Genetic variability, heritability and genetic advance for growth and yield in cucumber (*Cucumis sativus*)

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ABSTRACT

Assessment of variability is the most crucial pre-breeding technique in every crop improvement programme. This study was conducted to analyse the genetic diversity of seventy distinct cucumber varieties. In this investigation, the phenotypic coefficient of variation (PCV) was greater than its equivalent genotypic counterpart (GCV). The maximum phenotypic and genotypic coefficient (PCV and GCV) was observed for yield per vine followed by fruits per vine. In this experiment all the studied traits had high heritability coupled with high genetic advance.

Key words: Genetic variability, heritability, GCV, PCV, cucumber

INTRODUCTION

One of the most significant cucurbitaceous vegetable crops is cucumber (*Cucumis sativus* L.), which is widely cultivated in tropical and subtropical regions of the nation. Following the tomato, cabbage, and onion as the most significant vegetable crops, it is ranked fourth. A thermophilic and frost-sensitive species, cucumbers thrive at temperatures over 20°C. It is cultivated for its soft fruits, which are eaten fresh in salads, cooked like vegetables, or picked when still young. It includes a significant amount of vitamin B and C, carbohydrates, calcium, and phosphorus Kumar *et al.,* (2013). The amount of importance placed on research in this country for the purpose of improving this crop is extremely low. Based on the size of the characteristics of variability, an appropriate breeding strategy for improving cucumber can be developed. Therefore, the goal of the current study was to evaluate and quantify the genetic variability, heritability, genetic advance, and genetic advance above percent of mean for growth and yield parameters in 70 cucumber genotypes.

MATERIALS AND METHODS

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

Sl.no	Genotype name	Place of collection
G-1	Gandharvakottai	Department of Vegetable Science, TNAU Coimbatore
G-2	Kattur	Department of Vegetable Science, TNAU Coimbatore
G-3	Aipatti	Department of Vegetable Science, TNAU Coimbatore
G-4	Sathyamangalam	Department of Vegetable Science, TNAU Coimbatore
G-5	Parvai	Department of Vegetable Science, TNAU Coimbatore
G-6	Amaravathi	Department of Vegetable Science, TNAU Coimbatore
G-7	Piraittur	Department of Vegetable Science, TNAU Coimbatore
G-8	Iniyanur	Department of Vegetable Science, TNAU Coimbatore
G-9	Udaiyanur	Department of Vegetable Science, TNAU Coimbatore
G-10	Rasipuram	Department of Vegetable Science, TNAU Coimbatore
G-11	Peramangalam	Department of Vegetable Science, TNAU Coimbatore
G-12	Melmaravakadu	Department of Vegetable Science, TNAU Coimbatore
G-13	Karratampatti	Department of Vegetable Science, TNAU Coimbatore
G-14	Kuruvikarankulam	Department of Vegetable Science, TNAU Coimbatore
G-15	Kagahpuram	Department of Vegetable Science, TNAU Coimbatore
G-16	Kodaivasal	Department of Vegetable Science, TNAU Coimbatore
G-17	Uppliyapuram	Department of Vegetable Science, TNAU Coimbatore
G-18	Namanasamuthiram	Department of Vegetable Science, TNAU Coimbatore
G-19	Vennamuthupatti	Department of Vegetable Science, TNAU Coimbatore
G-20	Orathanadu	Department of Vegetable Science, TNAU Coimbatore
G-21	Kordachery	Department of Vegetable Science, TNAU Coimbatore
G-22	Pattukottai	Department of Vegetable Science, TNAU Coimbatore
G-23	Kollidam	Department of Vegetable Science, TNAU Coimbatore

