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AK Jawarkar

Ph.D. Scholar,
Department of Vegetable
Science, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

VS Kale

Professor, Department of
Vegetable Science,
Dr. Panjabrao Deshmukh Krishi
Vidyapeeth, Akola,
Maharashtra, India

PK Nagre

Associate Dean, College of
Agriculture, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

AM Sonkamble

Head, Department of Vegetable
Science, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

PV Jadhav

Associate Professor,
Department of Agriculture
Botany, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

HH Dikey

Associate Professor,
Regional Research Center,
Amravati, Maharashtra, India

Corresponding Author:

AK Jawarkar
Ph.D. Scholar,
Department of Vegetable
Science, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

Heterosis studies in chilli (*Capsicum annuum* L.)

AK Jawarkar, VS Kale, PK Nagre, AM Sonkamble, PV Jadhav and HH Dikey

Abstract

The study included two checks, Arka Harita and Arka Swetha, three lines (females), six testers (males), and the resulting 18 hybrids. The following parental lines seeds were collected from the NBPGR in New Delhi and the Instructional farm of the faculty of horticulture at Dr. Panjabrao Deshmukh Krishi Vidyapeeth in Akola. These parents were crossed in Line × tester design to produce 18 hybrids. The observations were recorded on nine different characters with view to study the heterosis, for yield and yield contributing characters. The cross combinations AKC -1-5 X IC- 362026, AKC -1-5 X IC- 362020, AKC -1-5 X IC- 537598, AKC -1-5 X GT-1-1 and Jayanti X IC – 572486 were identified as a potential crosses on the basis of average heterosis, heterobeltiosis and standard heterosis, which were also manifested heterotic effects for growth, earliness and quality traits and for leaf curl incidence the cross combinations AKC -1-5 X IC-572498, AKC -1-5 X GT-1-1, AKC -2-8-2 X IC- 362026, Jayanti X IC- 572498 and Jayanti X IC – 362020 show the high heterotic percent.

Keywords: Chilli, heterosis, yield, line x tester, quality parameters

Introduction

A major commercial crop in India is the chilli (*Capsicum annuum* L.), which is farmed for both its red and green fruits, which are used as spices. Its chromosome number is $2n=24$, and it is a member of the Solanaceae family. The oleoresin from chillies has been extracted by several food companies and is employed in the creation of processed goods and medicinal preparations. Chillies have two key characteristics: a pungency that is biting owing to the compound capsaicin and a striking red hue from the pigment capsanthin. Despite having the most area and output of chillies, India's yield potential is limited because of low-yielding cultivars and a high prevalence of pests and illnesses. Heterosis breeding is one technique to make a quantum leap in production and quality. Consequently, to accomplish this goal in less time.

Materials and Methods

The experiment was conducted at the Instructional farm, Department of Vegetable Science, Faculty of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, The study included two checks, Arka Harita and Arka Swetha, three lines (females), six testers (males), and the resulting 18 hybrids. The following parental lines seeds were collected from the NBPGR in New Delhi and the Instructional farm of the faculty of horticulture at Dr. Panjabrao Deshmukh Krishi Vidyapeeth in Akola. These parents were crossed in Line × tester design to produce 18 hybrids. All the 18 hybrids along with parents and standard check sown in *kharif* 2020-21 in Randomize Block Design with two replications. Observations were recorded Plant height (cm), Primary branches, Days to 50% flowering, Average fruit weight (g), Fruit yield per plant (g), Dry Fruit yield/plant (g), Fruit length (cm), Fruit diameter (cm) and Oleoresin (%). The mean over two replications for all hybrids and parents for each of the trait was calculated over mid-parent, better parent and standard check and used in the estimation of heterosis as per the standard procedure given by Turner (1953) ^[16] and Fonesca and Patterson (1968) ^[3] respectively.

Result and Discussion

Analysis of variance

The analysis of variance for line X tester analysis in F1 generation for both locations and pooled analysis of different traits are presented in Table 1 respectively. In the analysis of variance indicated significant differences due to genotypes for all characters studied.

Table 1 revealed that the replication differences were also flowering and oleoresin%. found significant in all characters except days to 50%

Table 1: Analysis of variance for parents and hybrids for various characters

Source of Variation	DF	Plant height (cm)	Primary branches	Days to 50% flowering	Average fruit weight (g)	Fruit yield per plant (g)	Dry fruit yield per plant (g)	Fruit length (cm)	Fruit girth (cm)	Oleoresin (%)
		1	2	3	4	5	6	7	8	9
Replication	1	46.8*	0.3*	0.01	0.4*	3780*	197.4	0	0	0
Genotypes	28	130.1**	0.5*	30.7**	2.9**	69155**	6290.3**	13.7**	0.1	1.9**
Error	28	19.5	0.00	0.00	0.1	2623	368.7	0.2	0.01	0.1

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

Table 2: *Per se* performance of parents and hybrids for plant height (cm), primary branches, Days to 50% flowering, Average fruit weight (g) and Fruit yield per plant (g).

