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Studies on heterosis for growth and yield attributing characters in Okra (*Abelmoschus esculentus* (L.) Moench)

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Abstract
The present investigation was conducted on heterosis for growth and fruit yield attributing characters in okra. Fifteen F_1 hybrids were generated by half diallel (excluding reciprocals) mating design. These F_1 hybrids along with six parents were evaluated in randomized block design with three replications during late *Rabi* season of 2018 at three locations HRS, Lam; KVK, V.R. Gudem and KVK, Vonipenta, Andhra Pradesh. Observations were recorded for five randomly selected and tagged plants from each treatment for growth and fruit yield attributing characters *viz.*, plant height (cm), days to first flowering, internodal length (cm), first flowering node, days to 50% flowering, days to first picking, days to last picking (days), number of fruits per plant, fruit length (cm), fruit girth (cm), fruit weight (g), number of seeds per fruit, test weight (g/100), fruit yield per plant (g) and fruit yield per hectare (t). The values of F_1 hybrids averaged over three replications were used for estimating heterosis and pooled data was obtained. The top five heterotic cross combinations *viz.*,440-10-1 x HRB-9-2, VRO-6 x HRB-9-2, TCR-1674 x HRB-9-2, VRO-6 x JPM-20-16-39 and VRO-3 x HRB-9-2 were identified as stable with desirable heterosis for fruit yield and other important traits**.**

Keywords: Okra, heterosis, half diallel, growth, yield

Introduction
Okra [*Abelomoschus esculentus* (L.) Moench] commonly known as lady's finger belongs to the family Malvaceae. It is native to Tropical Asia. Okra is an allopolyploid with the most observed chromosome number of 2n=8x=130. It is an often cross pollinated crop. Okra fruit contains 90% water, 3% dietary fibre, 7% carbohydrates, 2% protein, good quantities of minerals, vitamin C and A and moderate contents of thiamin, folate and magnesium (Chopra *et al*., 1956) [3].

During recent years, the commercial exploitation of hybrid vigour and selection of parents on the basis of combining ability have expanded a new alley in crop improvement. The term heterosis refers to a phenomenon in which F_1 shows increase or decrease in vigour over the parents. Shull (1908) [10] referred to this phenomenon as the stimulus of heterozygosity and hybrid vigour in okra has been first reported by Vijayaraghavan and Warier (1946) [15]. The ease in emasculation, very high percentage of fruit setting and higher seed yield per cross indicate the possibilities of exploitation of its hybrid vigour. Exploitation of heterosis in okra has been recognized as a practical tool in providing the breeders a means of improving yield and other important traits. For developing promising varieties through hybridization, the choice of parents is a matter of great concern to the plant breeder. A high yielding genotype may or may not transmit its superiority to its progenies. Therefore, the success of a breeding programme is determined by useful gene combinations in the form of high combining inbred.

Materials and Methods
The present investigation was carried out at three locations HRS, Lam; KVK, V.R. Gudem and KVK, Vonipenta, Andhra Pradesh, India during *rabi* and *summer*, 2018-19. The experimental material consisted of six parental lines *viz.*, VRO-3, VRO-6, 440-10-1, TCR-1674, JPM-20-16-39 and HRB-9-2 of these were crossed in diallel fashion excluding reciprocals during *Rabi*, 2018. The resultant 15 F_1 hybrids along with six parents and one check were evaluated in randomized block design with three replications with spacing of 60 x 30cm during *Summer*, 2019. Observations were recorded on five randomly selected plants from each plot for growth

and fruit yield parameters *viz.*, plant height (cm), days to first flowering, internodal length (cm), first flowering node, days to 50% flowering, days to first picking, days to last picking (days), number of fruits per plant, fruit length (cm), fruit girth (cm), fruit weight (g), number of seeds per fruit, test weight (g/100), fruit yield per plant (g) and fruit yield per hectare (t). The values of F_1 averaged over three replications were used for estimating heterosis. The magnitude of heterosis was calculated as percentage increase or decrease of F_1 mean over the mean of better parent (BP) (Turner, 1953 and Hays *et al.*, 1955) [14, 4] and per cent superiority over standard check were calculated. The analysis of variance, for all the characters under study, was carried out by the method suggested by Panse and Sukhatme (1985) [7].

Results and Discussion

The analysis of variance carried out for different traits of okra are presented in Table 1. The analysis of variance revealed significant differences among treatments for all the yield and quality traits indicating the presence of appreciable genetic diversity among the parents and cross combinations. This indicates the existence of wide variability in the material studied and there is a good scope for identifying promising parents and hybrid combinations, and improving the yield through its components. These results are in conformity with the findings of Arti verma and Soniasood (2015) [1], Tiwari *et al.* (2016) [13] and Shwetha *et al.* (2018) [11] in okra.

Per cent arelativeheterosis over relative parent, heterobeltiosis over better parent and standard heterosis in Tables 2, 3, 4, 5, 6, 7, 8, 9 10, 11, 12, 13, 14, 15 and 16. For plant height, pooled analysis for hybrids were in the range from -11.98 to 10.46 per cent of relative heterosis and from -16.17 to 4.58 per cent of heterobeltiosis. The standard heterosis over the hybrid Samrat varied from -10.15 to 11.41 per cent (Table 2). Similar results are reported by Satish *et al.* (2017) [9] and Makdoomi *et al.* (2018) [5]. In pooled analysis average heterosis ranged from -5.65 to 0 per cent. Heterobeltiosis ranged from -7.90 to -1.93 per cent. Six hybrids exhibited significant negative heterobeltiosis and flowered earlier than their corresponding parents. The standard heterosis over Samrat ranged from -1.71 to 1.97 per cent (Table 3). Similar results are reported by Sujith kumar *et al.* (2017) and Makdoomi *et al.* (2018) [5] for days to firs flowering. In pooled analysis the average heterosis ranged from -2.39 to 9.23 per cent. Heterobeltiosis ranged from -5.10 to 8.10 per cent. The standard heterosis over Samrat ranged from -13.82 to 3.50 per cent (Table 4). Similar results are reported by Satish *et al.* (2017) [9] and Makdoomi *et al.* (2018) [5] for intermodal length. In pooled analysis, average heterosis ranged from -22.50 to 11.94 per cent. Heterobeltiosis ranged from -29.67 to 13.12 per cent. The standard heterosis over Samrat ranged from –27.95 to 18.55 per cent (Table 5). Similar results are reported by Sujithkumar *et al.* (2017) for first flowering node. In pooled analysis average heterosis ranged from -7.08 to - 0.97 per cent. Heterobeltiosis ranged from -8.32 to -2.86 per cent. Nine hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Samrat ranged from –1.12 to 2.39 per cent (Table 6). Similar results are reported by Satish *et al.* (2017) [9] and Sujithkumar *et al.* (2017) for days to 50% flowering. In pooled analysis, average heterosis ranged from -6.14 to 0.47 per cent. Heterobeltiosis ranged from -7.86 to -0.85 per cent. The standard heterosis over Samrat ranged from -2.49 to 2.43 per cent (Table 7). Similar results are reported by Makdoomi *et al.* (2018) [5] for days to first picking. In pooled analysis, relative heterosis ranged from -2.16 to 3.00 per cent. Heterobeltiosis ranged from -3.10 to 2.82 per cent. One hybrid each has exhibited significant positive relative heterosis and heterobeltiosis while, two hybrids exhibited significant negative heterobeltiosis. The standard heterosis over Samrat ranged from -0.94 to 3.51 per cent (Table 8). Similar results are reported by Satish *et al.* (2017) [9] for days to last picking.

