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Nature of Gene action and Heritability for Yield and its contributing traits in Sponge gourd (*Luffa cylindrical* Roem.)

P. N. Sonavane, A.V. chandanshive and S. D. Gaikwad
Department of Horticulture, AICVIP (Vegetable Science)
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
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Abstract

The present investigations were carried out to estimate the genetic components of variation for yield and yield attributing traits in sponge gourd. Understanding the nature of gene action could be helpful in predicting the effectiveness of selection in a population. A clear knowledge of the type of gene action, its magnitude and composition of genetic variance is of fundamental importance to a plant breeder. The eight parental lines of sponge guard with diallel crosses (without reciprocals) were conducted for yield and its related traits .The estimates components of variance of SCA were higher than GCA for all characters except days to first female flower, days to first picking, fruit length, indicating predominance of non-additive gene action for most of the characters under study. The estimated variances due to sca (σ^2g) were magnitudually high and greater than the values of gca variance (σ^2g) for all the character studied except days required for first female flower, days required for first male flower in kharif season, length of fruit, girth of fruit and length of pedicel which reveals that for all the 13 (thirteen) characters studied the magnitude of dominance (non-additive) gene action was greater than that of addictive gene action. The heritability in narrow sense observed for all the characters was worked out by comparing the estimated values of genetic variance with total phenotypic variance. Preponderance of dominant gene in the expression suggested that hybrid breeding can be used efficiently improve yield and yield contributing traits in sponge gourd.

Key words : gene action, heritability, variance, earliness, yield, sponge gourd.

Sponge gourd [*Luffa cylindrica* (Roem) L.] is one of the most important cucurbitaceous vegetable crop grown throughout the tropical and sub tropical regions and cultivated both commercial scale and kitchen garden (Choudhary *et al*.,1996). Sponge gourd [*Luffa cylindrica* (Roem) L.] is one of the most important cucurbitaceous vegetable crop grown extensively throughout the tropical and sub-tropical regions of the world.

The crop has a long history of cultivation in the tropical countries of Asia and Africa (Oboh and Aluyor, 2009). *Luffa* is diploid species with 26 chromosomes (2n = 26) belongs to cucurbitaceous family and a cross-pollinated crop (Bal *et al.*, 2004) widely cultivated in *kharif* and summer seasons in India.

Sponge gourd belongs to the genus *Luffa* in which number of species have been identified by different workers. Chowdhary (2002) described eight species, while Seshadri (1986) described five species. However, more recently Chadha and Lal (1993) described six species *viz*., *L. acutangula*, *L. cylindrica*, *L. echinata*, *L. graveolens*, *L. hermaphrodite* and *L. umbellate* have been considered synonyms of species of momordica and cucurbita, respectively. Thus, only four species have been undisputedly established as species occurring mostly in tropical region of the old world. All these species are being grown in India. Of these, cultivated species, *L. cylindrica* and *L. acutangula* are economically important because of their unripe tender fruits used as vegetables.

Understanding the nature of gene action could be helpful in predicting the effectiveness of selection in a population. A clear knowledge

of the type of gene action, its magnitude and composition of genetic variance is of fundamental importance to a plant breeder. Yield is a complex character and is largely influenced by the genotype–environment interaction. An understanding of the mode of inheritance such complex quantitative character is essential for formulating effective selection procedure in order to improve the yield and its related characters.

The phenotypic expression of a quantitative trait is affected by four different type of gene action *viz*., additive, dominance, over dominance and epistasis. All the crop improvement programmes require a basic understanding of the types of gene action governing the inheritance of quantitative traits of economic importance. Cockerham (1961) reported the presence of non additive genetic variance is the primary justification for initiating a hybrid programme, while additive genetic variance is useful in selecting lines for hybridization. Therefore, the knowledge of various types of gene action controlling the traits is important in deciding a proper breeding technique (Miller *et al.*, 1990).

The estimates of gene effects and genetic variances will help in understanding the genetic potentiality of the population. The relative magnitude of the additive and dominance genetic variances will decide the breeding procedure to be followed for improving a given population.