S. No.	Genotypes	Plant height (cm)	Primary branches	Days to 50% flowering	Average fruit weight (g)	Fruit yield per plant (g)
		1	2	3	4	5
1	GT-1-1	83.0	6.2	60.8	4.2	950.5
2	IC- 362020	83.4	6.6	53.0	5.7	772.7
3	IC- 362026	84.6	7.1	49.2	4.8	895.1
4	IC- 572486	73.2	5.2	47.1	8.1	976.2
5	IC- 572498	61.9	6.2	58.4	3.1	826.4
6	IC- 537598	78.1	5.9	59.3	2.9	893.2
7	Jayanti	82.4	6.4	44.7	3.5	987.0
8	AKC -2-8-2	88.8	6.5	47.8	4.7	700.5
9	AKC -1-5	63.8	6.6	48.7	3.9	1022.7
	Parent Mean	77.7	6.3	52.1	4.5	891.6
10	Jayanti X GT-1-1	78.8	6.3	53.7	5.1	903.7
11	Jayanti X IC- 362020	81.4	6.4	50.1	4.0	779.2
12	Jayanti X IC- 362026	82.5	6.5	48.2	4.3	1020.7
13	Jayanti X IC- 572486	80.0	6.6	47.0	4.4	1057.4
14	Jayanti X IC- 572498	69.2	6.0	52.7	3.4	773.9
15	Jayanti X IC- 537598	81.4	6.1	53.3	3.7	1010.2
16	AKC -2-8-2 X GT-1-1	84.3	6.2	54.1	3.7	1016.7
17	AKC -2-8-2 X IC- 362020	82.0	6.3	50.7	5.4	787.3
18	AKC -2-8-2 X IC- 362026	87.9	6.9	48.6	3.7	959.8
19	AKC -2-8-2 X IC- 572486	80.0	6.3	47.4	3.3	1015.5
20	AKC -2-8-2 X IC- 572498	72.4	6.6	53.1	6.2	731.8
21	AKC -2-8-2 X IC- 537598	84.9	6.7	52.0	6.5	805.4
22	AKC -1-5 X GT-1-1	77.1	6.1	52.3	4.6	998.7
23	AKC -1-5 X IC- 362020	67.3	5.7	50.6	4.2	443.7
24	AKC -1-5 X IC- 362026	71.6	5.3	48.2	5.9	479.2
25	AKC -1-5 X IC- 572486	68.4	5.1	47.2	5.0	652.4
26	AKC -1-5 X IC- 572498	57.0	6.6	53.2	4.4	425.5
27	AKC -1-5 X IC- 537598	73.0	5.6	53.5	6.2	558.7
	Hybrid Mean	76.6	6.2	50.9	4.7	801.1
28	Arka Sweta	69.7	6.4	55.6	4.1	1008.2
29	Arka Harita	78.9	5.9	48.7	3.2	952.2
	Check Mean	74.3	6.2	52.2	3.7	980.2
	Grand Mean	76.2	6.2	51.7	4.3	891.0
	SE±	3.12	0.14	0.12	0.27	36.22
	CD @ 5%	9.05	0.41	0.34	0.77	104.92
	CD @ 1%	12.2	0.56	0.46	1.04	141.53

Table 3: *Per se* performance of parents and hybrids Dry fruit yield per plant (g), Fruit length (cm), Fruit diameter (cm) and Oleoresin (%)

SN	Genotypes	Dry fruit yield per plant (g)	Fruit length (cm)	Fruit diameter (cm)	Oleoresin (%)
		6	7	8	9
1	GT-1-1	322.8	7.5	1.0	10.0
2	IC- 362020	267.4	8.6	1.2	8.5
3	IC- 362026	311.4	7.8	1.3	9.9
4	IC- 572486	338.6	16.8	1.1	13.2
5	IC- 572498	284.3	3.5	1.3	10.7
6	IC- 537598	309.6	5.2	0.9	9.3
7	Jayanti	261.0	9.2	0.7	8.7
8	AKC -2-8-2	239.7	9.6	0.8	9.3
9	AKC -1-5	354.9	9.5	0.9	10.2
	Parent Mean	298.9	8.6	1.0	10.0
10	Jayanti X GT-1-1	313.3	8.5	1.0	9.7
11	Jayanti X IC- 362020	269.7	9.5	1.1	9.1
12	Jayanti X IC- 362026	300.0	8.8	0.8	9.9
13	Jayanti X IC- 572486	349.6	13	0.7	11.2
14	Jayanti X IC- 572498	267.8	6.6	1.0	9.7
15	Jayanti X IC- 537598	315.0	7.5	1.0	9.9
16	AKC -2-8-2 X GT-1-1	306.0	8.4	0.9	9.6
17	AKC -2-8-2 X IC- 362020	272.5	9.3	1.2	9.5
18	AKC -2-8-2 X IC- 362026	295.8	8.9	1.0	10
19	AKC -2-8-2 X IC- 572486	340.9	13.1	1.2	8.5
20	AKC -2-8-2 X IC- 572498	253.1	6.5	1.3	9.9
21	AKC -2-8-2 X IC- 537598	278.8	7.3	1.0	10.2
22	AKC -1-5 X GT-1-1	324.3	8.1	1.0	11.0
23	AKC -1-5 X IC- 362020	152.3	9.0	1.2	9.5
24	AKC -1-5 X IC- 362026	164.7	8.4	1.0	9.0
25	AKC -1-5 X IC- 572486	225.3	12.4	0.9	9.2
26	AKC -1-5 X IC- 572498	145.9	7.3	0.9	9.9
27	AKC -1-5 X IC- 537598	192.5	8.1	1.2	9.4
	Hybrid Mean	264.9	8.9	0.9	11.0
28	Arka Sweta	283.4	12.8	1.2	10.0
29	Arka Harita	284.5	10.0	1.2	9.7
	Check Mean	284	11.4	1.0	9.9
	Grand Mean	282.6	9.7	1.2	10.0
	SE±	13.58	0.32	0.07	8.1
	CD @ 5%	39.33	0.92	0.21	9.1
	CD @ 1%	53.06	1.24	0.63	9.6