In pooled analysis, the range of relative heterosis varied from-12.55 to 15.14 per cent. The range of heterosis over better parent varied from -21.11 to 5.7 per cent. Standard heterosis over the check Samrat ranged from -11.85 to 22.16. The cross 440-10-1 x HRB-9-2 exhibited significant positive heterosis of 22.16 per cent over check Samrat for number of fruits per plant (Table 9). Similar results are reported by Bhatt *et al.* (2016) [2], Satish *et al.* (2017) [9] and Makdoomi *et al.* (2018) [5]. For fruit length in pooled analysis, the range of relative heterosis varied from 0.98 to 10.34 per cent. The range of heterosis over better parent varied from -0.94 to 9.71 per cent. Seven hybrids over mid parent and three over better parent were found superior by exhibiting significant positive heterosis. Standard heterosis over Samrat ranged from -2.23 to 9.22. One hybrid 440-10-1 x HRB-9-2 exhibited significant positive heterosis of 9.22 per cent over check Samrat (Table 10). Similar results are reported by Satish *et al.* (2017) [9] and Makdoomi *et al.* (2018) [5]. In pooled analysis, the hybrids were in the range of -4.24 to 15.23 per cent for relative heterosis and from -5.88 to 13.38 per centof heterobeltiosis. Four crosses over mid parent and three over better parent have recorded significant positive effects. The standard heterosis over the check Samrat varied from 0.53 to 10.96 per cent. Two hybrids showed significant positive standard heterosis over Samratfor fruit girth (Table 11).Similar results are reported by More *et al.* (2015b) [6] and Makdoomi *et al.* (2018) [5] in okra.

For fruit weight in pooled analysis, relative heterosis ranged from 7.30 to 29.62 per cent. The heterobeltiosis ranged from 3.53 to 27.77 per cent. Twelve and seven hybrids exhibited significant positive relative heterosis and heterobeltiosis respectively. The standard heterosis over Samrat ranged from 2.68 to 25.46 per cent. Seven hybrids registered significant positive standard heterosis over Samrat (Table 12). Similar results are reported by More *et al.* (2015b) [6] and Makdoomi *et al.* (2018) [5] in okra. In pooled analysis, the range of relative heterosis varied from –8.8 to 17.43 per cent. The range of heterosis over better parent varied from -14.62 to 13.08 per cent. Seven hybrids showed significant positive average heterosis over mid parent and one hybrid over heterobeltiosis. Standard heterosis over Samrat ranged from -18.95 to 16.37.Two hybrids exhibited significant positive heterosis over Samrat for number of seeds per fruit (Table 13). These results are conformity with the findings of Sujith Kumar *et al.* (2017) and Makdoomi *et al.* (2018) [5]. For test weight of seeds pooled analysis of average heterosis for 15 hybrids studied indicated a range of -5.19 to 11.97 per cent. Heterobeltiosis ranged from -9.42 to 10.22 per cent. One hybrid exhibited significant positive relative heterosis. The standard heterosis over Samrat ranged from -14.11 to 1.30 per cent (Table 14). These results are conformity with the findings Patel and Patel (2016) and Makdoomi *et al.* (2018) [5] in okra.

In pooled analysis, average heterosis ranged from -5.77 to 50.49 per cent. Two hybrids exhibited significant positive

relative heterosis. Heterobeltiosis ranged from -7.43 to 28.67 per cent. The standard heterosis over Samrat ranged from -2.18 to 61.83 per cent. Three hybrids registered significant positive standard heterosis over Samrat for fruit yield per plant (Table 15). Similar results are reported by Makdoomi *et al*. (2018) [5]. For fruit yield per hectare in pooled analysis, average heterosis ranged from -6.59 to 54.86 per cent. Two hybrids exhibited significant positive relative heterosis. Heterobeltiosis ranged from -12.18 to 29.25 per cent. The standard heterosis over Samrat ranged from -2.58 to 68.67 per cent. Two hybrids registered significant positive standard heterosis over Samrat (Table 16).

Table 1: Pooled analysis of variance for combining ability (Half-diallel) for growth and fruit yield attributes for stability in okra

Source	Df	PH	DFF	IL	D50%F	FFN	DFP	DLP	NFP	FL	FG	FW	NSF	TWS	FYP	FYH
Replicates	2	43.468	2.393	0.143*	3.699	0.039	2.559	0.245	0.052	2.192**	0.044	0.486	1.658	0.475*	41.321	0.082
Treatments	20	122.251	2.432	0.220**	3.530*	1.260**	3.594**	4.026*	7.508**	0.814**	0.189*	9.642**	113.109**	0.359**	6301.180**	16.946*
Parents	5	145.478	4.008*	0.309**	3.197	1.614**	5.209**	4.165	14.480**	0.285	0.189	1.174	137.777**	0.667**	5812.716*	17.958
Hybrids	14	116.921	0.694	0.185**	0.946	1.111**	1.128	4.181*	5.533*	0.599*	0.122	4.771*	97.250**	0.216	4664.188*	11.954
Parent Vs. Hybrids	1	80.936	18.880**	0.261*	41.385**	1.565*	30.041**	1.163	0.299	6.479**	1.110**	120.171**	211.804**	0.823*	31661.390**	81.792**
Error	40	66.779	1.491	0.042	1.508	0.262	1.342	1.702	2.193	0.250	0.086	1.987	12.678	0.143	2351.297	7.35
Total	62	83.921	1.824	0.103	2.231	0.576	2.108	2.405	3.838	0.494	0.118	4.408	44.72	0.223	3550.938	10.211

** 1% level of significance,* 5% level of significance

PH = Plant height, DFF = Days to first flowering, IL = Internodal length, D50%F = Days to 50% flowering, FFN = First flowering node, DFP = Days to first picking, DLP = Days to last picking, NFP = Number of fruits per plant, FL = Fruit length, FG = Fruit girth, FW = Fruit weight, NSP = Number of seeds per fruit, TWS = Test weight of seeds, FYP = Fruit yield per plant, FYH = Fruit yield per hectare