For the genetic improvement of crops, one needs to elucidate the genetic nature and magnitude of quantatively inherited traits (heritiability) and estimates prepotency of parents in combinations (Negi *et al*., 2013). Therefore the present study was undertaken to study the nature of gene effects involved in the expression of characters. An assessment of genetic parameters for yield related traits will provide an ample amount of information to the breeder for the development of the efficient breeding strategies for improvement in sponge gourd.

Materials and Methods

Eight promising parental lines varities of diverse origin of sponge gourd selected, namely P1 (Phule prajkta), P2 (Pusa chikni), P3(Malkapur local), P4 (VR-1), P5(PSG-100), P6 (PSG-110), P7 (PSG-9), P8 (HASG-5) and 28 F1shybrids obtained by crossing them in half diallel (without reciprocals), in *Kharif*-2011.The performance of the parents and 28 F_1s hybrids with one standard check was assessed in a randomized block design (RBD) with two replications at AICVIP, Vegetable farm, Department of horticulture, M.P.K.V, Rahuri. Distance between rows was kept 150 cm and plants were spaced at 100 cm apart within row. Observations were recorded on ten(10) selected plants in each replication on days to first female flower, days to first male flower, days to first picking, yield per vine and ratio of male and female flower.

Gene action was calculated by griffing assumptions (1956b) based on Additive genetic variance σ^2 A = 2σ^2 gca, Non additive genetic variance σ^2 D = σ^2 sca. Heritability in narrow sense was calculated Falconer (1981).

$$h2\ (ns) = \frac{\sigma^2 A}{\sigma^2 A + \sigma^2 D + \sigma^2 e} \times 100$$

Where, σ^2 A = Additive genetic variance, σ^2 D = Dominance variance, σ^2 *e* = Environmental variance

Further heritability was calculated classified as high (30-60%), medium (10-30%) and low (5-10 %) following Robinson's (1965) method of heritability classification.

Results and Discussion

A. Components of genetic variance : Estimate of variance due to general combining ability (σ^2 gca) and specific combining ability (σ^2 sca) revealed that specific combining ability variances (σ^2 sca) were higher for all the characters except days required for first female flower, days required for first male flower, length of fruit, girth of fruit and length of pedicel in *kharif* as well as in summer season Table 1.

B. Gene action : The mean sum of squares due to general combining ability and specific combining ability were used to estimate the variances for gca and sca respectively based on which additive and non-additive components were worked out.

Table 1. Estimation of σ^2 gca and σ^2 sca variance and gene actions in sponge gourd

Characters	Season	σ^2 gca	σ^2 sca	σ^2 gca / σ^2 sca	Gene action
Days required for first female flower	K	1.58	1.12	1.41	Additive
	S	1.94	1.26	1.54	Additive
Days required for first male flower	K	1.99	0.70	2.84	Additive
	S	1.80	2.74	0.67	Non-Additive
Node no at which first female flower	K	0.71	0.93	0.75	Non-Additive
	S	0.44	0.62	0.71	Non-Additive
Node no at which first male flower	K	0.39	0.69	0.57	Non-Additive
	S	0.42	0.73	0.57	Non-Additive
Sex ratio	K	0.32	0.49	0.64	Non-Additive
	S	0.20	0.53	0.38	Non-Additive
Days required to first picking	K	2.05	2.46	0.83	Non-Additive
	S	2.81	2.94	0.95	Non-Additive
Days required to last picking	K	2.09	2.97	0.70	Non-Additive
	S	2.86	4.48	0.63	Non-Additive
Vine length (m)	K	0.20	0.20	0.96	Non-Additive
	S	0.27	1.21	0.22	Non-Additive
No of branches	K	0.98	3.11	0.31	Non-Additive
	S	1.00	3.01	0.33	Non-Additive
Length of fruit (cm)	K	0.67	-0.52	-1.27	Additive
	S	0.74	-0.27	-2.74	Additive
Girth of fruit (cm)	K	0.03	-0.13	-0.24	Additive
	S	0.01	-0.25	-0.05	Additive
Fruit diameter(cm)	K	-0.01	-0.16	0.09	Non-Additive
	S	-0.01	-0.11	0.10	Non-Additive
Length of pedicel (cm)	K	0.27	-0.02	-13.25	Additive
	S	0.60	-0.10	-5.62	Additive
Flesh thickness (mm)	K	0.01	0.10	0.14	Non-Additive
	S	0.04	0.14	0.35	Non-Additive
Fruit weight (g)	K	2.92	8.10	0.36	Non-Additive
	S	0.28	5.65	0.05	Non-Additive
No of fruits per vine	K	2.19	5.94	0.36	Non-Additive
	S	1.06	3.28	0.32	Non-Additive
Yield per vine (Kg)	K	0.02	0.07	0.30	Non-Additive
	S	0.01	0.03	0.38	Non-Additive
Yield per ha. (Qtl)	K	101.40	336.81	0.30	Non-Additive
	S	62.57	160.94	0.38	Non-Additive

