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Studies on genetic variability, heritability and genetic advance for growth, yield and its component traits in cucumber (*Cucumis sativus* L.)

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Abstract
The present investigation conducted at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Ayodhya, involving 28 diverse genotypes of cucumber (*Cucumis sativus* L.) in Randomized Block Design replicated thrice to estimate the genetic variability, heritability (bs) and genetic advance in present of mean for planning the leading strategy in the available germplasm. The observations were recorded on different characters like- Days to first male (staminate) flower anthesis, Days to first female (pistillate) flower anthesis, Node number to first staminate flower appearance, Node number to first pistillate flower appearance, Number of primary branches per plant, Vine length (m), Days to first fruit harvest, Fruit length (cm), Fruit diameter (cm), Number of fruit per plant, Average fruit weight (g) and Marketable fruit yield per plant (kg).
The analyses of variance revealed that mean sum of squares due to genotypes were highly significant for all the traits indicating ample variation among the genotypes. The estimates of heritability in board sense and genetic advance as a percentage of mean were studied in the study. The range of heritability in board sense varied from 58.20% to 99.0%. Maximum estimates of heritability was recorded for length of fruit (99.00%). Based on mean performance of genotype NDCC-23 followed by Pusa Uday (1.700 kg), NDCC-4 (1.660 kg), NDCC-5 (1.590 kg), and NDCC-19 (1.560 kg) were found as five most promising t yield per plant.
Hence due emphasis should be given to these characters during selection for developing high yielding genotypes in cucumber.

Keywords: Cucumber, genetic variability, variation and yield

Introduction
Cucumber (*Cucumis sativus* L.) is a member of family Cucurbitaceae, which comprises of about 120 genera and more than 800 species (Rubatzky and Yamaguchi, 1999) [7]. The genus *Cucumis* comprises of about 30 different species in two groups and distributed over two geographically distinct areas. The Asiatic group, to which cucumber belongs, has been found growing wild in the South and East of Himalayas and has diploid chromosome number 2n = 2x = 14 whereas, the African group, including West Indian Gherkin (*Cucumis anguria* L.) and muskmelon (*Cucumis melo* L.) have diploid chromosome number 2n = 2x = 24, have been found wild in Africa and Middle East. The species of one group are genetically and reproductively well isolated from that of other group. Cucumber is in cultivation for last over 3000 years and is thought to be originated in India. It further spread East ward to China and West ward to Asia Minor, North Africa and Southern Europe (Seshadri and Parthasarathy, 2002) [8]. Regarding the ancestral form, Sir Joseph Hooker concluded that Indian wild cucumber (*Cucumis sativus var. hardwickii* Kitamura.) which is found growing wild in the foothills of Himalaya, as either feral or progenitor of present day cucumber. Similar and strong evidence on this aspect was given after six isozyme analysis of Indian wild cucumber carried out by Issihiki *et al*. (1992) [4]. India is the world's second largest producer of vegetables after China, whereas in India it is grown in an area of 0.078 million hectares with a production of 1.142 million tonnes with productivity of 14.64 t/ha (Anonymous, 2017) [1]. For any effective selection programme, it would be desirable to consider the relative magnitude of association of various characters with yield.
Assessment of genetic diversity could be suitable in crop breeding for diverse applications such as identifying diverse parental genotypes. Genetic diversity is the amount of heritable variability between varieties or populations of organisms. Substantial effort has been directed towards collecting, preserving and evaluating genetic variability in crops (Golabadi *et al*., 2012) [3].