Table 2: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for plant height in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	-5.85	-8.11	-5.49	6.07	2.98	-30.35 **	12.78	7.63	13.02	4.83	2.87	-7.09
VRO-3 X 440-10-1	-7.82	-9.33	-3.58	11.02	10.12	-29.86 **	5.66	0.93	5.76	2.23	-0.09	-9.01
VRO-3 X TCR-1674	7.37	4.69	7.68	4.05	-7.93	-23.82 **	5.49	-1.30	8.09	5.71	0.24	-2.78
VRO-3 X JPM-20-16-39	-14.17	-19.93	-4.88	1.63	-9.3	-26.40 **	3.67	2.04	0.52	-3.20	-8.97	-10.15
VRO-3 X HRB-9-2	6.29	-1.49	18.69	2.55	-12.27	-21.41 *	1.04	-8.55	7.71	3.22	-7.26	1.17
VRO-6 X 440-10-1	11.92	7.48	14.31	7.52	3.57	-29.95 **	-5.17	-5.26	-0.52	3.63	3.20	-6.02
VRO-6 X TCR-1674	23.65 *	23.52	20.95	10.24	0.17	-17.11	-4.32	-6.29	2.63	8.30	4.58	1.43
VRO-6 X JPM-20-16-39	5.38	-3.88	14.19	27.00 **	16.43	-5.52	-2.21	-5.24	-0.49	8.12	3.52	2.18
VRO-6 X HRB-9-2	7.10	-2.93	16.95	5.23	-7.67	-17.28	6.82	1.03	18.99	6.49	-2.68	6.17
440-10-1 X TCR-1674	11.98	7.43	14.25	1.78	-10.57	-26.00 **	-6.09	-8.12	0.62	1.79	-1.32	-4.29
440-10-1 X JPM-20-16-39	-12.27	-16.87	-1.24	10.24	-2.32	-20.74 *	-7.97	-10.73	-6.46	-4.85	-8.52	-9.71
440-10-1 X HRB-9-2	6.10	-0.13	20.33	19.92	1.90	-8.71	8.11	2.15	20.31	10.46	1.33	10.55
TCR-1674 x JPM-20-16-39	-8.06	-16.22	-0.47	13.33	12.23	-7.14	3.99	-1.24	8.16	2.65	1.76	0.44
TCR-1674 X HRB-9-2	11.87	1.30	22.05	11.14	6.89	-4.24	3.10	-0.52	17.17	8.13	2.13	11.41
JPM-20-16-39 x HRB-9-2	-15.14	-15.73	1.53	-11.16	-15.35	-24.16 **	-9.74	-17.12	-2.39	-11.98	-16.17 *	-8.55

**1% level of significance, *5% level of significance

Table 3: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for days to first flowering in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	4.26	2.39	6.19	-2.88	-4.84	-0.84	-1.18	-3.14	-3.30	0.00	-1.93	0.56
VRO-3 X 440-10-1	-4.47	-8.71 *	0.18	-6.40	-10.69 **	-1.68	-1.76	-4.10	-3.47	-4.25	-7.90 **	-1.71
VRO-3 X TCR-1674	2.98	-0.82	7.08	-1.93	-6.14	2.69	-1.37	-1.71	-5.12	-0.14	-2.98	1.41
VRO-3 X JPM-20-16-39	2.24	-3.75	9.03 *	-0.41	-1.64	0.84	-2.26	-5.03	-3.47	-0.14	-3.48	1.97
VRO-3 X HRB-9-2	-0.96	-2.73	0.88	-2.9	-4.10	-1.68	0.34	-1.65	-1.82	-1.18	-2.82	-0.91
VRO-6 X 440-10-1	0.50	-2.26	7.26	-3.37	-5.95	3.53	-5.84 *	-6.23 *	-5.61	-2.91	-4.81	1.59
VRO-6 X TCR-1674	-8.03 *	-9.84 **	-2.65	-4.01	-6.30	2.52	-1.51	-3.14	-3.30	-4.51	-5.42 *	-1.14
VRO-6 X JPM-20-16-39	-3.59	-7.66 *	4.60	1.79	0.97	5.21	-5.81 *	-6.66 *	-5.12	-2.52	-3.96	1.47
VRO-6 X HRB-9-2	2.39	2.39	6.19	-4.88	-5.65	-1.68	-5.45 *	-5.45	-5.61	-2.7	-2.97	-0.51
440-10-1 X TCR-1674	-4.88	-5.65	3.54	-11.18**	-11.45 **	-2.52	-0.42	-2.46	-1.82	-5.65 **	-6.62 **	-0.34
440-10-1 X JPM-20-16-39	-4.76	-6.25	6.19	-6.72 *	-9.92 **	-0.84	-3.75	-4.22	-2.64	-5.09 *	-5.57 *	0.78
440-10-1 X HRB-9-2	-1.33	-4.03	5.31	-5.93	-9.16 **	0.00	-5.68 *	-6.07 *	-5.45	-4.33	-6.46 **	-0.17
TCR-1674 x JPM-20-16-39	-4.64	-6.88	5.49	-2.30	-5.38	3.53	-2.58	-5.03	-3.47	-3.18	-3.69	1.75
TCR-1674 X HRB-9-2	-4.68	-6.56	0.88	-4.84	-7.83 *	0.84	-3.87	-5.45	-5.61	-4.47	-5.64 *	-1.37
JPM-20-16-39 x HRB-9-2	-8.48 **	-12.34 **	-0.71	2.46	2.46	5.04	-4.18	-5.03	-3.47	-3.40	-5.08	0.28

** 1% level of significance,* 5% level of significance

Table 4: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for intermodal length in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	2.97	-0.61	-1.67	2.61	-0.07	-3.07	4.60	3.31	4.17	3.46	1.97	0.13
VRO-3 X 440-10-1	-4.80	-7.21	-8.20	-2.29	-4.81	-7.67	9.09	6.78	5.00	1.21	-1.21	-3.00
VRO-3 X TCR-1674	2.08	-2.49	-3.53	1.69	1.10	-1.93	0.81	-0.06	0.00	1.45	0.19	-1.63
VRO-3 X JPM-20-16-39	-0.59	-8.96	-9.93	-1.06	-7.15	-9.93	11.85	0.00	-1.67	3.76	-5.10	-6.82 *
VRO-3 X HRB-9-2	-5.36	-9.03	-10.00	-3.85	-7.29	-10.07	7.14	1.69	0.00	-0.23	-4.46	-6.19
VRO-6 X 440-10-1	-2.08	-3.05	-8.93	7.58	7.54	-1.07	-0.85	-4.13	-3.33	1.32	0.33	-4.32
VRO-6 X TCR-1674	13.03	11.80	2.93	10.69	8.41	3.93	2.88	2.48	3.33	8.31**	8.10 *	3.50
VRO-6 X JPM-20-16-39	13.65	7.60	-0.93	10.66	6.53	-2.07	4.67	-7.44	-6.67	9.23**	1.25	-3.44
VRO-6 X HRB-9-2	4.73	4.27	-4.0	6.67	5.58	-2.93	3.08	-3.31	-2.5	4.66	1.64	-3.06
440-10-1 X TCR-1674	9.86	7.59	1.07	7.45	5.29	0.93	-9.90	-12.55	-12.5	1.39	0.20	-4.07
440-10-1 X JPM-20-16-39	1.93	-4.40	-10.20	2.71	-1.16	-9.07	0.00	-8.85	-14.17	1.47	-5.08	-11.26 **
440-10-1 X HRB-9-2	-3.89	-5.25	-11.00	-1.06	-2.10	-9.93	-2.28	-5.31	-10.83	-2.39	-4.28	-10.51 **
TCR-1674 x JPM-20-16-39	-3.68	-7.85	-17.00 *	-3.76	-9.18	-12.93	13.58	0.78	0.83	2.72	-4.96	-9.01 **
TCR-1674 X HRB-9-2	13.53	12.78	2.93	9.72	6.40	2.00	-1.80	-7.55	-7.50	6.47*	3.20	-1.19
JPM-20-16-39 x HRB-9-2	-2.65	-7.45	-15.53 *	0.57	-2.22	-11.93	3.52	-2.83	-14.17	0.62	-4.11	-13.82 **

