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ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN SPONGE GOURD (*LUFFA CYLINDRICA* L. ROEM)

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ABSTRACT

An investigation was conducted to evaluate thirty sponge gourd genotypes, including one check variety (Pusa Chikni), for nineteen traits at the Main Experiment Station, Department of Vegetable Science, Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.), during the summer 2024. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The objective was to assess genetic variability among the genotypes using fifteen quantitative and four qualitative traits. The results revealed that the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were highest for the number of primary branches per plant, followed by the node number at which the first staminate flower appeared and vine length. The lowest variability was observed for moisture content. High heritability coupled with high genetic advance as a percentage of the mean was recorded for the number of nodes per vine, total soluble solids (T.S.S.), days to first staminate flower anthesis and days to first pistillate flower anthesis. These findings suggest that these traits are largely governed by genetic factors with minimal environmental influence, indicating significant potential for improvement through direct selection.
***Keywords*:** Variability, heritability, genetic advance, sponge gourd

Introduction

Sponge gourd (*Luffa cylindrica* L.), also known as vegetable sponge**,** sponge gourd, or rag gourd is a promising vegetable crop primarily cultivated in tropical regions of Africa and Asia and particularly India. It belongs to the Cucurbitaceae family, which comprises approximately 825 species across 118 genera (Kallo, 1993). Within this family, sponge gourd is classified under the genus *Luffa*, which includes seven annual climbing vine species native to the old-world tropics. The species has a diploid chromosome number of 2n = 2x = 26. Its primary cultivation and domestication are centered in India and other tropical regions, highlighting its importance as both a food and fiber source.

It is popular for spring, summer and rainy season crops. Luffa has seven species, including *Luffa acutangula* L. Roxb., *Luffa cylindrica* M. Roem., *Luffa echinata* Roxb., *Luffa graveolens*., *Luffa tuberose* Roxb., *Luffa acutangula* (ridge gourd) and *Luffa cylindrica* (sponge gourd), which are planted throughout India's tropical regions. Sponge gourd (*Luffa cylindrica* L.), commonly known as smooth loofa, bath sponge or dishcloth sponge, is called "muophuong" in Vietnam. The seed is either white or black in hue. Because of its rapid growth, short growing season and lack of sensitivity to light, it can produce two crops in a single year. Sponge gourd fruits are cylindrical, have ten orientations and are produced on sturdy vines with a fibrous vascular system. Immature green fruits are used in food preparation. Immature fruits are cooked and used to make chutneys and curries (Gopalan *et al*., 1999). Sponge gourd is widely cultivated for both its young, delicate fruits and the sponge used for cleaning. When consumed, the sponge gourd's fruits stimulate the appetite and are easy to digest. The nutritious vegetable sponge gourd

fruits per 100 g edible portion contains 93.2 g of moisture, 18 kcal of calories, 1.2 g of protein, 0.2 g of fat, 2.9 g of carbs, and 2.0 g of fiber. Calcium 36 mg, P 19 mg, Fe 1.1 mg, carotene 120 mg., thiamine 0.02 mg, riboflavin 0.06 mg, and niacin 0.4 mg. Similarly, the young leaves and tender fruits contain high levels of vitamin A, C and iron (Yawalker, 2004). In addition to improving blood circulation, the ripe fruit treats arthritic and rheumatic patients. Antioxidants including luffin A and luffin B, which are good for human health, have been found to be present in sponge gourds. Its purgative characteristics allow it to be used to treat lung issues, nephritis, dropsy, and chronic bronchitis. It is also used externally on the body to treat jaundice and fevers. Seed oil is used to treat several skin disorders, including leprosy (Pratap *et al*., 2012).

The young soft fruits of the non-bitter varieties are eaten fresh as cucumbers, cooked as vegetables, or used in soups. In cooking, the seeds provide a colourless, odourless, and tasteless oil. The plant also has medicinal characteristics and is used to treat coetaneous problems, granular conjunctivitis, adrenal type diabetes, hemorrhoids, and a variety of other conditions. Fibre is obtained from fully ripened and dried fruits and is used in cleaning automobiles, glassware, culinary utensils, commercial filters, pot holders, bathmats, and other applications (Portfield 1955). They can also be used for cleaning floors or cars without scratching. The cellulose content varies from 55 to 90%, the lignin content is within the range of 10 and 23%, and the hemicelluloses content is around 8 and 22% and ash 2.4% (Satyanarayana *et al*., 2007; Tanobe *et al*., 2005). Statistical analysis of the data was performed to estimate genotypic and phenotypic coefficients of variation (GCV and PCV) using the method proposed by Burton and De Vane (1953). Broad-sense heritability (h^2) for each trait was calculated as the ratio of genotypic variance to phenotypic variance, following the procedure of Lush (1949) and Hanson *et al*. (1956). Genetic advance was estimated using the method outlined by Johnson *et al*. (1955), and expressed as a percentage of the mean to categorize the extent of genetic improvement.

