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Studies on genetic variability, heritability and genetic advance in cucumber (*Cucumis sativus* L.)

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Abstract
An experiment was conducted to study genetic variability, heritability, and genetic advance in cucumber (*Cucumis sativus* L.). Twenty genotypes were used in this experiment. These genotypes were planted in Randomized Block Design with three replications during the summer season- 2018-19 at Horticulture Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). Genetic Variability, heritability, genetic advance and genetic gain for different characters were studied in 20 genotypes of cucumber. The phenotypic coefficient of variations (PCV) was higher than the genotypic coefficients of variations (GCV) for all traits studied. The maximum phenotypic and genotypic coefficient (PCV and GCV) was observed for vine length (12.55 & 11.41cm), number of primary branches (30.87 & 29.18), days to 50% flowering (11.33 & 10.13), days to first fruit harvest (11.78 & 10.53), number of fruits per plant (23.45 & 22.80), fruit length (22.48 & 21.32cm), fruit diameter (12.85 & 11.70cm), average fruit weight (29.82 & 28.65), fruit yield (16.95 & 15.84). Heritability estimates varied from 89.34 percent for the number of primary branches to 99.99 percent for average fruit weight. The genetic advancement as a percent of the mean (>30%) was found to be highest for average fruit weight, number of primary branches, number of fruits per plant, fruit length and fruit yield. whereas moderate genetic advance (<30 to >20%) was observed for fruit diameter, vine length, days to first fruit harvest, and days to 50% flowering.

Keywords: genetic variability, heritability and genetic, cucumber (*Cucumis sativus* L.)

Introduction
Cucumber (*Cucumis sativus* L.) is one of the most important vegetable crop of the family Cucurbitaceae with a chromosome number 2n=14. It is thought to be originated in India and China was considered as a secondary center of diversity (De Candolle, 1882). Because of its nature of high cross-pollination, hardly any genetically pure strain is available to the growers. The fruits are mainly eaten as salad and pickle and are often consumed as cooked vegetables in various ways. It contains 0.6 g protein, 2.6g carbohydrate, energy 12 cal, 18 mg Ca, 0.2 mg Fe, 0.02 mg thiamine, 0.02 mg riboflavin, 0.01 mg niacin, and 10 mg vitamin C per 100 g of edible portion. The fruit is used as astringent and antipyretic and also good for people suffering from constipation, jaundice, and indigestion. Seed oil is helpful for brain development and body smoothness (Robinson & Decker-Walter, 1999) [12]. Cucumber is a highly cross-pollinated crop and usually monoecious preferring warm weather and bright light for its better growth and development. However, it can be grown in both the summer and rainy season, but it cannot tolerate cold injury (Rastogi, 1998) [11]. An understanding of the nature and magnitude of the variability among the genetic stocks of cucumber is of prime importance for the breeder to select better parents for hybridization. Good knowledge of genetic wealth might also help in identifying desirable cultivars for commercial production. The genotype coefficient of variability and phenotypic coefficient of genetic variability are helpful in the breeding populations. Whereas, the estimate of heritability provides an index of transmissibility of characters. The estimates of parameters like the coefficient of variation, heritability, genetic advance are useful in formulating a suitable selection strategy for higher yield in cucumber. The estimates of parameters like the coefficient of variation, heritability, genetic advance are useful in formulating a suitable selection strategy for higher yield in cucumber.

Materials and Methods

An experiment consist of 20 genotypes of cucumber (*Cucumis sativus* L) was conducted at Horticultural Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during summer season-2018-19 in RBD with three replication. The genotypes were diverse for morphological and important economical traits. The genotypes were grown with a spacing of 1.5 meters × 0.60 cm. The experiment was grown with a standard package of practices. The observations on various growth, yield, and qualitative characters were recorded and observed highly significant differences for all the traits under study.

Result and Discussion

The analysis of variance revealed a significant variance (Table-1) among the genotypes for all traits *viz.* vine length, number of primary branches per plant, days to 50% flowering, days to first fruit harvest, number of fruits per plant, fruit length, fruit diameter, average fruit weight, fruit yield. The mean value of traits, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), Heritability, Genetic advance as percent of mean at 5% are mentioned in Table 1 and 2, respectively.