Table 4: Magnitude of heterosis for plant height (cm), primary branches and days to 50% flowering for chilli

SN	Genotypes	Plant Height				Primary Branches				Days to 50% flowering			
		MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2
1	Jayanti X GT-1-1	11.87 *	3.75	13.05 *	-0.13	9.25 **	-1.59	-2.33	6.78 *	28.65 **	28.38 **	-3.41 **	10.37 **
2	Jayanti X IC- 362020	21.87 **	4.38	16.63 **	3.04	3.10	0.76	-1.55	7.63 **	5.42 **	-0.28	-9.97 **	2.87 **
3	Jayanti X IC- 362026	10.73 *	5.88	18.28 **	4.50	20.17 **	13.49 **	0.78	10.17 **	-2.38 **	-7.94 **	-13.39 **	-1.03 **
4	Jayanti X IC- 572486	4.01	1.10	14.62 *	1.27	-10.34 **	-20.61 **	3.10	12.71 **	-6.13 **	-11.38 **	-15.45 **	-3.39 **
5	Jayanti X IC- 572498	-4.33	-14.50 *	-0.79	-12.35 *	-5.70 *	-6.06	-6.20 *	2.54	9.97 **	9.97 **	-5.21 **	8.32 **
6	Jayanti X IC- 537598	7.46	7.06	16.70 **	3.10	-2.06	-9.16 **	-5.43 *	3.39	11.20 **	10.84 **	-4.13 **	9.55 **
7	AKC -2-8-2 X GT-1-1	7.47	-3.00	20.86 **	6.78	8.94 **	-4.48	-3.88	5.08	-9.78 **	-13.94 **	-2.79 **	11.09 **
8	AKC -2-8-2 X IC- 362020	25.16 **	4.59	17.56 **	3.86	-1.50	-2.24	-1.55	7.63 **	-8.99 **	-9.97 **	-8.98 **	4.00 **
9	AKC -2-8-2 X IC- 362026	-19.16 **	-24.85 **	25.95 **	11.27 *	7.32 *	-1.49	6.98 **	16.95 **	-7.68 **	-8.97 **	-12.58 **	-0.10
10	AKC -2-8-2 X IC- 572486	8.42	2.27	14.62 *	1.27	13.00 **	3.28	-2.33	6.78 *	8.04 **	2.77 **	-14.82 **	-2.67 **
11	AKC -2-8-2 X IC- 572498	21.33 **	5.51	3.80	-8.30	0.00	-3.79	1.55	11.02 **	-4.98 **	-5.74 **	-4.49 **	9.14 **
12	AKC -2-8-2 X IC- 537598	9.96	7.00	21.72 **	7.54	11.11 **	6.56	3.88	13.56 **	-8.88 **	-9.91 **	-6.56 **	6.78 **
13	AKC -1-5 X GT-1-1	17.92 **	16.97 *	10.54	-2.34	23.72 **	16.67 **	-5.43 *	3.39	-3.73 **	-6.92 **	-6.02 **	7.39 **
14	AKC -1-5 X IC- 362020	11.39	2.90	-3.58	-14.82 **	-1.63	-8.33 *	-11.63 **	-3.39	1.74 **	-0.75 *	-9.16 **	3.80 **
15	AKC -1-5 X IC- 362026	16.12 **	11.58	2.72	-9.25	7.96 *	7.02	-17.83 **	-10.17 **	2.55 **	-0.28	-13.30 **	-0.92 **
16	AKC -1-5 X IC- 572486	20.43 **	17.66 **	-2.01	-13.43 *	19.81 **	16.98 **	-21.71 **	14.41 **	13.36 **	12.12 **	-15.18 **	-3.08 **
17	AKC -1-5 X IC- 572498	27.48 **	14.45 *	-18.28 **	-27.80 **	6.72 *	-3.79	2.33	11.86 **	-0.10	-4.70 **	-4.49 **	9.14 **
18	AKC -1-5 X IC- 537598	21.51 **	20.42 **	4.59	-7.60	26.61 **	23.21 **	-13.18 **	-5.08	-4.37 **	-9.07 **	-3.86 **	9.86 **
	SE±	3.91	4.51	3.97		0.18	0.21	0.15		0.15	0.17	0.15	

*, ** denotes significance at 5% 1%

Table 5: Magnitude of heterosis for average Fruit Weight (g), fruit yield/plant (g) and dry fruit yield (g) for chilli