** 1% level of significance,* 5% level of significance

Table 5: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for days to 50% flowering in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	-0.39	-3.03	6.67	-3.45	-4.55	-0.79	-0.31	-2.30	-1.55	-1.39	-3.30	1.33
VRO-3 X 440-10-1	-7.63 *	-11.68 **	0.83	-6.67 *	-10.64 **	-0.79	-1.03	-2.19	-3.10	-5.17 *	-8.32 **	-1.06
VRO-3 X TCR-1674	0.78	-2.26	8.33 *	-3.7	-7.80 *	2.36	0.00	0.00	-3.25	-1.03	-3.51	2.34
VRO-3 X JPM-20-16-39	-1.53	-5.84	7.50	-2.68	-3.79	0.00	1.33	-0.62	0.00	-0.97	-3.45	2.39
VRO-3 X HRB-9-2	-1.57	-3.10	4.17	-3.85	-4.58	-1.57	1.10	-0.92	-0.15	-1.45	-2.86	0.75
VRO-6 X 440-10-1	-4.09	-5.84	7.50	-4.76	-7.80 *	2.36	-3.02	-3.84	-3.1	-3.97	-5.36 *	2.13
VRO-6 X TCR-1674	-10.19**	-10.53 **	-0.83	-5.49	-8.51 **	1.57	-2.82	-4.76	-4.02	-6.20 **	-6.77 **	-1.12
VRO-6 X JPM-20-16-39	-10.04**	-11.68 **	0.83	-0.76	-0.76	3.15	-5.30 *	-5.38	-4.64	-5.39 **	-5.96 *	-0.26
VRO-6 X HRB-9-2	-2.68	-3.79	5.83	-5.70	-6.06	-2.36	-7.07 **	-7.07 *	-6.35 *	-5.15 *	-5.63 *	-1.12
440-10-1 X TCR-1674	-8.15 **	-9.49 **	3.33	-12.77**	-12.77 **	-3.15	0.40	-0.78	-1.70	-7.08 **	-7.88 **	-0.58
440-10-1 X JPM-20-16-39	-6.57 *	-6.57	6.67	-6.96 *	-9.93 **	0.00	-3.10	-3.85	-3.25	-5.58 **	-6.40 **	1.01
440-10-1 X HRB-9-2	-4.51	-7.30 *	5.83	-6.62 *	-9.93 **	0.00	-6.27 *	-7.07 *	-6.35 *	-5.79 **	-7.63 **	-0.31
TCR-1674 x JPM-20-16-39	-6.67 *	-8.03 *	5.00	-1.83	-4.96	5.51	-1.96	-3.85	-3.25	-3.50	-3.50	2.34
TCR-1674 X HRB-9-2	-6.87 *	-8.27 *	1.67	-5.15	-8.51 **	1.57	-2.82	-4.76	-4.02	-4.96 *	-6.02 *	-0.32
JPM-20-16-39 x HRB-9-2	-9.02 **	-11.68 **	0.83	1.90	1.52	5.51	-3.15	-3.23	-2.48	-3.44	-4.50	1.28

** 1% level of significance, *5% level of significance

Table 6: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for first flowering node in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	-23.2	-31.43	-26.15	-11.11	-15.15	-37.78 **	-20.48*	-23.26 *	-18.52	-18.39*	-23.33 **	-27.95 **
VRO-3 X 440-10-1	-24.14	-38.89 **	-15.38	1.33	-15.56	-15.56	-5.88	-11.11	-1.23	-9.23	-21.83 **	-10.61
VRO-3 X TCR-1674	-4.76	-15.49	-7.69	-7.69	-14.29	-33.33 *	7.50	7.50	6.17	-0.97	-6.79	-12.77
VRO-3 X JPM-20-16-39	-14.29	-29.41 *	-7.69	-14.84	-30.53 *	-26.67	-16.67	-25.00 **	-7.41	-15.38*	-28.23 **	-14.87
VRO-3 X HRB-9-2	-16.52	-20.00	-26.15	-24.44	-32.00	-43.33 **	13.94	10.59	16.05	-6.98	-12.27	-18.23 *
VRO-6 X 440-10-1	1.25	-10.00	24.62	-10.26	-22.22	-22.22	2.27	0.00	11.11	-1.98	-10.72	2.1
VRO-6 X TCR-1674	6.38	5.63	15.38	11.76	8.57	-15.56	-9.64	-12.79	-7.41	2.1	1.89	-4.26
VRO-6 X JPM-20-16-39	-9.68	-17.65	7.69	5.59	-10.53	-5.56	-29.03**	-34.00 **	-18.52	-11.89	-21.05 **	-6.35
VRO-6 X HRB-9-2	38.46 **	28.57	38.46 *	6.38	0.00	-16.67	0.58	0.00	6.17	13.58	13.12	6.29
440-10-1 X TCR-1674	-6.83	-16.67	15.38	-11.25	-21.11	-21.11	0.00	-5.56	4.94	-5.84	-14.39	-2.10
440-10-1 X JPM-20-16-39	-41.71**	-43.33 **	-21.54	-8.11	-10.53	-5.56	-14.74	-19.00 *	0.00	-21.08**	-22.50 **	-8.07
440-10-1 X HRB-9-2	-33.33**	-44.44 **	-23.08	-27.27*	-33.33 *	-33.33 *	-8.57	-11.11	-1.23	-22.50**	-29.67 **	-19.57 *
TCR-1674 x JPM-20-16-39	-35.90**	-41.18 **	-23.08	-20.00	-30.53 *	-26.67	0.00	-10.00	11.11	-17.78**	-26.46 **	-12.77
TCR-1674 X HRB-9-2	37.40 *	26.76	38.46 *	-10.34	-13.33	-27.78	3.03	0.00	4.94	8.84	8.62	1.65
JPM-20-16-39 x HRB-9-2	24.14	5.88	38.46 *	17.65	5.26	11.11	-2.70	-10.00	11.11	11.94	-0.05	18.55 *