Material and Methods

The present investigation was conducted during the summer season *Kharif*, 2024 at the Vegetable Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experiment was laid out in a Randomized Block Design (RBD) with three replications to evaluate thirty distinct genotypes. Each plot measured 3×3 meters with a plant-to-plant spacing of 0.5×0.5 meters. Observations were recorded from five randomly selected plants for nineteen quantitative and qualitative traits. The recorded parameters included: days to first staminate flower anthesis, days to first pistillate flower anthesis, node number at first staminate flower appearance, node number at first pistillate flower appearance, number of primary branches per plant, internodal length (cm), petiole length (cm), days to first fruit harvest, number of nodes per vine, vine length (m), fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant, moisture content (%), dry matter content (%), total soluble solids (T.S.S. %), vitamin C content (mg/100g) and fruit yield per plant (kg).

Result and Discussion

The extent of variability among genotypes was assessed using parameters such as range, mean, standard error, phenotypic and genotypic coefficients of variation (PCV and GCV), heritability, and genetic advance as a percentage of the mean. The analysis of variance (Table 1) revealed significant differences among genotypes for all the traits studied, indicating ample genetic diversity within the germplasm. This variability provides a solid foundation for crop improvement programs and emphasizes the importance of heritability in determining the potential for genetic gains. The observed range of variation for all traits (Table 2) confirmed the presence of considerable variability among the genotypes. For all traits examined, the PCV values exceeded the corresponding GCV values, suggesting that environmental factors significantly influenced trait expression. These findings are consistent with those reported by Som *et al*. (2020). Among the traits, the lowest PCV was observed for moisture content (2.07%), while the highest PCV was recorded for number of primary branches per plant (19.25%), followed by node at which the first staminate flower appeared (18.58%) and vine length (15.53%). Moderate PCV estimates were found for number of nodes per vine (13.37%), node number at first pistillate flower appearance (12.40%), fruit yield per plant (12.22%), internodal length (11.25%), and days to first staminate flower anthesis (10.13%). In terms of genotypic coefficient of variation, moisture content had the lowest GCV (1.29%), while the highest GCV was observed for node at first staminate flower appearance (14.03%), followed by number of primary branches per plant (13.88%), number of nodes per vine (11.78%), and vine length (11.08%). Moderate GCV estimates were recorded for internodal length (9.14%), node number at first pistillate flower appearance (8.97%), days to first staminate flower anthesis (8.76%), total soluble solids

(T.S.S.) (8.75%), and days to first pistillate flower anthesis (7.88%).

The estimate of heritability (broad sense) and genetic advance for different characters in sponge gourd have been presented in Table 2. The heritability in the broad sense ranged from (-23) for moisture to (78) in the case of the number of nodes per vine. High estimates of heritability (>75%) were recorded for two characters, i.e., number of nodes per vine (78%) and T.S.S. (77%). However, moderate heritability (>50% and <75%) was recorded for nine characters i.e. days to first staminate flower anthesis (75%), ascorbic acid mg/100gm (73%), days to first pistillate flower anthesis (71%), dry matter (68%), internodal length (66%), fruit diameter (59%), node no at which first staminate flower appearance (57%), node no at which first pistillate flower appearance (52%), number of primary branches per plant (52), and lower heritability (<50%) was recorded for remaining characters i.e. [days to first fruit harvest (49), vine length (49), fruit length (46), fruit yield per plant (43), average fruit weight (38), number of fruit per plant (37), petiole length (30), moisture (-23). The Highest value of genetic advance in per cent of mean was shown by node no at which first staminate flower appearance (21.84%). While petiole length exhibited lowest value (4.20%) for this parameter. The characters observed very high estimates of genetic advance was number of nodes per vine (11.52) and lowest genetic advance was estimated for fruit yield per plant (0.08).

High heritability coupled with high genetic advance in per cent of mean were recorded for number of node per vine (78% and 21.38%), T.S.S (77% and 15.81%), days to first staminate flower anthesis (75% and 15.60%), ascorbic acid mg/100gm (73 and 12.50), days to first pistillate flower anthesis (71 % and 13.68%), inter-nodal length (66% and 15.28%) fruit diameter (59% and 10.60%), node no at which first pistillate flower appearance (52% and 13.36%) and number of primary branches per plant (52% and 20.60%) indicating that these traits were little influenced by environment.