SN	Genotypes	Average Fruit Weight (g)				Fruit yield/plant (g)				Dry fruit yield (g)			
		MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2
1	Jayanti X GT-1-1	2.41	-15.84 *	24.39 *	59.38 **	13.98 *	-6.40	-10.36 *	-5.09	14.03 *	-5.30	10.53	10.12
2	Jayanti X IC- 362020	48.05 **	28.09 **	-2.44	25.00	7.25	-23.91 **	-22.71 **	-18.17 **	9.87	-21.55 **	-4.85	-5.20
3	Jayanti X IC- 362026	0.00	-24.00 **	3.66	32.81 *	13.73 *	-11.85 *	1.24	7.19	16.78 *	-8.64	5.84	5.45
4	Jayanti X IC- 572486	44.64 **	31.71 **	6.10	35.94 *	41.05 **	33.40 **	4.89	11.05 *	41.58 **	33.80 **	23.34 **	22.89 **
5	Jayanti X IC- 572498	-41.51 **	-49.59 **	-15.85	7.81	42.82 **	12.93	-23.24 **	-18.73 **	42.51 **	12.33	-5.50	-5.85
6	Jayanti X IC- 537598	-52.42 **	-52.80 **	-9.76	15.62	38.43 **	22.06 **	0.20	6.09	38.97 **	22.32 **	11.15	10.74
7	AKC -2-8-2 X GT-1-1	-39.13 **	-45.74 **	-10.98	14.06	35.42 **	22.56 **	0.85	6.78	3.55	-6.38	7.96	7.56
8	AKC -2-8-2 X IC- 362020	-12.84 *	-26.36 **	32.93 **	70.31 **	13.82	-13.03	-21.90 **	-17.31 **	12.90	-14.01	-3.85	-4.20
9	AKC -2-8-2 X IC- 362026	-38.58 **	-39.53 **	-9.76	15.62	49.96 **	26.99 **	-4.80	0.80	50.62 **	27.30 **	4.36	3.97
10	AKC -2-8-2 X IC- 572486	6.25	0.99	-20.73	1.56	9.47	-9.50	0.72	6.64	13.99 *	-3.41	20.27 **	19.83 **
11	AKC -2-8-2 X IC- 572498	-11.11	-12.09	50.00 **	92.19 **	9.43	-21.97 **	-27.41 **	-23.15 **	14.70	-16.85 *	-10.69	-11.02
12	AKC -2-8-2 X IC- 537598	-21.30 **	-32.00 **	57.32 **	101.56 **	31.08 **	2.21	-20.12 **	-15.42 **	16.09 *	-7.51	-1.62	-1.99
13	AKC -1-5 X GT-1-1	-5.95	-13.86	10.98	42.19 **	92.93 **	62.07 **	-0.94	4.88	85.17 **	55.15 **	14.43 *	14.01 *
14	AKC -1-5 X IC- 362020	-20.23 *	-22.47 *	2.44	31.25 *	78.05 **	74.39 **	-55.98 **	-53.40 **	79.64 **	75.89 **	-46.28 **	-46.48 **
15	AKC -1-5 X IC- 362026	-29.19 **	-40.80 **	45.12 **	85.94 **	101.54 **	80.80 **	-52.46 **	-49.67 **	82.77 **	63.68 **	-41.88 **	-42.10 **
16	AKC -1-5 X IC- 572486	-33.64 **	-38.66 **	23.17 *	57.81 **	79.69 **	55.84 **	-35.28 **	-31.48 **	56.90 **	35.80 **	-20.50 **	-20.79 **
17	AKC -1-5 X IC- 572498	4.81	-8.40	8.54	39.06 **	74.05 **	64.29 **	-57.79 **	-55.31 **	75.47 **	65.45 **	-48.52 **	-48.71 **
18	AKC -1-5 X IC- 537598	-39.34 **	-40.80 **	52.44 **	95.31 **	84.94 **	71.79 **	-44.58 **	-41.33 **	65.62 **	53.68 **	-32.09 **	-32.34 **
	SE±	0.33	0.38	0.42		45.87	52.96	47.28		17.25	19.92	17.67	

*, ** denotes significance at 5% 1%

Table 6: Magnitude of heterosis for fruit length (cm), fruit diameter (cm) and oleoresin (%) for chilli

