91
Fruit diameter (cm)	6.21	4.81-8.10	12.31	10.84	77.50	19.65
Fruit weight (g)	235.87	102.90-403.18	24.74	24.03	94.33	48.07
Yield per plant (kg)	2.50	0.75-6.46	49.02	48.37	97.39	98.34

Mean performance of genotypes

Among observed horticultural traits comparatively wide range was observed for length of vine (199.30 -378.40 cm), number of primary branches (2.53-6.51) and number of node per vine (15.10- 29.60) which are all important vegetative growth characters. The genotypes IC 595504 (378.40 cm), Musiri (6.51) and Pant Khira – 1 (29.60) were recorded maximum while genotypes IC 595514 (199.30 cm), AVCU 1203 (2.53) and IC 613482 (15.10) recorded the minimum for length of vine, number of primary branches and number of node per vine respectively. Wide range was observed for node number bearing first male (2.80-12.62) and female (3.99-9.80) flower and days for first male (27.20-39.58) and female (29.54-41.64) flower, which determine the earliness. It has been observed that among the population few genotypes were recorded for earliness. Early yield is an important trait which is responsible for high yield and hence breeder should look for this trait in the developing hybrids. Wide variation observed for days for first harvest (33.40-53.35), which is positively correlated with earliness. IC 539818 and AVCU 1303 recorded for earliest harvest of 33.40 and 34.51 days respectively.

Flowering attributes decide the yield of particular cultivars, In this study huge variation was observed with number of male flowers (3.48-172.73) and number of female flowers (19.76-64.64). High numbers of female flowers are positively

correlated with high yield and hence the genotypes which with maximum number of female flower will be the best parent for future breeding programme. Here AVCU 1206 (64.64) recorded higher number of female flower followed by AVCU 1205 (55.25) and AVCU 1203 (51.87). Wide range of variation (7.60-22.00, 6.94-29.12 cm, 4.81-8.10 cm and 102.90-403.18g) observed with respect to number of fruits per plant, fruit length, fruit diameter and fruit weight respectively, which are considered as major yield attributing characters. Local type Thillailampur (29.12 cm) recorded the longest fruit whereas IC 277030 (6.94 cm) recorded the smallest fruit. Long cucumber fruits are suitable for slicing and salad purpose, which is having huge demand in hotels. Short cucumber types are suitable for culinary purpose and medicinal purpose. Similarly, wide variation was observed for the traits of yield per plant (0.75-6.46 kg/plant). The genotype IC 595504 (6.65 kg) recorded the highest yield per plant followed by AVCU 1206 (4.71 kg) and IC 539818 (4.45 kg), which are highly recommended for further breeding programme. Similar results for various horticultural characters were earlier reported by Singh *et al.* (2002) ^[20], Das *et al.* (2003) ^[5], Verma (2003) ^[22], Kumar (2006) ^[12], Munshi *et al.* (2007) ^[16], Hanchinamani *et al.* (2008) ^[8], Yogesh *et al.* (2009) ^[23], Kumar *et al.* (2013) ^[14] and Ahirwar and Singh, (2018) ^[2] in cucumber.

Coefficient of variability

High (> 20%) phenotypic and genotypic coefficients of variation were recorded for number of primary branches (30.21 and 29.52), node number bearing first male flower (28.00 and 27.23), number of male flower (42.71 and 42.20), number of female flower (32.98 and 32.32), number of fruits per plant (32.02 and 31.38), fruit length (22.86 and 22.08), fruit weight (24.74 and 24.03) and yield per plant (49.02 and 48.37). These results are in similar with the findings of Kumar *et al.* (2008), Ahirwar and Singh (2018)^[2] and Deepa *et al.* (2018)^[6] for number of fruits per plant, fruit weight and yield per plant in cucumber. Ahirwar and Singh, 2018^[2] also reported high PCV and GCV for fruit length and yield, in cucumber. The results were in accordance with Rakhi and Rajamony (2005)^[19] for number of fruits per plant and fruit weight in culinary melons whereas Muthuselvi *et al.* (2019)^[17] reported high PCV and GCV for number of primary branches, Node at which first male flower appearance, Length of the fruit and fruit weight in snapmelon. Low (< 10%) phenotypic and genotypic coefficients of variation were observed for days for first male (8.47 and 6.30) and female (9.07 and 6.98) flower appearance. Similar finding were reported by Deepa *et al.* (2018)^[6] in cucumber and Muthuselvi *et al.* (2019)^[17] in snap melon. Estimates for PCV was higher than GCV for all the characters studied, though difference was very less in majority of the cases, implying that genotype contributed more than environment for these horticultural traits and selection based on phenotypic values is therefore feasible. Similar results were also reported by Afangideh and Uyoh (2007)^[1], Ene *et al.* (2016)^[7] and Deepa *et al.* (2018)^[6] in cucumber.

Heritability and genetic advance as percent mean

High heritability (> 60%) combined with high genetic advance as percent mean (> 20%) were observed for length of vine (86.23 and 28.62), number of primary branches (95.54 and 59.45), number of nodes per vine (91.11 and 36.66), node number bearing first male flower (94.57 and 54.54), node number bearing first female flower (90.77 and 36.66), number of male flower (97.66 and 85.91), number of female flower (96.07 and 65.27), number of fruits per plant (96.10 and 63.38), fruit length (93.24 and 43.91), fruit weight (94.33 and 48.07) and yield per plant (97.39 and 98.34). High heritability (> 60%) combined with moderate genetic advance as percent mean (10-20%) were recorded for days for first harvest (73.86 and 17.13) and fruit diameter (77.50 and 19.65). The trait days for first female flower (59.32 and 11.08) recorded moderate heritability (30-60%) combined with moderate genetic advance as percent mean (10-20%) respectively. Moderate heritability ((30-60%)) combined with low genetic advance as percent mean (<10%) were observed for days for first male flower (55.19 and 9.64). The traits which are having high heritability with high genetic advance as percent of mean are controlled by additive gene action and can be forwarded to next generation for further breeding programme. Similar results of high heritability with high genetic advance, high heritability with moderate genetic advance and moderate heritability with low genetic advance for the above characters was also reported by Kumar *et al.* (2008), Tomar *et al.* (2008)^[21], Yogesh *et al.* (2009)^[23], Kandasamy, (2017)^[11] and Deepa *et al.* (2018)^[6] in cucumber and by Muthuselvi *et al.* (2019)^[17] in snap melon.

Conclusion

In this study, length of vine, number of primary branches, number of nodes per vine, node number bearing first male flower, node number bearing first female flower, number of male flower, number of female flower, number of fruits per plant, fruit length, fruit weight, and yield per plant recorded high heritability. The above traits can be effectively improved by selection. Fruit diameter and earliness recorded high heritability and moderate genetic advance as percent of mean, which are controlled by non-additive gene action and less responsible for selection.

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