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STUDIES ON NATURE OF GENE ACTION AND HERITABILITY IN RIDGE GOURD (*LUFFA ACUTANGULA* L. ROXB.)

N.V. Mane[1]*, V.S. Jagtap[2], M.R. Kharade[1] and P.J. Karande[1]

[1]Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

[2]Department of Horticulture, College of Agriculture, Latur, Maharashtra, India.

*Corresponding author E-mail : nagnathmane77@gmail.com

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ABSTRACT

Selection of suitable breeding methodologies in bringing desirable improvement in crop plant require the complete knowledge about the nature of gene action involved in the inheritance of quantitative and quality traits. Gene action of growth and yield attributing traits in ridge gourd (*Luffa acutangula* (L.) Roxb.) were studied through half diallel analysis of 21 F_1 hybrids derived by crossing 7 parental lines (IC-257127, IC-275904, IC-343156, Kashi Shivani, Arka Sujat, Pusa Nutan and Pusa Nasdar). The gca variances were lower than sca variance for all the characters indicating predominance of non-additive gene action in both *kharif* and summer season, similarly dominance variance (σ^2 D) was greater than additive variance (σ^2 A) most of the characters excepts length of internodes, days to initiation of first male flower, days to initiation of first female flower, days to 50 percent flowering and days required to first harvest of fruit in *kharif* season only and length of fruit and diameter of fruit in both seasons. The highest heritability estimate recorded in the length of internodes in *kharif* season. Whereas, in summer season length of fruit. In medium heritability, for *kharif* season were recorded length of vine and diameter of fruit. However, in summer season were recorded number of male flowers. Hence, heterosis breeding is required to be followed for exploitation of these traits.

Key words : Gene action, Ridge gourd, Variance, Heritability.

Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.) belongs to the family Cucurbitaceae and genus *Luffa*. It is widely grown in tropical and subtropical parts of the country. Its chromosome number is 2n=2x=26. It is also called as angled gourd, angled loofah, Chinese okra, silky gourd and ribbed gourd (Muthaiah *et al*., 2017). The genus *Luffa* derives its name from the product 'loofah' which is used in bathing sponges, door mats, pillows and also for cleaning utensils. It is one of the important cucurbitaceous vegetables grown throughout India. It is considered to be the old-world species and is native of tropical Africa and South-East Asian region including India. For developing promising hybrids through hybridizations, the choice of parents is a matter of great concern to the plant breeder. A high yielding genotype may or may not diffuse its superiority to its progenies. Therefore, the success of a breeding programme is determined by useful gene combinations in the form of high combined inbred. The knowledge of nature of gene action governing the expression of various traits could be helpful in predicting the effectiveness of selection. The efficient partitioning of genetic variance into its components *viz*., additive, dominance and epistasis will help in formulating an effective and sound breeding programme. The success of a breeding programme is determined by useful gene combinations in the form of high combining inbred. The knowledge of the relative importance of additive and nonadditive gene action is essential to a plant breeder for the development of an efficient hybridization programme (Dudley and Moll, 1969). The present investigation was therefore, undertaken with a set of half diallel crosses to elicit information about the nature and magnitude of gene action for yield and its components in ridge gourd so as to formulate suitable breeding strategy.

Materials and Methods

Seven ridge gourd parents *viz*., IC-257127, IC-275904, IC-343156, Kashi Shivani, Arka Sujat, Pusa Nutan and Pusa Nasdar and 1 standard hybrid check (Vinayak) were chosen in this study. These seven parents were involved in 7 × 7 half-diallel combinations to develop 21 F_1 hybrids during summer, 2023. All the F_1 s along with their parents were evaluated in *Kharif*, 2023 and summer, 2024 in (RBD) randomized block design with two replications at Instructional Cum Research Farm, Department of Horticulture, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani- 431 402 (M. S.), India. The seed of each treatment were dibbled on July 01, 2023 for *kharif* season and February 01, 2024 for summer season. Each parent and their hybrids were entered as a separate treatment and represented by a separate bed. Each treatment consisted of a single row of ten plants accommodated in a bed of 10.0 x 1.5 m. The plants were spaced 1.5 m. between rows and 1.0 m between plant within row. The five plants were selected randomly for recording various observations such as growth parameters, fruit characters, harvesting and yield characters and fruit characters (qualitative).

Results and Discussion

The analysis of variance for general and specific combing ability of parents and their 21 F_1 hybrids is presented in Table 1. The variance for general combining

Table 1 : Analysis of variance for combining ability in 7 × 7 half diallel of Ridge gourd.