G-24	Kallakuruchi	Department of Vegetable Science, TNAU Coimbatore
G-25	Pondichery	Department of Vegetable Science, TNAU Coimbatore
G-26	Thirupavsnam	Department of Vegetable Science, TNAU Coimbatore
G-27	Kodavasal	Department of Vegetable Science, TNAU Coimbatore
G-28	Ponnavarayankottai	Department of Vegetable Science, TNAU Coimbatore
G-29	Thillaiyampuram	Department of Vegetable Science, TNAU Coimbatore
G-30	Periyakollapatti	Department of Vegetable Science, TNAU Coimbatore
G-31	Sankakiri	Department of Vegetable Science, TNAU Coimbatore
G-32	Solan	Department of Vegetable Science, TNAU Coimbatore
G-33	Sathur	Department of Vegetable Science, TNAU Coimbatore
G-34	Musiri	Department of Vegetable Science, TNAU Coimbatore
G-35	Kalachery	Department of Vegetable Science, TNAU Coimbatore
G-36	Namakkal	Department of Vegetable Science, TNAU Coimbatore
G-37	Dharawad green	Dharawad, Karnataka
G-38	Kerala type	Kerala
G-39	Kanchipuram	Department of Vegetable Science, TNAU Coimbatore
G-40	Gujurat local	Gujarat
G-41	Guntur long	Guntur, Andhra Pradesh
G-42	Guntur round	Guntur, Andhra Pradesh
G-43	Kerala type	Thrissur, kerala
G-44	Salad cucumber	Tumkur, Karnataka
G-45	White type	Mysore, Karnataka
G-46	Haryana local	Rewari, Haryana
G-47	Haryana local	Bhiwani, Haryana
G-48	Haryana local	Bhiwani, Haryana
G-49	Maharashtra Local	Nagpur, Maharashtra
G-50	Dharwad local	Dharawad, Karnataka
G-51	Yaganti	Department of Vegetable Science, TNAU Coimbatore
G-52	Mysore local	Mysore, Karnataka
G-53	Sirsi local	Sirsi, Karnataka
G-54	Delhi	Delhi
G-55	Natti	
G-56	NS-404	Namdhari seeds
G-57	Cucumber white kakri	Bangalore, Karnataka
G-58	Green long	Bangalore, Karnataka
G-59	Emerald green	Bangalore, Karnataka
G-60	Chikkaballapura	Chikkaballapura, Karnataka
G-61	KPHC-1	Kerala
G-62	Pusa seedless	IARI< New Delhi
G-63	Parthenocarpic cucumber-2	Department of Vegetable Science, TNAU Coimbatore

G-64	Parthenocarpic cucumber-3	Department of Vegetable Science, TNAU Coimbatore
G-65	Multi star-RZ	Department of Vegetable Science, TNAU Coimbatore
G-66	AVCV-1202	Department of Vegetable Science, TNAU Coimbatore
G-67	AVCV-1203	Department of Vegetable Science, TNAU Coimbatore
G-68	AVCV-1205	Department of Vegetable Science, TNAU Coimbatore
G-69	AVCV-1206	Department of Vegetable Science, TNAU Coimbatore
G-70	AVCV-1303	Department of Vegetable Science, TNAU Coimbatore

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 vine length, node number of first male flower, node number of first female flower, days taken for first male flowering, days taken for first female flowering, days for first fruit harvest, fruit length, fruit girth, fruits per vine, average fruit weight, yield per plant. The mean over replications for each character was statistically analysed using the 'Analysis of Variance' concepts outlined by Panse and Sukhatme (1967). Using the formulas suggested by Burton in 1952, the phenotypic and genotypic coefficients of variation (PCV, GCV) were assessed. Heritability in a broad sense was evaluated using formulas proposed by Lush (1940), and predicted genetic advance as a percent of the mean was determined using formulas proposed by Johnson *et al.*, (1955).

RESULTS AND DISCUSSION

Genetic variability is a critical component of a successful breeding programme in any crop species, and, prior to commencing an improvement programme, a thorough evaluation of the available genetic variability is required Haussmann et al, (2004). The phenotypic and genotypic coefficients of variability were found to be closely related, indicating little environmental effect on the expression of the numerous traits under study. Mean squares were significant for all the traits under investigation, showing that there is considerable genetic variability for all the plant characters evaluated, while the variation due to replication was non-significant, according to an analysis of variance for several quantitative characters (Table 1). The range, SEm, phenotypic variance (σ^2p), genotypic variance (σ^2G), genotypic coefficient of variation (GCV), heritability (broad sense), and genetic advance (GA) were used to assess the level of diversity in 70 cucumber germplasm samples (Tables 2 and 3).

Wide variations were seen across the board for all the characters. With a mean of 153.94 and 147.037, respectively, fruit weight had the widest range, followed by vine length (269.615-92.385), while the narrowest range was seen for trait yield per vine (4.12- 0.41) and node number for first male flower (11.5- 2), similar kinds of outcomes were seen in cucumber by Pushpalatha *et al.*, (2016), I.N. Shukla (2010), and Yogesh C (2009).

