Plant Archives Vol. 25, Supplement 1, 2025 pp. 1343-1347 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.182

STUDY OF HETEROSIS FOR YIELD ATTRIBUTES IN RIDGE *GOURD* (*LUFFA ACUTANGULA* L.ROXB.) IN SEMI ARID REGION IN RAJASTHAN INDIA

Deepika Sharma[1*] and A.K. Soni[2]
[1]School of Agricultural Sciences, Jaipur National University, Jagatpura, Jaipur, India
[2]Department of Horticulture, Sri Karan Narendra College of Agriculture, S.K.N.A.U., Jobner, Jaipur, India
*Corresponding author E mail: deepikajaiman88@gmail.com
(Date of Receiving : 14-08-2024; Date of Acceptance : 28-10-2024)

ABSTRACT

Heterosis studies carried out through half-diallel method (excluding reciprocals) using eight parents in ridge gourd for yield and quality components. F1's and parents were evaluated under two seasons *i.e.* rainy and summer. This analysis revealed that crosses Pusa Nutan x Arka Sujat, Pusa Nasdar x Pusa Nutan, AHRG-29 X Pusa Nutan, Pusa Nasdar X Konkan Harita and Pusa Nutan X Konkan Harita showed desirable heterosis, heterobeltiosis and economic heterosis for total fruit yield per vine, fruit length, and fruit weight. For days to first fruit harvest, the crosses Arka Sumeet x Swarna Uphar, Pusa Nutan X Arka Sumeet and Swarna Manjari x Pusa Nutan showed desirable heterosis, heterobeltiosis and economic heterosis. Some other crosses *viz*; Pusa Nutan X Konkan Harita for number of fruit per vine, Pusa Nasdar X Arka Sujat for fruit length and Arka Sujat X Arka Sumeet for fruit girth showed significant economic heterosis. Hence, these crosses were found to be promising for their use for yield improvement and other beneficial characters.
***Keywords*:** Heterosis, Heterobeltiosis, Economic heterosis, Ridge gourd.

Introduction

Ridge gourd [*Luffa acutangula* (Roxb.) L.] belongs to family cucurbitaceae and tropical vegetable grown throughout South East Asian countries. It is a popular vegetable both spring summer and rainy season. It is a monoecious and cross-pollinated crop, thus exhibits considerable heterozygosity, but does not have inbreeding depression. This results in the presence of natural variability in the population. This provides sufficient scope for utilization of heterosis on commercial scale which increases the production potential and productivity of ridge gourd. Despite the performance of wide variability, a very little work has been done in improving the existing cultivars of ridge gourd (Varalakshmi and Reddy, 1994; Karuppaiah *et al*., 2002 and Samadia, 2011). Being a cross pollinated crop ridge gourd gives better response to heterosis breeding. Hybrids have been commercially cultivated due to the advantage of early maturity, better quality, uniformity and stability of performance over open pollinated varieties. The farmers of the state mostly grow local cultivars which are lacking the desired characters but there is a continuous demand of consumers for the varieties having high quality. So material of ridge gourd should be given prime importance. Presence of ample variability in crop should be explored with help of heterosis and engender/increased such lines with above good characteristic. Earliness is also having a great importance to get higher net return to the cultivators. The present investigation was therefore, undertaken to explore the possibility of developing hybrids possessing resistance/tolerance to biotic and abiotic stresses with higher yield.

Materials and Methods

The experiment was laid out at Horticulture farm, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) during rainy and summer *i.e*. two seasons. Geographically, Jobner is situated at 26^0 5' North latitude, 75^0 20' East longitude and at an altitude of