Materials and Methods

The experiment on the present research work entitled "Estimate the correlation and path coefficient among the growth yield and its component traits in cucumber (*Cucumis sativus* L.)" was conducted at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during summer season of 2018. The experimental material for the present investigation comprised of 28 variable genotypes of cucumber including two check varieties, selected on the basis of genetic variability from the germplasm stock maintained at Main Experiment Station in the Department of Vegetable Science, N.D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). The Experiment was laid out in Randomized Block Design (RBD) with 26 genotype and 2 checks. The observation were recorded *viz*. Days to first male (staminate) flower anthesis, Days to first female (pistillate) flower anthesis, Node number to first staminate flower appearance, Node number to first pistillate flower appearance, Number of primary branches per plant, Vine length (m), Days to first fruit harvest, Fruit length (cm), Fruit diameter (cm), Number of fruit per plant, Average fruit weight (g) and Marketable fruit yield per plant (kg).

Analysis of variance of the data for the component traits was analyzed as per the following model given by Panse and Sukhatme (1967) [6]. The phenotypic, genotypic, environmental coefficients of variation, heritability in broad sense (h^2bs) and the expected genetic advance (GA) for different characters content were calculated as suggested by-Burton and De Vane (1953) and Johnson *et al*. (1955) [2, 5] respectively.

Result and discussion

The analysis of variance for different characters has been presented in (Table 1). The mean squares due to genotypes were highly significant for all the characters. In other words, the performances of the genotypes with respect of these characters were statistically different; suggesting that, there exists ample scope for selection in different traits for cucumber improvement. Perusal of Table-2 revealed that the phenotypic coefficients of variability were higher than the genotypic coefficients of variability for all the characters under study which indicates that environment played very important role in the expression of the traits. High magnitudes of variability was observed in case of Node number of first male flower followed by Average fruit weight per (g), Length of fruit (cm.), Number of Primary branch per plant, Number of fruit per plant, Vine length (m.), Node number of first female flower. Mean performance of genotype under studies are presented in (table 3) which show the extent of variation average performance among the genotype for the quantitative traits. The best five genotype which significantly out yielded the check variety on the basis of mean performance on the basis of mean performance for fruit yield were NDCC-23, Pusa Uday (1.700 kg), NDCC-4 (1.660 kg), NDCC-5 (1.590 kg), and NDCC-19 (1.560 kg) these genotype may further evaluated for yield performance towards development of new improved varieties of cucumber in future.

Table 1: Analysis of variance of different characters studied

SN	Characters	Source of variation	Replicate	Treatments	Error
		df	2	27	54
1	Node Number of first male flower		0.87	15.74**	0.72
2	Node Number of first female flower		0.80	10.24**	0.38
3	Days to first male flower anthesis		5.32	25.10**	3.70
4	Days to first female flower anthesis		54.40**	18.67**	2.01
5	Days to first fruit harvest		15.44*	30.49**	3.67
6	No. of Primary branch per plant		0.23	1.88**	0.30
7	Length of fruit (cm.)		1.09	59.71**	0.62
8	Diameter of fruit (cm.)		0.14	0.59**	0.05
9	Vine length (m.)		0.01	0.49**	0.01
10	Average fruit weight per (g)		1,563.25*	12,348.54**	454.94
11	Number of fruit per plant		0.87	14.22**	5.94
12	Fruit yield per plant (kg)		0.003**	0.085	0.071

* &** Signficant at 5% & 1% respectively

Table 2: Coefficient of variation and other parameters for different characters of cucumber