** 1% level of significance,* 5% level of significance

Table 7: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for days to first picking in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	3.47	3.02	4.37	-3.41	-4.01	-2.11	-1.56	-2.25	-4.4	-0.54	-0.85	-0.8
VRO-3 X 440-10-1	-4.36	-7.87 **	0.73	-5.69 *	-9.62 **	-0.70	-1.60	-3.81	-2.89	-3.91 *	-7.16 **	-0.99
VRO-3 X TCR-1674	1.26	-1.50	5.54	-2.49	-6.09 *	2.11	-1.91	-2.54	-4.81 *	-1.06	-3.43	0.85

VRO-3 X JPM-20-16-39	2.34	-1.91	8.38 **	0.07	-0.55	1.41	-1.04	-3.4	-2.2	0.47	-1.95	2.43
VRO-3 X HRB-9-2	-1.99	-3.09	0.44	-2.21	-3.54	-0.14	-0.42	-2.72	-1.65	-1.54	-3.12	-0.47
VRO-6 X 440-10-1	-0.90	-4.93	3.94	-4.12	-7.56 **	1.55	-5.74 **	-7.22 **	-6.33 **	-3.6	-6.59 **	-0.37
VRO-6 X TCR-1674	-5.76 *	-8.71 **	-2.19	-3.21	-6.22 *	1.97	-0.77	-0.84	-3.03	-3.25	-5.28 **	-1.08
VRO-6 X JPM-20-16-39	-3.52	-7.92 **	1.75	0.97	0.97	2.96	-5.74 **	-7.34 **	-6.19 **	-2.76	-4.82 *	-0.56
VRO-6 X HRB-9-2	0.71	-0.84	2.77	-5.41	-6.12	-2.82	-6.64 **	-8.16 **	-7.15 **	-3.83 *	-5.09 *	-2.49
440-10-1 X TCR-1674	-4.24	-5.2	3.64	-9.54 **	-10.00 **	-1.13	-0.69	-2.32	-1.38	-4.93 **	-5.92 **	0.33
440-10-1 X JPM-20-16-39	-3.32	-3.83	6.27	-5.05	-8.46 **	0.56	-2.04	-2.17	-0.96	-3.48	-4.47 *	1.89
440-10-1 X HRB-9-2	-3.35	-5.87	2.92	-7.19 **	-9.87 **	-0.99	-7.83 **	-7.89 **	-6.88 **	-6.14 **	-7.86 **	-1.74
TCR-1674 x JPM-20-16-39	-5.02	-6.46 *	3.35	-2.41	-5.44	2.82	-4.01 *	-5.71 **	-4.54 *	-3.81 *	-3.83	0.47
TCR-1674 X HRB-9-2	-3.87	-5.44	1.31	-4.45	-6.74 *	1.41	-3.39	-5.03 *	-3.99	-3.91 *	-4.69 *	-0.47
JPM-20-16-39 x HRB-9-2	-8.92 **	-11.74 **	-2.48	0.07	-0.68	2.82	-4.96 **	-5.03 *	-3.85	-4.61 **	-5.40 **	-1.17

** 1% level of significance,* 5% level of significance

Table 8: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for days to last picking in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	-2.53	-3.03	-1.06	1.33	-0.37	-0.44	6.35	5.53	5.44	1.54	1.04	1.22
VRO-3 X 440-10-1	-0.04	-0.70	0.28	-0.50	-1.80	-2.61	1.15	0.00	2.26	0.20	-0.37	-0.04
VRO-3 X TCR-1674	0.59	-0.61	2.81	2.23	0.15	0.82	1.11	-0.08	2.26	1.29	-0.19	1.98
VRO-3 X JPM-20-16-39	0.87	0.70	1.69	3.08	1.50	1.12	-1.91	-5.61	2.02	0.67	-1.03	1.61
VRO-3 X HRB-9-2	0.88	0.00	0.99	4.76*	3.38	2.54	-0.31	-2.17	1.56	1.75	1.00	1.68
VRO-6 X 440-10-1	-0.84	-2.00	0.00	-0.97	-1.34	-1.42	0.85	-1.06	1.17	-0.35	-0.42	-0.10
VRO-6 X TCR-1674	-0.27	-0.95	2.46	0.37	0.00	0.67	-3.45	-5.32	-3.11	-1.06	-2.03	0.10
VRO-6 X JPM-20-16-39	2.08	1.38	3.45 *	3.51	3.36	3.28	-5.76	-10.00 **	-2.72	0.01	-1.20	1.43
VRO-6 X HRB-9-2	0.70	-0.69	1.34	2.70	2.31	2.24	1.15	-1.50	2.26	1.50	1.25	1.93
440-10-1 X TCR-1674	-4.37 **	-6.12 **	-2.89	0.37	-0.37	0.3	-2.32	-2.36	-0.08	-2.16	-3.05 *	-0.94
440-10-1 X JPM-20-16-39	-0.56	-1.05	-0.42	0.23	0.00	-0.37	-5.66	-8.20 *	-0.78	-1.98	-3.10 *	-0.52
440-10-1 X HRB-9-2	2.97*	2.75	2.39	2.63	2.63	1.79	3.40	2.62	6.53	3.00**	2.82 *	3.51 **
TCR-1674 x JPM-20-16-39	1.03	-0.34	3.10	-0.97	-1.48	-0.82	-4.95	-7.48 *	0.00	-1.56	-1.80	0.82
TCR-1674 X HRB-9-2	-0.62	-2.65	0.70	-0.37	-1.11	-0.45	2.98	2.25	6.14	0.62	-0.12	2.05
JPM-20-16-39 x HRB-9-2	2.11	1.40	2.04	3.60	3.37	2.98	-0.92	-2.88	4.98	1.59	0.60	3.29 **

** 1% level of significance,* 5% level of significance

Table 9: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for number of fruits per plant in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	-11.59	-12.71	-6.36	4.29	-3.41	-33.33 **	5.70	2.55	7.11	-1.13	-4.64	-11.85
VRO-3 X 440-10-1	-4.17	-8.00	4.55	15.41	13.55	-30.98 **	1.29	-3.67	4.89	2.63	-1.25	-8.27
VRO-3 X TCR-1674	5.38	4.26	11.36	2.78	-11.9	-27.45 **	10.63	6.25	13.33	6.51	-0.02	-2.14
VRO-3 X JPM-20-16-39	-16.00	-27.81 **	5.00	-1.30	-19.15	-25.49 **	-6.31	-14.81	2.22	-8.72	-21.11 **	-7.01
VRO-3 X HRB-9-2	12.38	0.00	34.09 **	5.64	-14.17	-19.22	-7.87	-20.00	6.67	3.22	-11.24	5.89
VRO-6 X 440-10-1	19.34 *	16.00	31.82 **	-2.72	-8.52	-36.86 **	-1.67	-3.67	4.89	5.96	5.70	-1.82
VRO-6 X TCR-1674	10.40	10.17	18.18	1.04	-7.14	-23.53 *	-1.05	-2.08	4.44	3.60	0.72	-1.41
VRO-6 X JPM-20-16-39	-8.27	-20.31 *	15.91	16.79	2.13	-5.88	-2.57	-8.89	9.33	0.68	-10.18	5.87
VRO-6 X HRB-9-2	2.07	-8.14	23.18	0.96	-12.50	-17.65	2.8	-8.33	22.22	2.04	-9.45	8.04
440-10-1 X TCR-1674	3.51	0.40	14.09	-6.85	-19.05	-33.33 **	5.15	4.08	13.33	1.27	-1.31	-3.41
440-10-1 X JPM-20-16-39	-15.79	-25.00 **	9.09	8.21	-10.21	-17.25	-2.52	-7.04	11.56	-4.84	-14.93 *	0.28
440-10-1 X HRB-9-2	10.09	1.69	36.36 **	24.05 *	2.08	-3.92	13.76	3.33	37.78 **	15.14 *	2.39	22.16 **
TCR-1674 x JPM-20-16-39	-4.50	-17.19 *	20.45	14.61	8.51	0.00	-5.49	-10.74	7.11	0.78	-7.76	8.72
TCR-1674 X HRB-9-2	0.00	-10.17	20.45	0.00	-6.25	-11.76	7.78	-3.00	29.33 *	2.76	-6.47	11.59
JPM-20-16-39 x HRB-9-2	-15.12	-18.44 *	18.64	-11.58	-12.50	-17.65	-10.53	-15.00	13.33	-12.55*	-13.08	3.71