Estimation of range of mean for all the characters studied where a wide range was observed for days to 50% flowering was maximum recorded in genotype Pusa Uday (49.67 days) whereas, the minimum days to 50% flowering (34.11 days) was recorded in genotype DC- 22. Days to first fruit harvest was lowest observed in genotype Pusa Barkha (41.33 days) whereas, the days to first fruit harvest was highest recorded in Bengal local (T) (63.00 days). The longest fruit (22.04 cm) was observed in genotype Barsati whereas, the shortest fruit of (11.46 cm) was found in genotype DC- 22. The minimum fruit diameter of (3.75 cm) was recorded in genotype DC- 321 while, the maximum fruit diameter was observed in genotype Bengal local- 03 (6.70 cm). The range for average fruit weight varied from 58.33 g in genotype Pahari-77 to 251.33 g in genotype DC- 505. The genotype Barsati (5.33) was observed minimum number of fruits per plant whereas, both genotype PCUC-08 (10.89) and DC-332 (10.89) was recorded the maximum number of fruits per plant. The minimum number of primary branches was recorded in genotype DC- 327 (1.67) whereas, the maximum observed in genotype Pusa Uday (5.22). The shortest vine length was recorded in genotype DC- 332 (130.89 cm) whereas; the longest vine length was recorded in genotype Kalyanpur Green (199.00 cm). Whereas, the minimum and maximum fruit yield varied from (131.11 q/ha) Pahari-77 to (228.33 q/ha) Swarna Sheetal also reported the same results in their study. Mehdi and Khan (2009) [9], Hossain *et al*. (2010) [5], Golabadi, *et al.* (2013).

The result of genotypic coefficient of variation revealed that the vine length (11.41%), number of primary branches (29.18%), days to 50% flowering (10.13%), days to first fruit harvest (10.53%), number of fruits per plant (22.80%), fruit length (21.32%), fruit diameter (11.70%), average fruit weight (28.65%), the fruit yield (15.84%), while the lowest genotypic coefficient of variation recorded. The maximum value of the phenotypic coefficient of variation was found for vine length (12.55%), number of primary branches (30.87%), days to 50% flowering (11.33%), days to first fruit harvest (11.78%), number of fruits per plant (23.45%), fruit length (22.48%), fruit diameter (12.85) average fruit weight (29.82%), the fruit yield (16.95%), while the lowest phenotypic coefficient of variation recorded for. Similar observations were also reported by Kumar *et al.* (2008) [7], Ullah, *et al.* (2012) [16], Kandasamy (2017) [6], Tamang *et al.* (2018) [15], Bartaula *et al.* (2019) [2].

The range of heritability was maximum in average vine length (99.93%), number of primary branches (89.34%), days to 50% flowering (99.15%), days to first fruit harvest (99.60%), number of fruits per plant (94.52%), fruit length (99.96%), fruit diameter (99.60%), fruit weight (99.99%), fruit yield (99.97%), and. Similar results were obtained by Arun kumar *et al. (*2011) [1], Basavarajeshwari (2014), Pushpalatha, *et al*., (2016) [10], Kumari *et al.* (2017) [8] and Shah *et al.* (2018) [13].

Highest genetic advance as percent of mean was observed for vine length (23.49%), the number of primary branches (56.82%), days to 50% flowering (20.78%), days to first fruit harvest (21.64%), number of fruits per plant (45.67%), fruit length (43.91%), fruit diameter (24.06%), average fruit weight (59.01%), fruit yield (32.62%), and these results are according to the earlier studies by Arun Kumar *et al. (*2011) [1], Singh *et al.* (2013) [14], Kandasamy (2017) [6], Kumari *et al.* (2017) [8], Shah *et al.* (2018) [13].