The estimated variances due to sca (σ^2 s) were magnitudinally high and greater than the values of gca variance (σ^2 g) for all the character studied except days required for first female flower, days required for first male flower in *kharif* season, length of fruit, girth of fruit and length of pedicel which reveals that for all the 13 (thirteen) characters studied the magnitude of dominance (non-additive) gene action was greater than that of addictive gene action. (Tabel 1).

Similar finding reported by Sahani *et al*. (1987) presence of dominance gene action for fruit diameter and fruit length and additive component for fruit weight; whereas role of gene action was predominant for fruit number, appearance of female flower at lower node. Sonawane (2007) reported the magnitude of sca variance was higher than gca variance for all the characters the predominance of non additive gene action for yield contributing characters.

C. Heritability : The heritability in narrow sense observed for all the characters was worked out by comparing the estimated values of genetic variance with total phenotypic variance which is presented in (Table 2) the heritability in narrow sense was observed for days required for first female flower in *kharif* (32%) and in summer (33%) and for days required to first male flower in *kharif* (37%) and in summer (26%). In respect node number at which first female flower the heritability was observed (47%) in *kharif* season and (41%) in summer season similarly node number at which first male flower the heritability (38%) in *kharif* season and (44%) in summer season for the sex ratio it was (27%) and (23%) in *kharif* and summer season, for days required to first picking it was (28%) and(33%), for days required to last picking it was (32%) and (27%) in both *kharif* and summer season, for the vine length heritability was (32%) and (24%), for number of branches it was (30%) and (28%) for length of fruit it was (54%) and (46%) for Girth of fruit it was (17%) and (11%) for fruit diameter it was (91%) and (34%) in both *kharif* and summer season. In respect of length of pedicel it was (44%) and (73%) for flesh thickness (11%) and (23%) and for fruit weight it was (12%) and (19%) in both *kharif* and summer season. The heritability for number of

Tabel 2. Estimation of narrow sense heritability for different characters in sponge gourd

Characters	Season	Heritability h^2(ns)%
Days required for first female flower	K	32
	S	33
Days required for first male flower	K	37
	S	26
Node no at which first female flower	K	47
	S	41
Node no at which first male flower	K	38
	S	44
Sex ratio	K	27
	S	23
Days required to first picking	K	28
	S	33
Days required to last picking	K	32
	S	27
Vine length (m)	K	32
	S	24
No of branches	K	30
	S	28
Length of fruit (cm)	K	54
	S	46
Girth of fruit (cm)	K	17
	S	11
Fruit diameter(cm)	K	91
	S	34
Length of pedicel (cm)	K	44
	S	73
Flesh thickness (mm)	K	11
	S	23
Fruit weight (g)	K	12
	S	19
No of fruits per vine	K	27
	S	21
Yield per vine (Kg)	K	24
	S	24
Yield per ha. (Qtl)	K	24
	S	24

fruits per vine was (27%) and (21%) for yield per vine it was (24%) and (24%) in both *kharif* and summer season.

The similar findings reported by Abusaleha and Dutta (1990) reported high heritability estimates coupled with high genetic advance for fruits per vine, vine length, yield per vine, fruit length, nodal position of female flower and branches per vine in ridge gourd.

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