Source	d.f	Length of vine (cm)		Number of branches		Length of internodes (cm)		Number of nodes per vine		Days to initiation of first male flower	
		Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
GCA	**6**	5083.06**	2177.60**	0.92**	0.80**	9.98**	6.23**	29.14**	6.69**	50.87**	38.19**
SCA	**21**	3151.85**	1838.76**	1.32**	0.60**	1.31	2.43**	11.64**	12.25**	8.75*	11.53**
Error	**27**	641.53	364.14	0.06	0.04	0.80	0.85	2.19	0.92	3.53	3.83

Table 1 : Continued…

Source	d.f	Days to initiation of first female flower		Days to 50 per cent flowering		Number of female flowers		Number of male flowers		Days required to 1st harvest of fruit	
		Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
GCA	**6**	50.87**	39.81**	53.60**	39.28**	14.64*	12.65**	4699.84**	2779.12**	47.53**	24.45**
SCA	**21**	8.20*	11.01**	9.31*	14.66**	22.1**	22.39**	1650.66**	1423.19**	8.78	12.85*
Error	**27**	3.83	3.78	4.07	4.96	4.54	3.22	272.11	420.27	4.64	5.41

* and ** significance at 5% and 1% level, respectively.

Table 1 : Continued…

Source	d.f	Length of fruit (cm)		Diameter of fruit (cm)		Length of pedicel (cm)		Weight of fruit (g)		Number of fruits per vine	
		Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
GCA	**6**	45.65**	31.37**	0.05**	0.03**	0.64**	0.93**	214.85**	242.92**	22.70**	20.00**
SCA	**21**	7.18**	5.66**	0.03**	0.04**	0.72**	0.55**	70.59**	66.41**	10.64**	8.32**
Error	**27**	1.60	0.76	0.01	0.08	0.10	0.11	16.01	16.02	2.15	1.95

Table 1 : Continued…

Source	d.f	Yield per vine (kg)		Yield per plot (kg)		Yield per ha (q)	
		Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
GCA	**6**	0.47**	0.42**	41.78**	42.07**	1856.67**	1869.82**
SCA	**21**	0.20**	0.14**	18.06**	11.87**	802.75**	527.36**
Error	**27**	0.03	0.02	2.76	2.03	122.84	90.08

* and ** significance at 5% and 1% level, respectively.

Table 2 : Estimates of genetic variance component and heritability in various characters in 7 × 7 half diallel of Ridge gourd.

Genetic components	Length of vine (cm)		Number of branches		Length of internodes (cm)		Number of nodes per vine		Days to initiation of first male flower	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
σ^2 *gca*	493.50	201.50	0.10	0.09	1.02	0.60	2.99	0.64	5.26	3.82
σ^2 *sca*	2510.32	1474.63	1.26	0.56	0.51	1.58	9.44	11.33	5.22	7.70
σ^2 A	987.01	402.99	0.19	0.17	2.04	1.19	5.99	1.28	10.52	7.64
σ^2 D	2510.32	1474.63	1.26	0.56	0.51	1.58	9.44	11.33	5.22	7.70
h^2 (n.s) %	0.24	0.18	0.13	0.22	0.61	0.33	0.34	0.10	0.55	0.40
σ^2 *gca*/σ^2 *sca*	0.20	0.14	0.08	0.15	1.99	0.38	0.32	0.06	1.01	0.50

Table 2 continued...

Genetic components	Days to initiation of first female flower		Days to 50 per cent flowering		Number of female flowers		Number of male flowers		Days required to 1st harvest of fruit	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
σ^2 *gca*	5.23	4.00	5.50	3.81	1.12	1.05	491.97	262.09	4.77	2.12
σ^2 *sca*	4.38	7.23	5.25	9.71	17.64	19.17	1378.54	1002.91	4.13	7.45
σ^2 A	10.45	8.01	11.01	7.63	2.24	2.10	983.94	524.19	9.53	4.23
σ^2 D	4.38	7.23	5.25	9.71	17.64	19.17	1378.54	1002.91	4.13	7.45
h^2 (n.s) %	0.56	0.42	0.54	0.34	0.09	0.09	0.37	0.27	0.52	0.25
σ^2 *gca*/σ^2 *sca*	1.20	0.55	1.05	0.39	0.06	0.06	0.36	0.26	1.15	0.28

Table 2 continued...

Genetic components	Length of fruit (cm)		Diameter of fruit (cm)		Length of pedicel (cm)		Weight of fruit (g)		Number of fruits per vine	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer
σ^2 *gca*	4.89	3.40	0.04	0.03	0.06	0.09	22.09	25.21	2.28	2.01
σ^2 *sca*	5.58	4.90	0.02	0.03	0.63	0.45	54.57	50.39	8.49	6.37
σ^2 A	9.79	6.80	0.08	0.05	0.12	0.18	44.19	50.42	4.57	4.01
σ^2 D	5.58	4.90	0.02	0.03	0.63	0.45	54.57	50.39	8.49	6.37
h^2 (n.s) %	0.58	0.55	0.24	0.12	0.14	0.25	0.39	0.43	0.30	0.33
σ^2 *gca*/σ^2 *sca*	0.88	0.69	0.24	0.09	0.10	0.21	0.41	0.50	0.27	0.32

Table 2 continued...