Conclusion

The present study on sponge gourd revealed considerable exploitable variability across nineteen yield-related traits. Generally, the phenotypic coefficient of variation (PCV) exceeded the genotypic coefficient of variation (GCV) for all the traits examined, indicating a substantial influence of environmental factors on their expression. Among the traits, the lowest PCV was observed for moisture content (2.30), while the highest was recorded for the number of primary branches per plant (19.25). Similarly, the GCV ranged from a minimum of 1.29 for moisture content to a maximum of 14.03 for the node number at which the first staminate flower appeared.

Table 1 : Analysis of variance (mean sum of squares) for qualitative and quantitative parameters in Sponge gourd.

S. No.	Traits	Source of variation		
	D.F	Replication	Treatments	Error
		2	29	58
1.	Days to first staminate flower anthesis	0.4333	52.4460**	5.3069
2.	Days to first pistillate flower anthesis	12.1333	53.0655**	6.3747
3.	Node no at which first staminate flower appearance	3.2363	2.3314**	0.4673
4.	Node no at which first pistillate flower appearance	0.0114	1.5410**	0.3593
5.	Number of primary branches per plant	0.0443	0.9866**	0.2325
6.	Internodal length(cm)	2.4792	5.3851**	0.7904
7.	Petiole length (cm)	0.7941	1.2013**	0.5225
8.	Days to first fruit harvest	29.1	47.7092**	12.2954
9.	Number of node per vine	126.741	132.4145**	11.6158
10.	Vine length (m)	1.43	1.7624**	0.4528
11.	Fruit length (cm)	62.3059	7.7013**	2.1506
12	Fruit diameter(cm)	0.0711	0.2647**	0.0506
13.	Average fruit weight(g)	110.2631	120.7596**	41.9923
14.	Number of fruit per plant	0.9	0.5885**	0.2104
15.	Moisture (%)	9.2202	1.8360NS	4.2139
16.	Dry matter (%)	0.3823	1.8360**	0.2496
17.	T.S.S (%)	0.339	0.6022**	0.0548
18.	Vit-C (mg/100gm)	0.515	1.4352**	0.16
19.	Fruit yield per plant (kg)	0.028	0.0161**	0.0049

** Significant at 1% level* Significant at 5% level

Table 2 : Estimation of range, grand mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense, genetic advance (Ga), and genetic advance in percent of mean.

Sr. No.	Traits	Range		Grand Mean	ECV %	GCV %	PCV %	h^2 (Broad Sense)%	Genetic Advance	Gen. Adv. as % of Mean
		Lowest	Highest							
1.	Days to first staminate flower anthesis	32.33	52.33	45.27	5.09	8.76	10.13	75	7.06	15.60
2.	Days to first pistillate flower anthesis	37.00	57.00	50.03	5.05	7.88	9.36	71	6.85	13.68
3.	Node no at which first staminate flower appearance	3.80	7.70	5.62	12.17	14.03	18.58	57	1.23	21.84
4.	Node no at which first pistillate flower appearance	5.07	8.80	7.00	8.56	8.97	12.40	52	0.94	13.36
5.	Number of primary branches per plant	2.80	5.03	3.61	13.34	13.88	19.25	52	0.74	20.60
6.	Internodal length (cm)	9.17	14.70	13.55	6.56	9.14	11.25	66	2.07	15.28
7.	Petiole length (cm)	11.47	13.73	12.82	5.64	3.71	6.75	30	0.54	4.20
8.	Days to first fruit harvest	44.67	65.67	59.03	5.94	5.82	8.32	49	4.95	8.39
9.	Number of node per vine	42.93	65.60	53.86	6.33	11.78	13.37	78	11.52	21.38
10.	Vine length (m)	4.10	7.25	6.07	11.08	10.88	15.53	49	0.95	15.71
11.	Fruit length (cm)	23.07	30.00	27.07	5.42	5.03	7.39	46	1.91	7.04
12.	Fruit diameter (cm)	3.32	4.37	3.97	5.67	6.73	8.80	59	0.42	10.60
13.	Average fruit weight (g)	115	140.00	124.39	5.21	4.12	6.64	38	6.55	5.26
14.	Number of fruit per plant	5.43	7.03	6.11	7.51	5.81	9.50	37	0.45	7.33
15.	Moisture (%)	87.87	90.73	89.42	2.30	1.29	2.07	-23	-0.88	-0.99
16.	Dry matter (%)	9.27	12.13	10.58	4.72	6.87	8.34	68	1.23	11.67
17.	T.S.S (%)	4.02	5.52	4.88	4.80	8.75	9.98	77	0.77	15.81
18.	Vit-c (mg/100gm)	7.70	10.27	9.16	4.37	7.12	8.35	73	1.14	12.50
19.	Fruit yield per plant (kg)	0.65	0.96	0.76	9.20	8.04	12.22	43	0.08	10.89

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