The parallel analysis of genotypic and phenotypic coefficient of variation revealed that, for nearly all the traits, phenotypic coefficient of variation was marginally larger than genotypic coefficient of variation (Table 2). The GCV, a measure of the population's genetic diversity, ranged from 32.17 (days till first fruit harvest) to 74.13. (Yield per vine). For characteristics like Vine length, Node number of first male flower, Node number of first female flower, Fruit length, Fruit girth, Number of fruits per vine, Fruit weight, and Yield per vine, the GCV values were notably high. Characters with a wider variety of variance have more potential for development though selection. It is well known that the genotypic coefficient of variation is more significant than the phenotypic coefficient of variation because genetic variation offers breeding programmes a means of selection. Similar kinds of outcomes were seen in cucumber by K Karthick (2019), Ahirwar and Singh, (2018), Pushpalatha *et al.,* (2016), I.N. Shukla (2010), and Yogesh C (2009) in cucumber.

The gain to be achieved via selection is influenced by the heritability, intensity of selection, and level of population diversity. It is apparent from (table 3) that high heritability values were documented for all variables with a wide range of observed frequencies (72.434 percent to 97.374 percent) confirming the findings of Pushpalatha *et al.,* (2016), Gaikwad et al (2011) and Uddin et al (2006).

When heritability and genetic progress are evaluated together, heritable variation can be determined with a better degree of precision. Johnson *et al.,* (1955) noted that without genetic progress, the estimations of heritability would not be useful in selection programmes. Like heritability It is apparent from (table 3) that high genetic advance (%) values were documented for all variables with a wide range of observed frequencies (28.028 to 148.95). Similar results for fruit length were reported by Sampurna Bartaula (2019,) Shwetha Sharma (2017), Pushpalatha (2016)**,** Kumar *et al.,* (2013) Yogesh *et al.,* (2009).

CONCLUSION

Understanding genetic variability, as measured by coefficient of variation, heritability, and genetic progress, was crucial in the development of trait-specific breeding methods. This study found high heritability for vine length, first male flower node number, first female flower node number, fruits per plant, fruit length, fruit weight, and fruits per vine. Since the aforementioned attributes are governed by additive gene activity, selection can successfully improve them. The following varieties fared well in the current study: Aipatti, Parvai, Amaravathi, Uppliyapuram, Sankakiri, Sathur, Dharawad green, Salad type cucumber, Dharwad local, and Emerald green, these genotypes can be used in future breeding efforts.

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Table 1: Analysis of variance for growth and yield characters in cucumber

Sl No.	Character	Mean sum of squares		
		Replication 2	Treatment 13	Error 26
1	Vine length	0.07	3278.296**	59.797
2	Node number of first male flower	0.109	4.865**	0.065
3	Node number of first female flower	1.348**	7.671**	0.192
4	Days taken for first male flowering	3.147	132.614**	2.513
5	Days taken for first female flowering	7.624	124.703**	3.422
6	Days for first fruit harvest	1.562	119.535**	4.495
7	Fruit length	0.383	28.562**	0.441
8	Fruit girth	2.584	18.569**	2.969
9	Fruits per vine	0.012	25.434**	0.162
10	Average fruit weight	5.046	2,194.40**	85.982
11	Yield per plant	31.471**	47.36**	1

Table 2: Genetic parameter of variability for fruit growth, fruit yield and its component traits in cucumber.

Sl No.	Traits	Mean	Range		Coefficient of variation (%)	
			Max	Min	GCV	PCV
01	Vine length	153.94	269.615	92.385	26.059	26.539
02	Node number of first male flower	4.377	11.5	1.33	35.391	35.865
03	Node number of first female flower	5.841	11.5	2	33.108	33.948
04	Days taken for first male flowering	43.664	59.5	26	18.471	18.825

05	Days taken for first female flowering	46.962	62.5	27.83	16.582	17.043
06	Days taken for first fruit harvest	53.684	69	32.17	14.128	14.669
07	Fruit length	18.349	35.92	8.675	20.435	20.753
08	Fruit girth	10.941	20.95	5.745	25.527	29.994
09	Number of fruits per vine	7.447	19.165	4	47.735	48.041
10	Fruit weight	147.037	236.935	64.73	22.082	22.965
11	Yield per vine	1.162	4.12	0.41	73.849	75.425

Table 3: Genetic parameter of Heritability (h^2 %), GA as % of mean for fruit growth, fruit yield and its component Trait in cucumber.

Sl no.	Traits	Heritability (h^2 %)	GA as % of mean
01	Vine length	96.417	52.711
02	Node number of first male flower	97.374	71.942
03	Node number of first female flower	95.115	66.517
04	Days taken for first male flowering	96.281	37.337
05	Days taken for first female flowering	94.658	33.234
06	Days taken for first fruit harvest	92.752	28.028
07	Fruit length	96.96	41.452
08	Fruit girth	72.434	44.755
09	Number of fruits per vine	98.731	97.709
10	Fruit weight	92.459	43.74
11	Yield per vine	95.864	148.95