** 1% level of significance,* 5% level of significance

Table 10: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for fruit length in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	0.87	0.03	2.11	-1.79	-3.24	-16.92 *	7.69	5.93	7.61	2.75	2.26	-2.23
VRO-3 X 440-10-1	3.25	2.65	3.04	-4.65	-6.03	-16.92 *	4.69	0.58	7.27	1.43	-0.46	-2.08
VRO-3 X TCR-1674	0.83	0.66	1.39	3.42	-1.18	-15.15 *	6.41	4.33	6.70	3.81	3.30	-2.18
VRO-3 X JPM-20-16-39	4.97	3.14	3.53	7.45	5.85	-9.12	15.29 **	12.76**	15.91 **	9.79**	9.71 **	3.88
VRO-3 X HRB-9-2	0.76	0.75	1.13	14.48	12.82	-0.25	5.22	0.00	9.09	6.68*	4.05	3.63
VRO-6 X 440-10-1	16.57 **	14.94**	17.33 **	-8.25	-10.88	-21.21 **	-3.96	-6.24	0.00	0.98	-0.44	-2.06
VRO-6 X TCR-1674	-1.38	-2.04	0.00	16.29 *	12.73	-6.06	2.56	2.22	4.55	5.27	4.25	-0.33
VRO-6 X JPM-20-16-39	2.01	-0.60	1.48	8.80	8.79	-9.34	8.64	8.00	11.02 *	6.65*	6.05	1.40
VRO-6 X HRB-9-2	10.38 *	9.44	11.72 *	10.87	7.68	-4.80	3.56	0.00	9.09	7.76**	5.61	5.18

440-10-1 X TCR-1674	11.00 *	10.17	10.97 *	-2.11	-7.74	-18.43 *	5.73	3.56	10.45 *	5.05	2.58	0.91
440-10-1 X JPM-20-16-39	11.41 *	10.09	9.23	5.00	1.97	-9.85	2.00	0.15	6.82	5.70	3.64	1.95
440-10-1 X HRB-9-2	19.10 **	18.43**	18.84 **	11.37	11.37	-1.54	3.23	2.08	11.36 *	10.34 **	9.66 **	9.22 **
TCR-1674 x JPM-20-16-39	5.46	3.45	4.20	15.05	11.55	-7.07	4.18	3.91	6.82	7.67*	7.22 *	1.37
TCR-1674 X HRB-9-2	0.07	-0.11	0.61	3.96	-2.03	-13.38	2.15	-1.04	7.95	2.05	-0.94	-1.35
JPM-20-16-39 x HRB-9-2	15.40 **	13.41**	13.80 **	17.62 *	14.22	0.98	-3.46	-6.25	2.27	8.38**	5.63	5.20

** 1% level of significance,* 5% level of significance

Table 11: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for fruit girth in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	12.85 *	9.61	10.39	-1.23	-4.32	-7.27	5.24	2.61	6.15	5.71	2.71	3.14
VRO-3 X 440-10-1	0.38	-5.50	1.61	-4.29	-11.41	-5.45	2.81	-1.08	5.17	-0.24	-5.88	0.53
VRO-3 X TCR-1674	8.72	5.05	6.93	-4.29	-10.92	-6.06	1.69	-1.64	3.45	2.11	-2.50	1.54
VRO-3 X JPM-20-16-39	20.23 **	20.19**	14.16 *	9.44	5.17	3.64	15.94 **	14.94**	14.94 **	15.23 **	13.38**	10.96 *
VRO-3 X HRB-9-2	16.96 **	16.13*	11.83	18.24 **	15.89*	9.64	1.14	-1.12	1.72	11.71 **	9.85 *	7.64
VRO-6 X 440-10-1	2.07	-1.17	6.27	-10.18	-14.31 *	-8.55	0.27	-1.08	5.17	-2.46	-5.38	1.07
VRO-6 X TCR-1674	14.16 *	13.56*	15.59 *	1.17	-2.93	2.36	3.31	2.46	7.76	6.17	4.27	8.59
VRO-6 X JPM-20-16-39	17.22 **	13.88*	14.70 *	6.05	5.17	3.64	11.86 **	10	13.79 **	11.80 **	10.38*	10.84 *
VRO-6 X HRB-9-2	16.43 **	13.88*	14.70 *	10.7	9.38	6.00	3.06	2.78	6.32	9.88*	8.55	9.00
440-10-1 X TCR-1674	2.74	0.00	7.53	-17.74**	-18.23 **	-12.73	1.90	1.35	7.76	-4.24	-5.44	1.01
440-10-1 X JPM-20-16-39	10.62	4.17	12.01	-6.11	-9.71	-3.64	0.28	-2.70	3.45	1.65	-2.61	4.03
440-10-1 X HRB-9-2	9.03	3.33	11.11	6.56	0.51	7.27	1.65	0.00	6.32	5.64	1.28	8.18
TCR-1674 x JPM-20-16-39	9.84	6.16	8.06	1.60	-1.72	3.64	4.2	1.64	6.90	5.16	1.99	6.22
TCR-1674 X HRB-9-2	13.99 *	10.92	12.90	-1.85	-6.90	-1.82	1.10	0.00	5.17	4.34	1.25	5.45
JPM-20-16-39 x HRB-9-2	18.99 **	18.18**	13.80 *	2.98	0.92	-0.55	0.28	-1.12	1.72	7.26	7.19	5.04