Traits	Range	PCV %	GCV %	ECV %	h^2 (Broad Sense)	Genetic Advancement	Gen. Adv as % of Mean
Node number of first male flower	2.37 – 12.23	38.99	38.09	14.42	95.40	4.50	76.66
Node number of first female flower	4.70 – 13.43	18.50	18.19	6.14	96.30	3.66	36.79
Days to first male flower anthesis	34.70 –44.26	7.38	6.82	4.91	85.20	5.07	12.97
Days to first female flower anthesis	37.26 – 44.50	6.13	5.79	3.48	89.20	4.58	11.27
Days to first fruit harvest	47.63 – 60.50	5.77	5.41	3.47	88.00	5.77	10.46
Number of Primary branch per plant	2.00 – 4.67	24.03	22.04	16.61	84.10	1.37	41.62
Length of fruit (cm.)	5.50 – 23.50	29.72	29.56	5.25	99.00	9.09	60.59
Diameter of fruit (cm.)	2.00 – 3.93	15.06	14.40	7.65	91.40	0.83	28.37
Vine length (m.)	1.18 – 2.73	20.80	20.57	5.36	97.80	0.81	41.91
Average fruit weight per (g)	88.33 –342.0	35.84	35.17	11.91	96.30	127.29	71.11
Number of fruit per plant	7.23 – 16.00	22.09	16.86	24.73	58.20	2.611	26.50
Fru:it yield per plant (kg)	1.01 – 1.83	11.86	9.72	13.43	81.95	3.703	39.81

Table 3: Mean performance of different characters of cucumber germplasm

S. No	Genotypes	Node No.of first male flower	Node No.of first female flower	Days to first male flower anthesis	Days to first female flower anthesis	Days to first fruit harvest	No.of Primary branches per plant	Length of fruit (cm.)	Diameter of fruit (cm.)	Vine length (m.)	Average fruit weight (g)	No.of fruit per plant	Fruit yield per plant (kg)
1	NDCC -1	2.37*	8.40*	35.03*	38.30*	52.40	2.33	13.40	2.93	2.13*	129.67	10.37	1.31
2	NDCC -2	3.90*	9.50	36.83	39.43	53.60	3.67*	11.47	3.30	2.24*	160.33	8.87	1.36
3	NDCC -3	4.33*	9.50	38.13	41.43	55.47	2.67*	7.67	2.97	1.82	170.67	7.90	1.40
4	NDCC -4	4.00*	12.07	37.37	39.40	57.43	3.67*	9.30	3.27	2.26*	145.00	7.33	1.66
5	NDCC -5	4.27*	9.70	39.73	42.40	56.63	2.33	17.40*	2.67	1.75	195.00	8.77	1.59
6	NDCC -6	6.77	12.07	42.93	44.30	58.63	3.00*	15.43	3.00	1.63	220.33*	11.93	1.30
7	NDCC -7	3.87*	8.37*	37.00	39.53	54.57	4.33*	5.50	2.33	1.86	235.00*	13.03	1.32
8	NDCC -8	4.70	10.67	40.30	44.37	60.37	4.33*	13.50	3.30	2.13*	187.67	11.57	1.01
9	NDCC -9	3.33*	6.63*	34.07*	37.43*	53.57	4.67*	15.47	3.00	1.18	225.00*	8.63	1.45
10	NDCC -10	9.80	9.87	43.07	44.33	59.47	2.33	21.53*	3.33*	1.72	249.00*	9.97	1.35
11	NDCC -11	7.43	10.37	38.10	39.37	55.57	3.67*	13.53	2.37	1.85	155.00	9.43	1.32
12	NDCC -12	7.83	8.97	40.47	42.50	57.43	4.00*	15.43	3.30	2.33*	284.33*	8.27	1.42
13	NDCC-13	4.47*	11.43	44.27	42.47	55.37	3.67*	17.37*	3.03	1.75	310.00*	7.97	1.56
14	NDCC -14	4.40*	10.90	38.77	38.33*	51.47*	3.00	19.43*	3.60*	1.94	140.00	7.37	1.48
15	NDCC -15	12.23	9.87	45.00	41.33	57.50	3.67*	21.67*	3.93*	1.56	120.00	10.17	1.35
16	NDCC -16	6.17	11.40	39.23	41.57	55.47	4.67*	8.50	2.00	2.65*	160.00	13.80	1.38
17	NDCC -17	7.77	11.83	40.30	43.33*	60.50	2.33	11.47	3.03	2.65*	109.67	10.00	1.37
18	NDCC -18	4.43	9.23	37.27	41.37	56.47	3.33*	13.40	2.63	1.48	121.67	12.17	1.26
