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Evaluation of genetic variability, heritability and genetic advance in sponge gourd (*Luffa cylindrica* L. Roem.) for various quantitative traits

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Abstract
The present investigation was carried out at Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during summer season, to evaluate the available germplasms for yield and its component traits of 30 genotypes, with three replications in Randomized Block Design. The study revealed that the mean sum squares due to genotypes were significant for all the characters, though the wide range of genetic variability in the material. Genetic variability, heritability and genetic advance were studied in 13 genotypes of sponge gourd. The phenotypic coefficient of variations (PCV) was higher than the genotypic coefficients of variations (GCV) for all traits studied, indicating that the apparent variation is not only genetic but also influenced by the growing environment in the expression of the characters. The genotypic coefficients of variation and phenotypic coefficients of variation were moderate to low for all the characters except Vine length(39.53%, 40.09%) followed by node number to anthesis of first staminate flower (33.12%, 34.13%) and lower value days to first marketable fruit harvest (11.79%, 13.28%), days to anthesis of first staminate flower (12.57%, 13.69%) and days to anthesis of first pistillate flower (13.69%, 14.78%).High heritability coupled with high genetic advance was estimated for most of the traits *viz*., vine length (97.24%, 80.31%), node number to anthesis of first staminate flower (94.21%, 66.23%) and number of fruits per plant (92.49%, 45.65%)thus indicating that these traits had additive gene effect so that, they are more reliable for effective selection.

Keywords: Genetic variability, heritability and genetic advance, *Luffa cylindrica* L. Roem

Introduction
Luffa [*Luffa cylindrica* (L). Roem.] Commonly called as sponge gourd, Loofah vegetable sponge or dish cloth, having diploid chromosome number 2n = 2x = 26. The sponge gourd large amount of variation has been observed for many economically important traits. In India, wide range of variability is available in the land races or cultivars, in terms of qualitative characters of sponge gourd. The observations were recorded on node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days anthesis of first pistillate flower, days to first fruit harvest, Vine length (m), number of nodes per vine Number of primary branches per plant, fruit length (cm), fruit diameter (cm), number of fruits per plant, average fruit weight (g) and total marketable fruit yield per plant (kg). Variability in cucurbitaceous crop occurs in the form of land races, traditional cultivars, wild relatives form and related non edible wild weedy species. In India little attention has been given for the genetic improvement of sponge gourd by collecting diverse germplasm, their morphological characterization and assessing the variability parameters like coefficient of variation. The appropriate breeding methodologies may be adopted for genetic improvement of this crop for simultaneously improvement of different characters, information regarding mutual relationship among the characters and direction of correlation analysis provides an effective means of finding out direct and indirect causes of association among causal variables. Though the literature in respect of germplasm evaluation variability and correlation studies in sponge gourd is not meager but these are based on testing of limited number of germplasm. Moreover, the results of the earlier studies on such aspects are relevant only for the materials and environments involved in the particular study and cannot be generalized.

Therefore, studies on above aspects on the available germplasm under the environment where, it is to be exploited, is essential for successful utilization of germplasm resources in the development of superior varieties.

Materials and Methods

The experimental material for the present investigation comprised 30 genotypes of sponge gourd 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 and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the summer season. The experiment was conducted in Randomized Block Design with three replications to assess the performance of 30 genotypes of sponge gourd. The crop was planted in 3.0 m. for row length, spaced 3.0 m. apart where, 0.5m. Plant to plant spacing was maintained. The experiment was conducted during summer season of 2017. All the recommended agronomic package and practices and plant protection measures were followed to raise a good crop. The observations were recorded on the five plants, summed up and divided by five to get mean value. The characters observed *viz.*, node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days anthesis of first pistillate flower, days to first fruit harvest, Vine length (m), number of nodes per vine, number of primary branches per plant, fruit length (cm), fruit diameter (cm), number of fruits per plant, average fruit weight (g) and total marketable fruit yield per plant (kg).

Statistical analysis

The average values for each genotype in each replication for the traits studied were used for further statistical analysis. A brief outline of the procedure adopted for the estimation of statistical parameters. Analysis of variance**,** the data for the component traits was analysed as per the following model given by Panse and Sukhatme (1984) [8]. The calculated 'F' values were compared with the tabulated 'F' values at 5% level of significance. If the calculated 'F' value was higher than the tabulated, it was considered to be significant. All the characters which showed significant differences among genotypes were further subjected to the analysis for the different parameters. The phenotypic, genotypic, environmental coefficients of variation, heritability in broad sense (h^2_{bs}) and the expected genetic advance (GA) for different characters content were calculated as suggested by Burton and de Vane (1953) [3] and Johnson *et al.*, (1955) [6].

a) Heritability and genetic advance: Heritability in broad sense (h^2_{bs}) was calculated using the formula suggested by Burton and de Vane (1953) [3].

$$H^2_{(bs)} = \frac{\sigma^2 g}{\sigma^2 g + \sigma^2 e} \text{ or } \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

b) Genetic advance: Genetic advance (G.A.) was estimated by the method suggested by Johnson *et al*. (1955) [6].

$$G.A. = \frac{\sigma^2 g}{\sigma^2 p} . K . \sigma p$$

$$= h^2 . K . \sigma p$$

Where

K = Selection differential at 5% selection intensity (2.06).