427 meters above mean sea level. This region falls under Agro-Climatic Zone-III A (Semi-Arid Eastern Plain Zone) of Rajasthan. Eight diverse ridge gourd parent *viz.*, Swarna Manjari (P_1), Pusa Nasdar (P_2), AHRG-29 (P_3), Pusa Nutan (P_4), Arka Sujat (P_5), Arka Sumeet (P_6), Swarna Uphar (P_7) and Konkan Harita (P_8) were selected and crossed with all possible combinations (28 F_1) excluding reciprocals. The F_1's and parents evaluated under complete randomized block design, which was replicated three times during rainy and summer. Observation were recorded for days to first fruit harvested, number of fruit per vine, fruit length (cm), fruit girth (cm), fruit weight (g) and fruit yield per vine (g). The heterosis was worked out over mid parent, over better parent and over standard check (Kaveri). Heterosis expressed as per cent increase or decrease in the mean value of F_1 hybrid over mid parent, and heterobeltiosis as increase or decrease in the mean value of F_1 hybrid over better parent, were calculated according to method suggested by Fonseca and Patterson (1968).

(i) Per cent heterosis of a cross was calculated by the following formula,

$$\text{Heterosis}\,(\%) = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$$

Where,

$\overline{F_1}$ is the mean over replications of hybrid between i^{th} and j^{th} parents.

$\overline{MP}$, is the mean over replications of the two parents, i^{th} and j^{th} parents of a cross.

(ii) Percentage heterobeltiosis of a cross was calculated by the following formula,

$$\text{Heterobeltiosiss}\,(\%) = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$$

Where,

$\overline{F_1}$ is the mean over replications of hybrid between i^{th} and j^{th} parents.

$\overline{BP}$, is the mean over replications of the better parent among i^{th} and j^{th} parents of a cross.

(iii) Percentage standard heterosis of a cross was calculated by the following formula,

$$\text{Standard heterosis}\,(\%) = \frac{\overline{F_1} - \overline{SC}}{\overline{SC}} \times 100$$

Where,

$\overline{F_1}$ is the mean over replications of hybrid between i^{th} and j^{th} parents.

$\overline{SC}$, is the mean over replications of the standard check.

Results and Discussion

The pooled analysis of variance revealed mean square due to season were significant for vine length, number of primary branches per vine, days to opening of first female flower, days to opening of first male flower, male female ratio, days to opening of first fruit harvest, number of fruits per vine, fruit length, fruit girth, fruit weight, total fruit yield per vine, fruit flesh thickness and moisture content in percent in ridge gourd. Mean square due to genotype was significant in most of the above-mentioned characters except fruit girth, fruit flesh thickness and moisture content in percent. The result obtain in the present study are corroborative with the findings of Poshiya *et al.* (2015) and Pandey *et al.* (2010). The mean sum of square due to parents significant for vine length, number of primary branches per vine, days to opening of first female flower, days to opening of first male flower, male female ratio, days to opening of first fruit harvest, number of fruits per vine, fruit length, fruit weight and total fruit yield per vine. The significance of this character is due to the genetic makeup of their parent. This result confirms the research of Singh and Tiwari (2018). The mean sum of square due to F_1's was significant in all most all the characters except fruit girth, fruit flesh thickness and moisture content in percent. This is due to the number of hybrids showing significant desirable heterosis over better parent and standard check (Singh and Tiwari (2018) and Pandey *et al.* (2010).

The mean sum of square due to parent vs. F_1's were significant for vine length, number of primary branches per vine, days to opening of first female flower, days to opening of first male flower, male female ratio, days to opening of first fruit harvest, number of fruits per vine, fruit length, fruit weight and total fruit yield per vine of ridge gourd in both the season and pooled data analysis. This is due to the all the character indicating the presence of considerable amount of genetic variability (Prabhakar 2008). The mean sum of square due to genotype X season interaction was significant for the number of primary branches per vine and total fruit yield per vine indicating differential response of genotype changes in the season for these characters. These results are confirmatory with the research of Bairwa *et al.* (2015) and Acharya *et al*. (2019).

Parent X season and replication were non-significant for all the traits studied in pooled data. These results are accordance with the findings of Bairwa *et al.* (2015) and Acharya *et al.* (2019). The mean sum of square due to hybrid X season interaction was significant for number of primary branches and total fruit yield per vine indicating differential response of hybrids with the change of season *i.e.* temperature, humidity, sunshine and other factors influencing the production of crop [Bairwa *et al.* (2015) and Acharya *et al*. (2019)].