SN	Genotypes	fruit length (cm)				Fruit diameter (cm)				Oleoresin (%)			
		MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2	MPH	BPH	SH1	SH2
1	Jayanti X GT-1-1	-41.06 **	-42.53 **	-33.59 **	-15.00 **	2.70	-5.00	-20.00 **	25.00 **	-9.30 **	-9.50 **	-3.00 *	19.75 **
2	Jayanti X IC- 362020	-15.27 **	-34.10 **	-25.78 **	-5.00	13.64 **	4.17	-16.00 **	31.25 **	-18.96 **	-22.62 **	-9.00 **	12.35 **
3	Jayanti X IC- 362026	-26.24 **	-40.23 **	-31.64 **	-12.50 *	18.18 **	8.33	-40.00 **	-6.25	-5.29 **	-10.86 **	-1.50	21.60 **
4	Jayanti X IC- 572486	77.78 **	35.48 **	1.17	29.50 **	5.00	-8.70	-44.00 **	-12.50	28.78 **	20.00 **	12.50 **	38.89 **
5	Jayanti X IC- 572498	-49.09 **	-51.72 **	-48.44 **	-34.00 **	10.64 *	8.33	-20.00 **	25.00 **	9.46 **	6.47 **	-3.00 *	19.75 **
6	Jayanti X IC- 537598	-28.77 **	-35.80 **	-41.02 **	-24.50 **	-19.15 **	-20.83 **	-24.00 **	18.75 **	-3.38 **	-4.62 **	-0.50	22.84 **
7	AKC -2-8-2 X GT-1-1	-6.60	-25.81 **	-34.38 **	-16.00 **	-16.67 **	-21.05 **	-32.00 **	6.25	-12.78 **	-20.91 **	-4.00 **	18.52 **
8	AKC -2-8-2 X IC- 362020	31.96 **	31.51 **	-26.95 **	-6.50	-20.93 **	-29.17 **	-4.00	50.00 **	-2.11	-7.46 **	-5.50 **	16.67 **
9	AKC -2-8-2 X IC- 362026	22.73 **	16.67 **	-30.47 **	-11.00 *	-11.63 **	-20.83 **	-16.00 **	31.25 **	9.63 **	5.13 **	2.50 *	26.54 **
10	AKC -2-8-2 X IC- 572486	-17.07 **	-31.45 **	1.95	30.50 **	14.29 *	11.11	-20.00 **	25.00 **	-3.96 **	-11.82 **	10.50 **	36.42 **
11	AKC -2-8-2 X IC- 572498	23.78 **	17.28 **	-49.22 **	-35.00 **	0.00	-12.50 *	-8.00	43.75 **	-5.45 **	-9.45 **	-5.00 **	17.28 **
12	AKC -2-8-2 X IC- 537598	8.02	8.02	-42.97 **	-27.00 **	-28.57 **	-37.50 **	-24.00 **	18.75 **	3.96 **	1.03	-10.50 **	10.49 **
13	AKC -1-5 X GT-1-1	21.31 **	4.44	-36.72 **	-19.00 **	-17.65 **	-17.65 **	-28.00 **	12.50	7.66 **	2.27	-8.00 **	13.58 **
14	AKC -1-5 X IC- 362020	-18.52 **	-26.26 **	-30.08 **	-10.50	-2.44	-16.67 **	-32.00 **	6.25	-2.76 *	-3.48 *	-1.00	22.22 **
15	AKC -1-5 X IC- 362026	-11.44 *	-15.64 **	-34.77 **	-16.50 **	-7.32	-20.83 **	-4.00	50.00 **	1.27	0.51	-5.50 **	16.67 **
16	AKC -1-5 X IC- 572486	-19.04 **	-32.26 **	-3.13	24.00 **	-17.07 **	-29.17 **	-32.00 **	6.25	-6.11 **	-12.73 **	10.00 **	35.80 **
17	AKC -1-5 X IC- 572498	19.87 **	11.98 *	-43.36 **	-27.50 **	0.00	0.00	-4.00	50.00 **	-3.08 *	-5.97 **	0.50	24.07 **
18	AKC -1-5 X IC- 537598	8.21	6.59	-36.72 **	-19.00 **	-12.50 **	-12.50 *	-4.00	50.00 **	6.77 **	5.13 **	-2.50 *	20.37 **
	SE±	0.4	0.46	0.51		0.05	0.06	0.05		0.11	0.13	0.11	

*, ** denotes significance at 5% 1%

Per se Performance

Plant height (cm): The maximum plant height from the parental lines were observed in AKC-2-8-2 (88.8 cm), which is at par with IC-362026 (84.6 cm), IC-362020 (83.4 cm), GT-1-1 (83.0 cm) and Jayanti (82.4 cm). Whereas, the minimum plant height was recorded in IC- 572498 (61.9 cm). Among the hybrids AKC -2-8-2 X IC- 362026 (87.9 cm) recorded maximum plant height and was found at par with

AKC -2-8-2 X IC- 537598 (84.9 cm), AKC -2-8-2 X GT-1-1 (84.3 cm), Jayanti X IC- 362026 (82.5 cm), AKC -28-2 X IC- 362020 (82 cm), Jayanti X IC- 537598 (81.4 cm), Jayanti X IC- 362020 (81.4 cm), Jayanti X IC- 572486 (80 cm), Jayanti X IC- 572486 (80 cm) and Jayanti X GT-1-1 (78.8 cm). The minimum plant height was observed in AKC-1-5 X IC- 572498 (57cm).

Plant branches

In pooled analysis, the maximum primary branches were recorded in IC-362020 (7.1) followed by IC-362026 (6.6), IC-572498 (6.6) and AKC-1-5 (6.5). Whereas, the genotype IC-572486 (5.2) recorded minimum number of primary branches per plant.

Among the hybrids, AKC -2-8-2 X IC- 362026 (6.9) recorded maximum number of primary branches per plant, at par with AKC -2-8-2 X IC- 537598 (6.7), Jayanti X IC- 572486 (6.6), AKC -1-5 X IC- 572498 (6.6). However, the hybrid AKC -1-5 X IC- 572486 (5.1) recorded minimum number of primary branches per plant.

Days to 50% flowering

From the parents, Jayanti (44.7 days) recorded minimum days to 50% flowering, followed by IC- 572486 (47.1 days), AKC-2-8-2 (47.8 days). Whereas, the genotype GT- 1-1 (60.8 days) recorded maximum days to 50% flowering.