Table 1: Estimates of Genetic Variability parameters in Cucumber

Parameters	Mean	Min	Max	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	Genetic Advance as % mean
Vine length (cm)	**153.60**	**130.89**	**199.00**	**11.41**	**12.55**	**99.93**	**36.07**	**23.49**
Number of primary branches	3.26	1.67	5.22	29.18	30.87	89.34	1.85	56.82
Days to 50% flowering	44.62	34.11	49.67	10.13	11.33	99.15	9.27	20.78
Days to 1st fruit harvest	54.88	41.33	63.00	10.53	11.78	99.60	11.88	21.64
Number of fruits per plant	7.86	5.33	11.56	22.80	23.45	94.52	3.59	45.67
Fruit length (cm)	15.57	11.46	22.04	21.32	22.48	99.96	6.84	43.91
Fruit diameter (cm)	5.19	3.75	6.70	11.70	12.85	99.60	1.25	24.06
Average fruit weight (gm)	147.74	58.33	251.33	28.65	29.82	99.99	87.18	59.01
Fruit yield q/ha	178.94	131.11	228.33	15.84	16.95	99.97	58.37	32.62

Table 2: Mean performance of 20 genotypes for 9 characters in Cucumber

Sr. No.	Genotypes	Vine length (cm)	Number of Primary Branches	Days to 50% Flowering	Days to 1st fruit harvest	Number of fruits per plant	Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (gm)	Fruit yield q/ha
1	DC-321	136.89	2.67	44.89	55.11	9.33	12.43	3.75	81.55	180.78
2	DC-22	156.56	2.78	34.11	44.78	6.55	11.46	5.40	95.00	197.22
3	DC-332	130.89	2.89	43.00	48.78	10.89	13.92	4.92	116.78	173.78
4	DC-327	161.00	1.67	45.78	58.00	7.11	15.51	5.30	149.00	202.00
5	Barsati	167.56	4.33	45.89	62.00	5.33	22.04	5.51	121.11	159.55

6	DC-505	155.78	2.33	49.22	59.44	7.00	15.16	4.65	251.33	216.00
7	DC-104	134.11	1.89	39.67	53.56	8.44	12.58	5.08	179.00	168.33
8	PCUC-08	146.33	3.78	45.89	52.33	10.89	15.68	4.40	162.44	220.00
9	Punjab Naveen	181.22	3.11	40.78	50.44	8.00	18.73	5.21	155.67	158.00
10	Pusa Uday	141.33	5.22	49.67	56.11	7.00	16.09	5.31	194.00	162.22
11	PusaBarkha	151.67	3.89	34.56	41.33	9.55	20.05	6.18	130.33	148.33
12	Poinsette	152.11	2.00	46.56	60.67	6.33	12.26	4.83	148.33	179.78
13	Bengal local(J)	143.00	3.22	47.44	59.33	10.56	15.45	5.56	122.67	151.11
14	Bengal Local(T)	152.33	5.00	49.33	63.00	5.78	12.53	5.15	149.22	164.22
15	Kalyanpur Green	199.00	2.78	48.11	56.89	7.78	18.78	5.07	183.67	192.00
16	Himangi	182.33	3.00	39.44	49.11	6.44	19.40	5.00	162.22	140.67
17	Swarna Poorna	153.66	3.11	44.67	52.67	7.11	20.82	5.20	173.78	221.11
18	Bengal Local-3	145.78	4.22	46.33	59.33	8.67	14.28	6.70	130.67	184.33
19	Pahari-77	139.33	3.78	45.67	55.33	5.67	12.15	5.58	58.33	131.11
20	Swarna Sheetal	141.11	3.44	41.33	59.33	9.78	12.06	5.03	179.78	228.33
	Mean	153.60	3.26	44.62	54.88	7.86	15.57	5.19	147.74	178.94
	Min	130.89	1.67	34.11	41.33	5.33	11.46	3.75	58.33	131.11
	Max	199.00	5.22	49.67	63.00	11.56	22.04	6.70	251.33	228.33
	SE(m)±	0.38	0.27	0.34	0.30	0.35	0.06	0.03	0.37	0.38
	C.D.	0.76	0.55	0.70	0.61	0.72	0.11	0.06	0.76	0.77
	C.V.	0.30	10.08	0.94	0.67	5.49	0.43	0.74	0.31	0.26

From the present study, it is concluded that the substantial variability for the considered traits studies in cucumber genotype was observed and this might be used as an important input for the future breeding program. It is expected that from these results new cucumber varieties can be obtained to increase the production and productivity to the crop substantially.

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