The crosses which exhibited maximum heterotic effect over standard check for early fruiting were Swaran Manjri X Pusa Nutan (-21.26**), Swarna Manjri X Konkan Harita (-20.72**) and Pusa Nasdar x Pusa Nutan (-20.72**) while for no. of fruit per vine best cross was Pusa Nutan X Konkan Harita (37.07*) (Table 2). The heterosis for earliness for these crosses has also been reported by Janaranjani *et al.* (2015), Adarsh *et al.* (2017) and Jayanth *et al.* (2019). Similar results for No. of fruit per vine was obtained by Pandey *et al.* (2005), Narasannavar *et al.* (2014), Naliyadhara *et al.* (2007), Patel and Desai (2008), Rajneesh and Singh (2018) and Laxuman *et al.*(2012).

In case of fruit girth and fruit length Arka Sujat X Arka Sumeet (28.64*) and Pusa Nutan X Arka Sumeet (28.01*) for fruit girth, Pusa Nasdar X Arka Sujat (32.23**) and Arka Sujat X Konkan Harita (31.60*) for fruit length (Table 3) showed the maximum heterotic effect in desirable direction over standard check. The similar results were earlier obtained by Poshiya *et al.* (2015).

Heterosis studies for various characters revealed that among the twenty eight crosses, maximum heterotic effects in desirable direction for yield attributes over standard check were exhibited by the cross combinations *viz;* Pusa Nasdar x Pusa Nutan (36.11**) and Pusa Nasdar X Konkan Harita (32.78**) for fruit yield per vine, Pusa Nasdar x Pusa Nutan (31.93**), Arka Sujat X Arka Sumeet (31.22**) and Swarna Manjari X Konkan Harita (30.58*) for fruit weight (Table 4). Manifestation of hybrid vigor for total fruit yield per vine in various cucurbits have also been observed by Narasannavar *et al.* (2014) and Malav and Verma (2018) which confirms the findings of the present investigation.

This study concluded that out of twenty-eight crosses Pusa Nasdar X Pusa Nutan, Pusa Nasdar X Konkan Harita exhibited positive significant for most of the characters *i.e.* total fruit yield per vine, fruit length, and fruit weight while negative significant economic heterosis for days to first fruit harvest. Some other crosses *viz*; Pusa Nutan X Konkan Harita for number of fruits per vine, Pusa Nasdar X Arka Sujat for fruit length and Arka Sujat X Arka Sumeet for fruit girth showed significant economic heterosis. These crosses were found to be promising for their use for yield improvement and other beneficial characters.

Sufficient degree of heterosis, heterobeltiosis and economic heterosis was observed for all the characters. Among top crosses, the crosses Pusa Nutan x Arka Sujat, Pusa Nasdar x Pusa Nutan, Pusa Nasdar X Konkan Harita and Pusa Nutan X Konkan Harita showed desirable heterosis, heterobeltiosis and economic heterosis for total fruit yield per vine. For days to first fruit harvest, the crosses Arka Sumeet x Swarna Uphar, Pusa Nutan X Arka Sumeet, Swarna Manjari x Pusa Nutan, Pusa Nasdar X Konkan Harita, Pusa Nasdar X Pusa Nutan and Swarna Manjari X Konkan Harita showed desirable heterosis, heterobeltiosis and economic heterosis.