H^2 = Heritability

i) Genetic advance in percent of mean ($\overline{GA}$)

$$G.A.(\%) = \frac{\text{Genetic adavance}}{\overline{X}} \times 100$$

Results and Discussion

In the present investigation, the analysis of variance (Table 1) revealed significant differences at 1% level of significance for almost all the character, which showed a wide range of variability among the 13 genotypes for all the characters. The range of variation was high for average fruit weight(2079.22) followed by number of nodes per vine (298.89), days to first marketable fruit harvest (151.28), days to anthesis of first pistillate flower (118.43), days to anthesis of first staminate flower (83.03), fruit length (74.70), number of fruits per plant (67.23), node to anthesis of first staminate flower (15.17), node number to anthesis of first pistillate flower (14.28) and vine length (12.10) signifying the presence of enough variability among the genotypes used in the present study.

The phenotypic variance of each character was partitioned into genotypic and environmental comfier in order components. The phenotypic and genotypic coefficient of variations were estimated to assess the existing variability are present in table 2. In general the phenotypic coefficient of variability was higher than genotypic coefficient of variability which indicated that environment influenced considerably in expression of these traits. The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels were observed forVine length (40.09%, 39.53%) followed by node number to anthesis of first staminate flower (34.13%, 33.12%) and number of fruits per plant (23.96%, 23.04%) whereas, total fruit yield per plant (22.33%, 20.41%), number of primary branches per plant (22.28%, 20.24%), fruit length (21.09%, 19.57%), node number to anthesis of first pistillate flower (20.14%, 19.19%), number of nodes per vine (19.86%, 18.46%), average fruit weight (17.94%, 16.61%), fruit diameter (17.71%, 16.00%), days to anthesis of first pistillate flower (14.78%, 13.69%) and days to anthesis of first staminate flower (13.69%, 12.57%) showed moderate coefficient of variability while days to first fruit harvest (13.28%, 11.79%) had lowest coefficients of variability result obtained in present investigations are in agreement with the finding of Mohanty (2000) [7] in sponge gourd and Singh (2006) [10] in bitter gourd.

Table 1: Analysis of variance (mean squares) for 13 characters in sponge gourd

S. No.	Characters	Source of variation		
		Replications	Treatments	Error
	d.f.	2	29	58
1	Node no. to anthesis of first staminate flower	0.234	15.178**	0.304
2	Node no. to anthesis of first pistillate flower	0.032	14.281**	0.470
3	Days to anthesis of first staminate flower	13.760	83.030**	4.832
4	Days to anthesis of first pistillate flower	3.937	118.430**	6.209

5	Days to first marketable fruit harvest	32.943	151.282**	12.375
6	Vine length (m)	0.065	12.104**	0.113
7	No. of nodes per vine	14.726	298.897**	14.890
8	No. of primary branches per plant	0.049	4.001**	0.264
9	Fruit length (cm)	1.221	74.700**	3.829
10	Fruit diameter (cm)	0.193	1.054**	0.074
11	No. of fruits per plant	3.975	67.236**	1.771
12	Average fruit weight (gm)	99.920	2079.222**	109.575
13	Fruit yield per plant	0.155	0.966**	0.059

** - Significant at 1 per cent probability level

Table 2: Estimates of range, grand mean, phenotypic, genotypic, environmental, coefficients of variation, heritability in broad (h^2_{bs}) sense and genetic advance in per cent of mean ($\overline{GA}$) for 13 characters in sponge gourd germplasm

S. No.	Characters	Range		Grand mean	P.C.V. (%)	G.C.V. (%)	E.C.V. (%)	Heritability Broad Sense (%) (h^2_{bs})	Genetic Advance 5%	Genetic Advance in per cent of mean
		Lowest	Highest							
1.	Node no. to anthesis of first staminate flower	3.67	12.26	6.72	34.13	33.12	8.21	94.21	4.45	66.23
2.	Node no. to anthesis of first pistillate flower	7.13	15.43	11.18	20.14	19.19	6.13	90.72	4.20	37.65
3.	Days to anthesis of first staminate flower	31.67	48.63	40.58	13.69	12.57	5.41	84.36	9.66	23.80
4.	Days to anthesis of first pistillate flower	32.33	51.67	44.67	14.78	13.69	5.57	85.76	11.66	26.12
5.	Days to first marketable fruit harvest	44.87	68.50	57.68	13.28	11.79	6.09	78.91	12.45	21.58
6.	Vine length (m)	2.36	8.93	5.05	40.09	39.53	6.65	97.24	4.06	80.31
7.	No. of nodes per vine	34.20	74.36	52.69	19.86	18.46	7.32	86.41	18.63	35.35
8.	No. of primary branches per plant	3.76	8.73	5.51	22.28	20.24	9.33	82.47	2.08	37.86
9.	Fruit length (cm)	17.36	38.93	24.83	21.09	19.57	7.88	86.05	9.28	37.40
10.	Fruit diameter (cm)	2.43	4.86	3.57	17.71	16.00	7.59	81.64	1.06	29.79
11.	No. of fruits per plant	10.70	32.26	20.27	23.96	23.04	6.56	92.49	9.25	45.65
12.	Average fruit weight (gm)	106.40	211.46	154.20	17.94	16.61	6.78	85.70	48.86	31.68
13.	Fruit yield per plant	1.55	3.75	2.69	22.33	20.41	9.06	83.52	1.03	38.42

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