Among the hybrids, Jayanti X IC - 572486 (47.0 days) recorded minimum days to 50% flowering, followed by AKC 1-5 X IC - 572486 (47.2 days), AKC -2-8-2 X IC- 572486 (47.4 days). However, the hybrid AKC -2-8-2 X GT-1-1 (54.1 days) recorded maximum days to 50% flowering.

Fruit weight (g)

The genotype IC- 572486 (8.1 g) recorded high fruit weight, followed by IC- 362020 (5.7 g) and IC- 362026 (4.8 g). Whereas the genotype IC-572498 (2.9 g) recorded lowest fruit weight.

Among the hybrids, AKC -2-8-2 X IC- 537598 (6.5 g), AKC -2-8-2 X IC- 572498 (6.2 g), AKC -1-5 X IC- 537598 (6.2 g) and AKC -1-5 X IC- 362026 (5.9 g), whereas, the hybrid AKC -2-8-2 X IC- 572486 (3.3 g) recorded lowest fruit weight.

Fruit yield per plant (g)

The parental lines AKC-1-5 (1022.7 g) recorded highest fruit yield per plant (g), followed by Jayanti (987 g), IC-572486 (976.2 g), GT-1-1 (950.5 g) and IC-362026 (895.1 g). Whereas, the genotype AKC-2-8-2 (700.5 g) recorded lowest fruit yield per plant (g).

Among the hybrids, Jayanti X IC- 572486 (1057.4 g) recorded highest fruit yield per plant, followed by Jayanti X IC- 362026 (1020.7 g), AKC-2-8-2 X GT-1-1 (1016.7 g), AKC -2-8-2 X IC- 572486 (1015.5 g). Whereas, the lowest fruit yield were recorded in the hybrid AKC -1-5 X IC- 572498 (425.5 g).

Dry fruit yield per plant (g)

The AKC-1-5 (354.9 g) recorded highest dry fruit yield per plant, followed by IC-572486 (338.6 g) and GT-1-1 (322.8 g). Whereas, the genotype AKC-2-8-2 (239.7 g) recorded lowest dry fruit yield per plant.

Among the hybrids, Jayanti X IC- 572486 (349.6 g) recorded highest dry fruit yield per plant, followed by AKC -2-8-2 X IC- 572486 (340.9 g), AKC -1-5 X GT-1-1 (324.3 g), Jayanti X IC- 537598 (315.0 g). The hybrid AKC -1-5 X IC- 572498 (145.9 g) recorded lowest dry fruit yield per plant.

Fruit length (cm)

The genotype IC-572486 (16.8 cm) recorded highest fruit length, followed by AKC-2-8-2 (9.6 cm), AKC -1-5 (9.5 cm) and Jayanti (9.2 cm). Whereas, the genotype IC – 572498 (3.5

cm) recorded lowest fruit length.

Among the hybrids, AKC -2-8-2 X IC- 572486 (13.1 cm) recorded highest fruit length, followed by Jayanti X IC- 572486 (13.0 cm), AKC -1-5 X IC- 572486 (12.4 cm). Whereas, the hybrid AKC -2-8-2 X IC- 572498 (6.5 cm) recorded lowest fruit length.

Fruit diameter (cm)

The IC-572498 (1.3 cm) recorded highest fruit diameter, followed by IC-362020 (1.2 cm), IC-572486 (1.1 cm), GT-1-1 (1.0 cm). The genotype IC-362026 (0.7 cm) recorded lowest fruit diameter.

Among the hybrids, AKC -2-8-2 X IC- 572498 (1.3 cm) recorded maximum fruit diameter and minimum was recorded in the hybrid Jayanti X IC- 572486 (0.7 cm).

Oleoresin (%)

The IC-572486 (13.2%) recorded highest oleoresin content, followed by IC- 572498 (10.7%) and AKC-1-5 (10.2%). Whereas, the Jayanti (8.7%) recorded lowest oleoresin (%).

Among the hybrids, Jayanti X IC- 572486 (11.2%) recorded highest oleoresin content and minimum oleoresin percent was recorded in hybrid AKC -2-8-2 X IC- 572486 (8.5%).

Heterosis

All the characters have considerable amount of heterosis over mid parent, better parent and check in most of cross combinations barring few exceptions. The degree or magnitude of heterosis however, it differed for different characters in different crosses.

Plant height (cm)

The heterosis over mid parent ranged from -19.16 percent to 27.48 percent. The hybrid AKC -1-5 X IC- 572498 (27.48%) recorded highly significant positive heterosis.

Heterosis over better parent ranged from -24.85 percent to 20.42 percent. Hybrid AKC -1-5 X IC- 537598 (20.42%) recorded highly significant positive heterosis as compared with checks.

Heterosis over standard check-1, ranged from -18.98 percent to 25.95 percent. The hybrid AKC -2-8-2 X IC- 362026 (25.95%) recorded significant positive heterosis over standard check-1.

However, heterosis over standard check-2, ranged from -27.80 percent to 11.27 percent. The hybrid AKC -2-8-2 X IC- 362026 (11.27%) recorded significant positive heterosis over standard check-2.

The similar kind of results are noted by Ram and Lal (1989)^[12], Patel *et al.* (1997)^[10], Thiruvvelavan *et al.*, (2002)^[15], Lankesh Kumar (2005)^[6] Reddy (2006)^[13] and Mohite-Patil (2011)^[8]. The mid parent heterosis was ranged from (-19.16 to 27.48) and in case of heterosis over standard check-2, respectively found desirable for plant height in chilli.