Genetic components	Yield per vine (kg)		Yield per plot (kg)		Yield per ha (q)	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
σ^2 *gca*	0.05	0.04	4.34	4.45	192.65	197.75
σ^2 *sca*	0.17	0.12	15.30	9.84	679.91	437.28
σ^2 A	0.10	0.09	8.67	8.90	385.30	395.50
σ^2 D	0.17	0.12	15.30	9.84	679.91	437.28
h^2 (n.s) %	0.33	0.39	0.32	0.43	0.32	0.43
σ^2 *gca*/σ^2 *sca*	0.29	0.37	0.28	0.45	0.28	0.45

ability was highly significant for all the characters in both the *kharif* and summer seasons. The variance for specific combining ability was highly significant for most of the characters in both the *kharif* and summer seasons, except the length of internodes and days required to first harvest of fruit in *kharif* season only. Similar findings were reported by Chandan *et al*. (2019), Singh *et al*. (2019), Srikanth *et al*. (2020) and Kumar *et al*. (2021).

The estimates of gca and sca variances (σ^2 *gca* and σ^2 *sca*), additive and dominance variances (σ^2 A and σ^2 D), heritability [h^2 (ns)] and gene action are presented in Table 2. The *sca* variances were greater than *gca* variances for most of the characters in *kharif* and summer season, except length of internodes, days to initiation of first male flower, days to initiation of first female flower, days to 50 percent flowering, days required to first harvest of fruit and diameter of fruit in *kharif* season only. The dominance variance (σ^2 D) was greater than additive variance (σ^2 A) most of the characters excepts length of internodes, days to initiation of first male flower, days to 50 percent flowering and days required to first harvest of fruit in *kharif* season only and weight of fruit in summer season only. However, days to initiation of first female flower, length of fruit and diameter of fruit in both *kharif* and summer seasons recorded dominance variance (σ^2 D) was greater than additive variance (σ^2 A).

The predominance of non-additive gene action (dominance) observed for all the characters in both *kharif* and summer seasons excepts length of internodes, days to initiation of first male flower, days to initiation of first female flower, days to 50 percent flowering and days required to first harvest of fruit in *kharif* season only. Previous studies have shown that dominance gene action plays a major role in the inheritance of yield and yield-contributing traits in ridge gourd. The predominance of non-additive gene action suggests that there is significant potential for exploiting heterosis (hybrid vigor) in the breeding of ridge gourd. This indicates that hybrid varieties, developed by crossing genetically diverse parent lines, may exhibit superior traits, such as higher yield or better adaptability, compared to the parental lines. Similar results were reported by Hadiya *et al*. (2020) and Srikanth *et al*. (2021).

To the estimates of heritability [h^2 (ns)] of both *kharif* and summer season are presented in Table 2. The highest heritability estimate recorded in the length of internodes (61%) followed by length of fruit (58%), days to initiation of first female flower (56%), days to initiation of first male flower (55%), days to 50 per cent flowering (54%), days required to 1st harvest of fruit (52%), weight of fruit (39%), number of male flower (37%), number of nodes per vine (34%), yield per vine (33%), yield per plot and yield per ha. (32%) and number of fruits per vine (30%) in *kharif* season. Whereas, in summer season length of fruit (55%) followed by weight of fruit, yield per plot and yield per ha. (43%), days to initiation of first female flower (42%), days to initiation of first male flower (40%), yield per vine (39%), days to 50 per cent flowering (34%), length of internodes and number of fruits per vine (33%).

In medium heritability for *kharif* season the characters recorded length of vine and diameter of fruit (24%) followed by length of pedicel (14%) and number of branches (13%). However, in summer season characters *viz*., number of male flowers (27%), days required to 1st harvest of fruit and length of pedicel (25%), number of branches (22%), length of vine (18%), diameter of fruit (12%) and number of nodes per vine (10%) was recorded. In the low heritability for both *kharif* and summer season the character number of female flower (09%) was recorded. In ridge gourd breeding, understanding the heritability of different traits is crucial. Traits with high heritability indicate the influenced by environmental effect, so these traits can be improved through direct selection, while traits with moderate to low heritability, driven by non-additive gene action, are better suited for heterosis breeding. This nuanced approach enables breeders to focus on the most effective strategies for improving both yield and overall plant performance. Similar results were reported by Radha Rani K. (2014)

Conclusion

The presence of non-additive gene action and additive gene action revealed that heterosis breeding and simple selection is required to be followed for further improvement of ridge gourd respectively. Sufficient genetic variability was generated for yield and related traits after crossing seven diverse genotypes of ridge gourd in a diallel mating design (excluding reciprocals).

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