Table 1 : Analysis of variance for yield and its contributing characters of ridge gourd during both the seasons and in pooled analysis

Source of variation	d.f.	VL	NPB	DFFF	DFMF	MF	DFFH	NFV	FL	FG	FW	TFYV	FFT	MCP
Season	1	89263.340**	22.874**	1031.407**	1018.338**	229.848**	1005.352**	112.681**	179.234**	31.122**	68198.41**	15834950.0**	20.387**	2197.759**
Rep./ Season	4	800.366	0.218	1.255	1.074	1.86	1.63	0.688	1.137	0.886	213.154	10793.83	0.014	0.706
Genotypes	35	10334.550**	2.739**	145.027**	128.690**	23.120**	147.496**	11.141**	19.485**	0.748	2308.315**	352846.9**	0.091	1.080
Parent (P)	7	4271.143**	1.120**	191.235**	161.321**	24.595**	233.464**	7.993**	18.167**	0.605	849.219**	3572206.9**	0.087	0.513
F_1's (H)	27	12050.250**	3.208**	136.507**	121.156**	20.645**	127.535**	12.249**	17.369**	0.813	2465.641**	324069.5**	0.094	1.236
P v/s H	1	6454.604*	1.419*	51.596**	103.704**	79.596**	84.668**	3.26	85.864**	0.0006	8274.175**	1099317.0**	0.045	0.843

Gen. X Sea.	35	92.519	0.525**	1.693	1.033	0.228	1.466	0.857	0.354	0.447	84.124	22915.710**	0.060	0.634
Parent x Sea.	7	210.75	0.39	0.878	0.655	0.125	1.238	0.405	0.286	0.627	62.739	11434.05	0.020	0.279
Hybrid X Sea.	27	54.193	0.579**	1.967	1.066	0.259	1.56	1.006	0.371	0.364	81.801	24369.4**	0.072	0.717
P vs. H x Sea.	1	299.704	0	0	2.799	0.102	0.529	0.005	0.364	1.450	296.533	64037.44*	0.018	0.868
Error	140	960.447	0.212	6.093	3.041	1.211	8.13	0.866	2.314	0.465	139.32	10313.81	0.056	0.609
SEm (g) ±		12.65	0.19	1.01	0.71	0.45	1.16	0.38	0.62	0.27	4.82	41.46	0.09	0.31
CD (5%)		35.37	0.53	2.82	1.99	1.26	3.25	1.06	1.74	0.76	13.47	115.92	0.26	0.87
SEm (gxs) ±		17.89	0.27	1.43	1.01	0.64	1.65	0.54	0.88	0.38	6.81	58.63	0.13	0.44
CD (5%)		50.03	0.74	3.99	2.81	1.78	4.60	1.50	2.46	1.07	19.05	163.94	0.37	1.24
CV		8.54	8.70	5.04	4.19	7.86	5.09	9.09	6.83	7.73	8.71	7.30	6.67	0.84

* Significant at p=0.05 and ** significant at p=0.01

VL=Vine length, NPB=Number of primary branches, DFFF=Days to opening of first female flower,
DFMF=Days to opening of first male flower, MF=Male female ratio, DFFH=Days to first fruit harvest,
NFV= Number of fruit per vine, FL= Fruit length, FG=Fruit girth,
FW=Fruit weight, TFYV=Total fruit yield per vine, FFT=Fruit flesh thickness,
MCP=Moisture content in percent

Table 2 : Average heterosis, Heterobeltiosis and Economic heterosis of the promising crosses for days to first fruit harvested and number of fruit per vine

S. No.	Hybrids	days to first fruit harvested			number of fruit per vine		
		Average heterosis	Heterobeltiosis	Economic heterosis	Average heterosis	Heterobeltiosis	Economic heterosis
1	Swarna Manjari X Pusa Nasdar	18.68**	18.09**	-5.78	7.21	6.65	31.70*
2	Swarna Manjari X Pusa Nutan	-2.44	-4.46	-21.26**	12.24	-0.66	30.23
3	Swarna Manjari X Konkan Harita	-9.99**	-18.38**	-20.72**	-9.41	-20.47**	4.25
4	Pusa Nasdar X AHRG-29	1.45	-0.63	-17.32**	5.05	-1.17	30.92*
5	Pusa Nasdar X Pusa Nutan	-2.27	-3.82	-20.72**	8.99	-3.98	27.20
6	Pusa Nasdar X Konkan Harita	-10.09**	-18.11**	-20.47**	8.56	-5.12	25.69
7	Pusa Nutan X Konkan Harita	-2.92	-10.27**	-12.87*	37.04**	35.77**	37.07*
8	Arka Sumeet X Swarna Uphar	-18.90**	-20.77**	-18.9**	11.90	5.76	31.84*
9	Swarna Uphar X Konkan Harita	-18.33*	-18.55**	-20.47**	-7.37	-16.87*	3.62