Primary branches

Heterosis over mid parent ranged from -10.34 percent to 26.61 percent. The hybrid AKC -1-5 X IC- 537598 (26.61%) recorded highly significant positive heterosis.

The heterosis over better parent ranged from -20.61 to 23.21 percent. Hybrid AKC -1-5 X IC- 537598 (23.21%) recorded significantly positive heterosis as compare with checks.

Heterosis over standard check-1, ranged from -21.71 percent to 6.98 percent. The hybrid AKC -2-8-2 X IC- 362026

(6.98%) recorded significant positive heterosis over check variety, Arka Sweta.

Days to 50% flowering

Heterosis over mid parent ranged from -9.78 percent to 28.65 percent. Out of 18 hybrids, 08 hybrids showed significantly positive heterosis while, 09 hybrids showed significantly negative heterosis. The hybrid AKC -2-8-2 X GT-1-1 (-9.78%) recorded highly significant negative heterosis.

Over the better parent ranged from -13.94 percent to 28.38 percent. Out of 18 hybrids, 05 hybrids showed significantly positive heterosis while, 11 hybrids showed significantly negative heterosis. Hybrid AKC -2-8-2 X GT-1-1 (-13.94%) recorded highly significant negative heterosis as compare with checks.

Heterosis over standard check-1, ranged from -15.45 percent to -2.79 percent. The hybrid Jayanti X IC- 572486 (-15.45%) recorded significant negative heterosis over check variety Arka Sweta. However, heterosis over standard check-2, ranged from -3.39 percent to 11.09 percent. The hybrid Jayanti X IC- 572486 (-3.39%) recorded significant negative heterosis over check variety Arka Harita. Similar range of heterosis observed by the Thiruvellavan (2002) [15] observed -7.43 percent to 20.11 percent for standard heterosis While Narasimha *et al.*, (2003) [9] as -3.54 percent to 22.85 percent and -9.84 percent to 14.82 percent heterosis over B.P and standard check respectively, and -3.99 percent to 14.62 percent for standard heterosis was observed by Laksmiah *et al.* (1987) [5], Lankesh Kumar (2005) [6], Adpawar *et al.* (2006) [1], Prasath and Ponnuswami (2008) [11].

Average fruit weight (g)

Over mid parent ranged from -52.42 percent to 48.05 percent. Out of 18 hybrids, 02 hybrids showed significantly positive heterosis while, 10 hybrids showed significantly negative heterosis. Hybrid Jayanti X IC- 362020 (48.05%) recorded highly significant positive heterosis as compare with checks.

Heterosis over better parent ranged from -52.80 percent to 31.71 percent. From 18 hybrids, 02 hybrids showed significantly positive heterosis while, 12 hybrids showed significantly negative heterosis. The F₁ Jayanti X IC- 572486 (31.71%) recorded highly significant positive heterosis as compare with checks.

Heterosis over standard check-1, ranged from -15.85 percent to 57.32 percent. The hybrid AKC -2-8-2 X IC- 537598 (57.32%) recorded significant positive heterosis over check variety Arka Sweta. However, heterosis over standard check-2 Arka Harita ranged from 1.56 percent to 101.56 percent. The hybrid AKC -2-8-2 X IC- 537598 (101.56%) recorded significant positive heterosis over check variety Arka Sweta. Lakshmaiah *et al.* (1987) [5] showed 14.15 percent maximum heterosis over mid parents and similar trend was presented by Kaul and Sharma (1988) [4], Ram and Lal (1989) [12] and Prasath and Ponnuswami (2008) [11].

Fruit yield per plant (g)

Heterosis over mid parent ranged from 7.25 percent to 101.54 percent. Out of 18 hybrids, 14 hybrids showed significantly positive heterosis. Hybrid AKC -1-5 X IC- 362026 (101.54%) recorded highly significant positive heterosis as compare with checks.

Heterosis over better parent ranged from -23.91 percent to 80.80 percent. Out of 18 hybrids, 10 hybrids were

significantly positive heterosis while, 03 hybrids showed significantly negative heterosis. Hybrid AKC -1-5 X IC- 362026 (80.80%) recorded highly significant positive heterosis as compare with checks.

Heterosis over standard check-1, ranged from -57.79 percent to 4.89 percent. However, heterosis over standard check-2 ranged from -55.31 percent to 11.05 percent.

The hybrid Jayanti X IC- 572486 (11.05%) recorded significant positive heterosis over check variety Arka Sweta. Similar result was observed in Lohithaswa (2001) [7] reported -42.59 percent to 45.29 percent heterosis over standard check. Patel *et al.* (1997) [10] also reported -40.51 percent to 51.29 percent heterosis over mid parent with similar trend of heterosis for green fruit yield per plant.

Dry fruit yield per plant (g)

In pooled analysis, heterosis over mid parent ranged from 3.55 percent to 85.17 percent. Out of 18 hybrids, 14 hybrids showed significantly positive heterosis. Hybrid AKC -1-5 X GT-1-1 (85.17%) recorded highly significant positive heterosis as compare with checks.