** 1% level of significance,* 5% level of significance

Table 12: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for fruit weight in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	28.43 **	26.10**	30.02 **	0.25	0.00	-22.69 **	14.09	11.26	17.07	15.07 *	13.17	7.93
VRO-3 X 440-10-1	18.43 *	13.43	16.96	3.27	1.99	-21.15 *	17.91	15.56	21.6	14.11 *	11.23	6.09
VRO-3 X TCR-1674	7.79	2.35	17.39	16.86	11.82	-5.38	23.68 *	20.20	26.48 *	16.37 **	14.14	13.20
VRO-3 X JPM-20-16-39	27.99 **	22.36*	38.32 **	31.07 **	27.96**	3.85	30.07 **	27.48*	34.15 **	29.62 **	27.77**	25.46 **
VRO-3 X HRB-9-2	26.25 **	26.00**	30.43 **	31.46 **	24.44*	7.69	9.63	9.27	14.98	21.16 **	19.35**	17.33 *
VRO-6 X 440-10-1	41.03 **	37.50**	36.65 **	3.54	2.50	-21.15 *	-3.29	-3.79	-2.79	12.96	11.95	3.23
VRO-6 X TCR-1674	8.92	1.64	16.58	11.9	6.82	-9.62	2.45	2.09	2.09	7.30	3.53	2.68
VRO-6 X JPM-20-16-39	14.62	7.69	21.74 *	22.14 *	18.96	-3.46	35.18 **	34.48**	35.89 **	24.56 **	20.77**	18.59 **
VRO-6 X HRB-9-2	29.18 **	26.60**	31.06 **	24.71 **	17.78	1.92	31.18 **	28.33*	34.15 **	28.68 **	24.70**	22.58 **
440-10-1 X TCR-1674	6.93	-2.53	11.8	-5.77	-10.91	-24.62 **	35.65 **	34.48**	35.89 **	14.43 *	9.46	8.56
440-10-1 X JPM-20-16-39	21.56 **	11.54	26.09 **	5.65	1.90	-17.31 *	19.66	19.66	20.91	16.46 **	11.94	9.91
440-10-1 X HRB-9-2	28.66 **	23.00*	27.33 **	25.89 **	17.78	1.92	31.53 **	29.33*	35.19 **	29.00 **	23.92**	21.82 **
TCR-1674 x JPM-20-16-39	1.84	1.10	15.96	21.11 *	18.64	0.38	31.13 **	30.00*	31.36 *	17.99 **	17.40*	16.44 *
TCR-1674 X HRB-9-2	23.95 **	17.91*	35.24 **	3.37	2.22	-11.54	19.66	16.67	21.95	16.47 **	15.96*	15.01 *
JPM-20-16-39 x HRB-9-2	4.23	-0.16	12.86	16.97	13.33	-1.92	8.47	6.67	11.50	9.41	9.35	7.50

** 1% level of significance,* 5% level of significance

Table 13: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for number of seeds per fruit in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	21.59 *	12.27	14.95	-4.15	-14.77	-30.98 **	7.67	4.82	-7.67	8.85	8.73	-8.95
VRO-3 X 440-10-1	1.55	-4.73	11.31	-9.57	-17.59	-36.85 **	0.11	-2.13	-9.74	-1.97	-7.40	-12.79 *
VRO-3 X TCR-1674	21.25 *	19.02	21.86 *	-7.82	-16.32	-35.33 **	17.38 *	13.81	6.74	11.71 *	8.08	-3.21
VRO-3 X JPM-20-16-39	-20.94**	-35.97 **	5.78	12.37	0.82	-20.00 **	10.62	2.09	6.32	-1.64	-14.62 **	-2.87
VRO-3 X HRB-9-2	20.10 *	19.14	21.98 *	19.22 *	9.35	-17.39 **	2.90	2.35	-9.84	13.50 **	11.25	-2.98
VRO-6 X 440-10-1	-5.43	-17.63	-3.77	-10.90	-13.29	-29.78 **	-10.21	-14.49	-21.14 **	-8.80	-13.94 *	-18.95 **
VRO-6 X TCR-1674	26.78 **	19.11	17.46	18.13 *	15.44	-6.52	-2.34	-7.73	-13.47	13.34 **	9.54	-1.90
VRO-6 X JPM-20-16-39	30.67 **	-0.38	64.57 **	6.58	5.50	-14.57 *	11.60	0.50	4.66	17.43 **	1.84	15.86 **
VRO-6 X HRB-9-2	16.62	8.48	9.30	1.53	-1.88	-20.54 **	14.34	11.89	-2.49	11.06 *	8.73	-5.18
440-10-1 X TCR-1674	14.64	5.70	23.49 *	-8.19	-8.58	-29.35 **	-1.39	-2.21	-8.29	2.24	-0.27	-6.08
440-10-1 X JPM-20-16-39	12.25	-4.18	58.29 **	-20.42**	-21.78 **	-37.93 **	0.79	-4.98	-1.04	-0.05	-8.65	3.92
440-10-1 X HRB-9-2	1.04	-5.91	9.92	17.86 *	17.02	-10.33	12.07	8.99	0.52	9.81	5.74	-0.41
TCR-1674 x JPM-20-16-39	7.71	-13.99 *	42.09 **	1.46	0.14	-20.54 **	8.48	3.08	7.36	6.33	-4.98	8.10
TCR-1674 X HRB-9-2	13.42	12.22	13.07	28.02 **	26.58**	-2.17	4.81	1.10	-5.18	14.58 **	13.08*	1.26
JPM-20-16-39 x HRB-9-2	29.90 **	4.56	72.74 **	17.89 *	15.07	-8.70	-1.95	-9.95	-6.22	15.81 **	2.29	16.37 **

** 1% level of significance,* 5% level of significance

Table 14: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for test weight of seeds in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	13.57	10.37	5.32	3.13	2.02	-11.03	4.14	1.25	-0.82	7.30	5.35	-1.45
VRO-3 X 440-10-1	11.41	8.86	-1.96	6.30	4.31	-9.03	7.62	7.35	-0.68	8.67	7.16	-3.40
VRO-3 X TCR-1674	15.41	5.24	-5.23	-0.39	-1.95	-14.48 *	3.54	1.85	-2.59	6.49	3.39	-6.80
VRO-3 X JPM-20-16-39	-12.11	-21.31 *	-10.36	-3.06	-6.96	-11.76	4.81	2.38	-0.68	-3.64	-9.42	-7.20
VRO-3 X HRB-9-2	-1.51	-9.86	-2.24	6.47	1.84	-2.73	0.50	-1.82	-4.76	1.36	-3.93	-3.30
VRO-6 X 440-10-1	-19.23	-23.24	-26.75 *	11.71	10.8	-5.45	-3.63	-6.53	-8.44	-5.19	-8.18	-14.11 **
VRO-6 X TCR-1674	27.83 *	13.60	8.40	4.00	3.48	-11.7	-6.11	-7.22	-9.12	8.05	3.05	-3.60
VRO-6 X JPM-20-16-39	-1.43	-9.43	3.17	7.90	2.49	-2.79	-0.95	-1.44	-3.45	1.12	-3.27	-0.90
VRO-6 X HRB-9-2	9.46	2.88	11.58	1.54	-3.87	-8.18	-2.02	-2.50	-4.49	3.25	-0.40	0.25
440-10-1 X TCR-1674	30.15 *	21.24	4.20	1.69	1.36	-14.36 *	3.65	1.71	-2.72	11.97 *	10.22	-3.40
440-10-1 X JPM-20-16-39	10.25	-3.28	10.18	2.71	-3.19	-8.18	1.18	-1.4	-4.35	5.00	-2.59	-0.20
440-10-1 X HRB-9-2	19.40	7.02	16.06	-1.52	-7.49	-11.64	1.32	-1.26	-4.22	7.28	0.35	1.00
TCR-1674 x JPM-20-16-39	10.7	-8.61	4.11	0.57	-4.92	-9.82	-1.69	-2.38	-5.31	3.34	-5.52	-3.20
TCR-1674 X HRB-9-2	24.49 *	4.82	13.68	-7.07	-12.44	-16.36 **	3.53	2.81	-0.27	8.12	-0.35	0.30
JPM-20-16-39 x HRB-9-2	3.67	1.19	15.27	-2.26	-2.60	-6.97	-3.23	-3.23	-6.12	-0.25	-1.12	1.30