*, ** indicate significance at P=0.05 and P=0.01 levels, respectively

Table 3 : Average heterosis, Heterobeltiosis and Economic heterosis of the promising crosses for fruit length and fruit girth (cm)

S. No.	Hybrids	fruit length			fruit girth		
		Average heterosis	Heterobeltiosis	Economic heterosis	Average heterosis	Heterobeltiosis	Economic heterosis
1	Swarna Manjari X Konkan Harita	31.76**	29.65**	30.67**	10.84	6.04	17.52
2	Pusa Nasdar X Arka Sujat	14.65**	14.13*	32.23**	-4.41	-19.93**	4.22
3	Pusa Nasdar X Konkan Harita	22.16**	12.51*	30.35**	-1.26	-12.22*	14.19
4	Pusa Nutan X Arka Sumeet	5.65	0.42	18.53	26.61**	20.32**	28.01*
5	Pusa Nutan X Konkan Harita	15.07**	5.08	24.03*	5.79	3.25	9.85
6	Arka Sujat X Arka Sumeet	11.66*	7.54	23.45*	40.04**	34.25**	28.64*
7	Arka Sujat X Konkan Harita	23.95**	14.64*	31.60**	2.23	-4.53	-3.32

*, ** indicate significance at P=0.05 and P=0.01 levels, respectively

Table 4 : Average heterosis, Heterobeltiosis and Economic heterosis of the promising crosses for fruit weight (g) and total fruit yield per vine (g)

S. No.	Hybrids	fruit weight (g)			total fruit yield per vine (g)		
		Average heterosis	Heterobeltiosis	Economic heterosis	Average heterosis	Heterobeltiosis	Economic heterosis
1.	Swarna Manjari X Konkan Harita	32.22**	27.91**	30.58*	16.66**	2.23	15.23
2	Pusa Nasdar X AHRG-29	13.53*	2.91	13.88	19.62**	2.76	26.93*
3	Pusa Nasdar X Pusa Nutan	34.22**	19.22**	31.93*	37.06**	10.19*	36.11**
4	Pusa Nasdar X Swarna Uphar	14.55*	6.76	18.15	14.63**	3.88	28.32**
5	Pusa Nasdar X Konkan Harita	21.00*	12.67	24.69	27.45**	7.49	32.78**
6	Pusa Nutan X Konkan Harita	21.79**	15.72*	10.43	35.59**	27.80**	28.03**
7	Arka Sujat X Arka Sumeet	49.74**	40.62**	31.22*	14.06*	12.39	-7.82
8	Swarna Uphar X Konkan Harita	35.91**	35.78**	29.82*	21.47**	12.08*	12.48

*, ** indicate significance at P=0.05 and P=0.01 levels, respectively

References

Acharya, S.K., Kaushik, R.A., Ameta, K.D., Dubey, R.B. and Upadhyay, B. (2019). Heterosis and combining ability in bitter gourd (*Momordica charantia* L.). *International Journal of Bioassays*, **8**(1):5692-5711.

Adarsh, A., Kumar, R., Kumar, A., Neetunand and Singh, H.K. (2017). Estimation of gene action and heterosis in bottle gourd (*Lagenaria siceraria* Mol. Standl.). *Environment & Ecology;* **35** (2A): 936-944.

Bairwa, S.K., Soni, A.K., Singh, B. and Yadav, P.K. 2015. Combining ability studies in ridge gourd [*Luffa acutangula* (Roxb.) L.]. *The Bioscan,* **10**(4): 1969-1974 (Supplement on genetics and plant breeding).