Heterosis over better parent ranged from -21.55 percent to 75.89 percent. Out of 18 hybrids, 09 hybrids showed significantly positive heterosis while, 02 hybrids showed significantly negative heterosis. Hybrid AKC -1-5 X IC- 362020 (75.89%) recorded highly significant positive heterosis as compare with checks.

Heterosis over standard check -1 ranged from -48.52 percent to 23.34 percent. The hybrid Jayanti X IC- 572486 (23.34%) recorded significant positive heterosis over check variety Arka Sweta. However, heterosis over (SH2) Arka Harita ranged from -48.71 percent to 22.89 percent. The hybrid Jayanti X IC- 572486 (22.89%) recorded significant positive heterosis over check variety Arka Harita.

Fruit length (cm)

In pooled analysis, heterosis over mid parent ranged from -49.09 percent to 77.78 percent. Out of 18 hybrids, 06 hybrids showed significantly positive heterosis while, 09 hybrids showed significantly negative heterosis. Hybrid Jayanti X IC- 572486 (77.78%) recorded highly significant positive heterosis as compared with checks.

Heterosis over better parent ranged from -51.72 percent to 35.38 percent. Out of 18 hybrids, 05 hybrids showed significantly positive heterosis while, 10 hybrids showed significantly negative heterosis. Hybrid Jayanti X IC- 572486 (35.38%) recorded highly significant positive heterosis as compared with checks.

Heterosis over standard check-1, ranged from -49.22 percent to 1.95 percent. However, heterosis over standard check-2, ranged from -35.00 percent to 30.50 percent. The hybrid AKC -2-8-2 X IC- 572486 (30.50%) recorded significant positive heterosis over standard check-2.

Lakshmaiah *et al.* (1987) [5] showed 14.15 percent maximum heterosis over mid parent also similar trend showed by Kaul and Sharma (1988) [4], Ram and Lal (1989) [12] and Prasath and Ponnuswami (2008) [11].

Fruit diameter (cm)

Heterosis over mid parent ranged from -28.57 percent to 18.18 percent. Out of 18 hybrids, 04 hybrids showed significantly positive heterosis while, 08 hybrids showed significantly negative heterosis. The hybrid Jayanti X IC-

362026 (18.18%) recorded highly significant positive heterosis as compared with checks.

Heterosis over better parent ranged from -37.50 percent to 11.11 percent. Out of 18 hybrids, 08 hybrids showed significantly positive heterosis while, 11 hybrids showed significantly negative heterosis. Hybrid AKC -2-8-2 X IC-572486 (11.11%) recorded positive heterosis as compared with checks.

Heterosis over standard check-1, ranged from -44.00 percent to -4.00 percent. However, heterosis over (SH2) Arka Harita ranged from -12.50 percent to 50.00 percent. The hybrid AKC -1-5 X IC- 572498 (50.00%) recorded significant positive heterosis over check variety Arka Harita.

Similar results were observed by Patil (1990) [8] as -13.20 percent to 43.20 percent heterosis over mid parent while similar trend observed by Narasimha *et al.*, (2003) [9] for standard check While Mohite-Patil (2011) [8] reported -33.97 percent to 35.67 percent over mid parent, 39.52 percent to 19.47 percent over better parent . and -12.82 percent to 62.02 percent over standard check.

Oleoresin (%)

Heterosis over mid parent ranged from -18.96 percent to 28.78 percent. Out of 18 hybrids, 06 hybrid showed significantly positive heterosis while, 10 hybrids showed significantly negative heterosis. Hybrid Jayanti X IC- 572486 (28.78%) recorded highly significant positive heterosis as compared with checks.

Heterosis over better parent ranged from -22.62 percent to 20.00 percent. Out of 18 hybrids, 04 hybrid showed significantly positive heterosis while, 11 hybrids showed significantly negative heterosis. Jayanti X IC- 572486 (20.00%) recorded highly significant positive heterosis.

Heterosis over standard check-1 ranged from -10.50 percent to 12.50 percent. Jayanti X IC- 572486 (12.50%) recorded significant heterosis over standard check-2. However, heterosis over (SH2) Arka Harita ranged from 10.49 percent to 38.89 percent. The hybrid Jayanti X IC- 572486 (38.89%) recorded significant positive heterosis over check variety Arka Harita. These results are in conformity with Tembhrune and Rao (2012) [14] and Chaudhary *et al.* (2013) [2].

Conclusion

In the present investigation, the wide range of heterosis over mid parent, better parent and standard check was recorded for all nine characters under study. Among the 18 crosses the cross combination AKC -1-5 x IC- 362026, AKC -1-5 x IC-362020, AKC -1-5 X IC- 537598, AKC -1-5 x GT-1-1 and Jayanti X IC – 572486 exhibited high heterosis, heterobeltiosis and standard heterosis for yield per plant along with the most of characters and that heterotic hybrids are in line to their *per se* performance.

For earliness purpose the cross combination AKC-2-8-2 X IC-362026, Jayanti X IC-572486, AKC-2-8-2 X IC- 362026 and AKC-1-5 X IC-537598 found negatively significant heterosis for the earliness traits viz., days to flower initiation, days to 50% flowering and days to first harvest.

The heterotic response observed in these hybrids was further supported by the predominant role of non-additive component in the inheritance of the characters. These cross combinations could be exploited in heterosis breeding programme.

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