** 1% level of significance,* 5% level of significance

Table 15: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for yield per plant in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	15.78	14.73	32.59	3.16	-2.43	-50.04 **	25.25	17.54	23.30	16.98	12.82	-2.18
VRO-3 X 440-10-1	21.46	19.08	37.63	9.48	6.41	-48.53 **	18.81	6.14	24.10	17.77	11.99	0.00
VRO-3 X TCR-1674	19.79	13.23	46.96	18.44	-2.19	-31.47 *	56.11	46.47	53.72	33.76	21.74	19.53
VRO-3 X JPM-20-16-39	7.42	-12.05	59.44 *	22.28	-4.45	-22.50	25.03	10.04	33.15	17.59	-2.27	18.85
VRO-3 X HRB-9-2	40.61 **	19.84	96.60 **	34.26	3.20	-12.32	6.82	-11.78	24.53	25.43	2.88	29.39
VRO-6 X 440-10-1	76.44 **	74.56**	98.08 **	-5.23	-7.86	-52.81 **	-14.49	-18.89	-5.16	17.89	16.18	3.75
VRO-6 X TCR-1674	70.78 **	60.04**	107.72 **	14.68	-0.76	-30.46 *	-2.81	-2.84	1.97	26.92	19.50	17.33
VRO-6 X JPM-20-16-39	3.66	-15.73	52.78 *	43.23 *	16.83	-5.25	35.39	26.38	52.91	25.52	7.51	30.74
VRO-6 X HRB-9-2	34.11 *	13.43	86.09 **	26.23	1.16	-14.06	39.23	21.34	71.29 *	34.31 *	13.45	42.68 *
440-10-1 X TCR-1674	14.13	5.89	37.44	-16.78	-29.67	-50.72 **	43.52	36.17	59.22	19.13	13.74	11.67
440-10-1 X JPM-20-16-39	2.19	-17.61	49.38 *	11.27	-11.19	-27.97	8.25	6.43	28.77	6.75	-7.43	12.58
440-10-1 X HRB-9-2	50.08 **	25.84	106.44 **	47.71 *	15.9	-1.53	52.35 *	39.27	96.60 **	50.49 **	28.67	61.83 **
TCR-1674 x JPM-20-16-39	-1.21	-15.24	53.66 *	35.70 *	26.47	2.57	17.84	10.03	33.13	15.45	4.33	26.88
TCR-1674 X HRB-9-2	24.38	11.39	82.74 **	2.39	-6.58	-20.64	33.58	16.45	64.38	22.20	8.80	36.83 *
JPM-20-16-39 x HRB-9-2	-14.49	-18.55	47.66 *	-1.41	-3.64	-18.14	-0.29	-7.41	30.70	-5.77	-7.33	16.55

** 1% level of significance,* 5% level of significance

Table 16: Estimates of relative heterosis (RH), heterobeltiosis (Hb) and standard heterosis (SH) for yield per hectare in okra

Cross combination	V.R. Gudem			Lam			Vonipenta			Pooled		
	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH	RH	Hb	SH
VRO-3 X VRO-6	19.07	17.74	40.62	4.5	-3.26	-57.90 **	29.59	20.38	27.22	20.88	15.65	-2.58
VRO-3 X 440-10-1	25.97	23.01	46.90	13.41	8.94	-56.17 **	21.8	7.00	28.15	21.74	14.50	0.00
VRO-3 X TCR-1674	23.59	15.60	58.56	24.12	-2.73	-36.46 *	65.97	54.31	62.76	40.96	25.97	23.11
VRO-3 X JPM-20-16-39	4.70	-16.60	67.93 *	21.71	-10.28	-29.90	24.99	7.98	34.5	16.28	-6.25	17.78
VRO-3 X HRB-9-2	39.10 *	15.73	108.13 **	38.93	0.64	-16.88	0.70	-18.83	20.21	23.10	-2.16	27.68
VRO-6 X 440-10-1	104.70 **	102.11**	135.98 **	-7.3	-10.8	-61.18 **	-16.59	-21.50	-5.99	25.75	23.52	7.88
VRO-6 X TCR-1674	84.57 **	70.84**	134.33 **	18.93	-0.92	-35.28	-3.12	-3.21	2.29	32.45	23.31	20.51
VRO-6 X JPM-20-16-39	0.39	-20.70	59.67	47.96	15.18	-10.00	36.95	26.56	57.65	25.62	4.93	31.82
VRO-6 X HRB-9-2	35.67 *	11.87	101.19 **	26.53	-3.4	-20.21	41.17	20.95	79.14 *	35.93 *	11.84	45.95 *
440-10-1 X TCR-1674	16.90	6.95	46.69	-21.78	-36.8	-58.71 **	50.26	41.30	69.23	23.01	16.47	13.83
440-10-1 X JPM-20-16-39	-1.36	-22.80	55.44	7.58	-18.51	-36.33 *	5.92	3.88	29.39	3.61	-12.18	10.33
440-10-1 X HRB-9-2	54.32 **	25.99	126.57 **	53.50 *	14.14	-5.72	55.92 *	41.00	108.84 **	54.86 **	29.25	68.67 **
TCR-1674 x JPM-20-16-39	-5.03	-20.17	60.74 *	43.51 *	31.74	2.94	20.62	11.38	38.74	16.66	3.71	30.29
TCR-1674 X HRB-9-2	24.32	9.57	97.04 **	-2.41	-12.62	-27.82	34.89	15.48	71.03	21.83	6.53	39.03
JPM-20-16-39 x HRB-9-2	-16.35	-20.82	59.43	-1.70	-4.35	-21.00	-0.35	-8.27	35.86	-6.59	-8.34	19.62

** 1% level of significance,* 5% level of significance

Conclusion

The present investigation reveals that the cross combinations combinations *viz.*,440-10-1 x HRB-9-2, VRO-6 x HRB-9-2, TCR-1674 x HRB-9-2, VRO-6 x JPM-20-16-39 and VRO-3 x HRB-9-2 were identified as stable with desirable heterosis for fruit yield and other important traits.

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