19	NDCC -19	2.37*	11.87	41.37	42.33	58.63	4.00*	20.33*	3.60*	2.73*	88.33	9.20	1.56
20	NDCC -20	3.90*	12.27	38.30	37.27*	50.43*	2.33	23.50*	2.93	2.07	194.00	10.77	1.36
21	NDCC -21	4.33*	10.83	40.63	39.53	52.67	2.33	14.43	2.60	2.52*	131.67	8.27	1.56
22	NDCC -22	4.00*	8.77*	37.37	39.43	51.57*	3.33*	19.33*	2.97	2.06	124.33	7.80	1.53
23	NDCC -23	4.27*	9.03	41.33	40.33	53.40	4.33*	18.53*	3.30	1.35	158.33	7.23	1.83
24	NDCC -24	6.77	9.83	36.47	40.57	55.70	2.00	11.50	2.37	1.65	104.67	8.53	1.40
25	NDCC (Gy) -25	3.43	4.70*	34.70*	34.50*	47.63*	3.00*	11.60	2.67	2.07	124.33	16.00*	1.30
26	Pusa Barkha	3.33*	7.93*	36.47	37.43*	51.37*	2.67*	15.43	2.70	1.80	342.00*	12.50	1.15
27	Pant Khira-1 (C)	4.70	9.63	38.30	41.43	53.60	3.33*	16.53*	2.97	1.91	189.00	9.30	1.38
28	Pusa Uday (C)	9.80	13.43	43.47	44.50	58.50	3.33*	17.60*	2.37	1.34	237.00*	8.70	1.70
	Mean	5.87	9.97	39.15	40.66	55.19	3.30	15.01	2.95	1.94	179.00	9.85	1.42
	C.V.	14.42	6.15	4.92	3.49	3.47	16.62	5.25	7.65	5.36	11.92	24.74	18.84
	S.E.	0.49	0.35	1.11	0.82	1.11	0.32	0.46	0.13	0.06	12.31	1.41	0.15
	C.D. 5%	1.39	1.00	3.15	2.32	3.14	0.90	1.29	0.37	0.17	34.92	3.99	0.44
	C.D. 1%	1.85	1.34	4.20	3.09	4.18	1.19	1.72	0.49	0.23	46.50	5.31	0.58
	Min.	2.37	4.70	34.07	34.50	47.63	2.00	5.50	2.00	1.18	88.33	7.23	1.01
	Max	12.23	13.43	45.00	44.50	60.50	4.67	23.50	3.93	2.73	342.00	16.00	1.83

The result on heritability and genetic advance in per cent of mean of present investigation has been presented in Table-2.

Range of heritability estimates in board sense varied from 58.20% to 99.0%. Maximum estimates of heritability was recorded for length of fruit (99.00%). Heritability estimates were high for vine length (97.80%), average fruit weight (96.30%), node number of first female flower (96.30%), node number of first male flower (95.40%), diameter of fruit (91.40%), days to first female flower anthesis (89.20%), days to first fruit harvest (88.00%), days to first male flower anthesis (85.20%), number of primary branch per plant (84.10%), whereas fruit yield per plant (81.95%), and number of fruit per plant (58.20%) had moderate heritability among all the characters.

Highest estimates of genetic advance in percent of mean was observed for node no. of first male flower (76.66), average fruit weight (71.11), length of fruit (60.59), vine length (41.91), number of primary branch per plant (41.62), fruit yield per plant (39.81), and node number of first female flower (36.79). Lowest estimates of genetic advance in percent of mean was observed for days to first fruit harvest (10.46), followed by days to first female flower anthesis (11.27) and number of fruit per plant (26.50). Thus it could be concluded that there exists ample variability in the available germplasm. The inheritance of traits with high heritability and genetic advance revealed that there is great scope in yield improvement in cucumber following selection.

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