Fonseca, S. and Petterson, F.L. (1968). Hybrid vigour in seven diallel crosses in common winter wheat (*Triticum aestivum* L.). *Crop Science,* **8**: 85-88.

Janaranjani, K.G., Kanthaswamy, V. and Kumar, S.R. (2015). Heterosis, combining ability and character association in bottle gourd for yield attributes. *International Journal of Vegetable Science*; DOI: 10.1080/19315260.2015.1084967.

Jayanth, S., Lal, M., Duhan, D.S. and Vidya, R. (2019). Estimation of heterosis and combining ability for earliness and vegetative traits in bottle gourd [*Lagenaria siceraria* (Molina.) Standl.]. *International Journal of Chemical Studies*; **7**(1): 20-25.

Karuppaiah, P., Kavitha, R. and Senthil Kumar, P. (2002). Studies on variability, heritability and genetic advance in ridge gourd. *Indian Journal of Horticulture,* **59**(3): 307-312.

Laxuman, Patil, S.A., Salimath, P.M., Dharmatti, P.R., Byadgi, A.S. and Yenagi, N. (2012). Heterosis and combining ability analysis for productivity traits in bitter gourd (*Momordica charantia* L.). *Karnataka Journal of Agriculture Science,* **25**(1): 9-13.

Malav, N. and Verma, S. (2018). Heterosis in cucumber (*Cucumis sativus*. L.). *International Journal of Chemical Studies*, **6**(3): 1538-1540.

Naliyadhara, M.V., Dhaduk, L.K., Barad, A.V., Purohit, V.L. and Vachhani, J.L. (2007). Heterosis for fruit yield and its components in sponge gourd (*Luffa cylindrica* (Roxb.) L.). *National Journal of Plant Improvement,* **9**(2): 132-135.

Narsannavar, A.R., Gasti, V.D., Shantappa,T., Mulge, R., Allolli, T.B. and Thammaiah, N. (2014). Heterosis studies in ridge gourd (*Luffa acutangula* (Roxb.) L.). *Karnataka Journal of Agriculture Science,* **27**(1): 47-51.

Pandey, S., Jha, A., Kumar, S. and Rai, M. (2010). Genetics and heterosis of squality and yield of pumpkin. *Indian Journal of Horticulture;* **67**(3): 333-338.

Pandey, S., Rai, M., Singh, B. and Pandey A.K. (2005). Heterosis and combining ability in ash gourd [*Benincasa hispida* (Thunb.) Cogn.]. *Vegetable Science*; **32**(1): 33-36.

Patel, S.R. and Desai, D.T. (2008). Heterosis and combining ability studies in sponge gourd [*Luffa cylindrica* (Roem) L.] *Vegetable Sci*ence, **35**(2): 199-200.

Poshiya, S.C., Dhaduk, L.K., Raval lata and Mehta, D.R. (2015). Heterocis study in ridge gourd (*Luffa acutangula* (Roxb.) L.). *Electronic Journal of Plant Breeding*, **6**(2): 581-585.

Prabhakar, B.N. (2008). Combining ability and heterosis for fruit yield and yield components in ridge gourd (*Luffa acutangula* (Roxb.) L.). *Journal of Resource, Acharya N G Ranga Agricultural University,* **36**(4): 24-32.

Rajneesh and Singh, V.B. (2018). Exploitation of heterosis for growth and yield attributes in sponge gourd [*Luffa cylindrica* (Roem) L.]. *Journal of Pharmacognosy and Phytochemistry*; **7**(4): 210-215.

Samadia, D.K. (2011). Genetic variability studies in Ridge gourd under arid environment. *Indian Journal of Horticulture,* **68**(2): 275-277.

Singh, H.K. and Tiwari, A. (2018). Exploitation of heterosis for yield and contributing traits in cucumber (*Cucumis sativus* L.). *Journal of Pharmacognosy and Phytochemistry*; **7**(3): 395-397.

Varalakshami, B. and Reddy, Y.N. (1994). Correlation and path analysis studies in ridge gourd. *Indian Journal of Horticulture,* **55**(3): 248-256.