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Study of Heterosis for Yield and Yield Contributing Traits in Desi Cotton (*Gossypium arboreum* L.)

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The Line x Tester method of analysis was followed involving 5 females viz., PA 740, PA760, PA848, PA828 and PAIG 77 and 6 males viz., AKA 9703, JLA 505, RAC 024, AKA 7, PA 08 and Phule Dhanwantary for study of heterosis for various yield and fibre characters. The F_1's and their parents were evaluated in Randomized Block Design with two replications. Observations were recorded on Days to 50% flowering, Plant height (cm), Number of sympodia per plant, Number of bolls per plant, Boll weight (g), Seed index, Seed cotton yield per plant (g) and Lint index. The high magnitude of heterosis for seed cotton yield per plant indicated that the cross PA 848 x Phule Dhanwantary (118.59 %), PAIG 77 x AKA 9703 (93.34 %) and PA 760 x PA 08 (82.22 %).

Introduction

Cotton is the most important fibre crop of India. Despite the increasing production of synthetic fibre, cotton has its reputation as "King of Fibres" due to its inherent properties. The production of cotton in the country is not making a striding increase. Conversely, the yield plateau in the cotton productivity can be broken by identifying high economic heterosis. The low production of cotton can be increased by increasing the area under hybrid cultivation, as hybrids are not only important for their high productivity but are generally good for stability for production also. They hold the key for making breakthrough in production of cotton and therefore, should be given more attention. For commercial exploitation of heterosis, the magnitude of heterosis provides a basis for genetic diversity and is a guide to the choice of desirable parents for developing superior F1hybrids, so as to exploit hybrid vigour or building the better gene pool after growing in subsequent generations. Cotton improvement programmes primarily lay emphasis from development of hybrids, which have contributed in improving productivity of cotton (Christopher *et al*, 2003). Hybridization is the most potent technique for breaking yield barriers. Effective improvement in yield may be brought about through selection on yield component characters. The objective of the present study was to determine the extent of heterosis foe seed cotton yield and yield contributing traits to identify promising hybrids.

Materials and Methods

The present investigation on "study of heterosis for yield and fibre quality traits in desi cotton" was conducted at Cotton Research Station, Mahboob Baugh Farm, VNMKV, Parbhani.

The experimental material for the present investigation consisted of eleven diverse genotypes. These selected eight genotypes possess good amount of variation for seed cotton yield per plant along with yield contributing traits were, Lines: PA 740, PA 760, PA 848, PA 828 and PAIG 77, Testers: AKA 9703, JLA 505, RAC 024, AKA 7 PA 08 and Phule Dhanwantary.

The experiment was laid in Randomized Block Design with two replications. The treatment consists of thirty crosses (F_1s) and eleven parents in the experiment.

The variety PKVDH 1, PKV Suvarna and PhuleDhanwantary were used as checks and parents were sown in adjacent separate blocks. Each treatment was randomized in each block sown in rows of 60 cm x 30 cm spacing. The heterosis was calculated over mid parent, better parent and standard checks as per the procedure suggested by Fonesca and Patterson (1968).

Results and Discussion

The analysis of variance showed significant differences among treatments for the characters studied (Table 1).

Heterosis (%) over mid parent (MP), better parent (BP) and standard check (SC) was calculated for yield and yield contributing characters. The results obtained are presented in Table 2, which are discussed below.

For days to 50 per cent flowering, the cross combination PA 848 x PA 08 displayed highest significant negative heterosis over mid parent (- 15.79 %), PA 828 x AKA 7 (-15.89%), while the cross combination PA 828 x AKA 7 (-11.19%) recorded significant negative heterosis over standard check PKVDH 1 and NACH 12. Out of thirty crosses, four crosses exhibited negatively significant heterosis over standard check PKV Suvarna. Significant negative heterosis for earliness was also reported by Deosarkar *et al.,* (2009), Patel *et al.,* (2010) and Jaiwar *et al.,* (2012).

High number of sympodia per plant with minimum number of monopodial branches is an indication of higher productivity. The cross combination PA 848 x JLA 505 exhibited highest significant positive heterosis over mid parent and better parent, whereas cross combination PAIG 77 x Phule Dhanwantary displayed highest positive significant heterosis over standard check PKV Suvarna. Seventeen crosses were found significantly superior over standard check PKV Suvarna. Heterosis for this trait was also reported by the earlier workers Tuteja *et al.,* (2011) and Balu *et al.,* (2012).

Plant height is an important morphological trait in cotton which provides space for nodes and internodes from where monopodial and sympodial branches arise. Thus it plays an important role in determining the morphological frame work relating to plant type, duration and productivity. The proportion of sympodial and monopodial branches, size and arrangement in a particular genotype together with height of the plant determine architecture of the cotton plant.

Table.1 Analysis of variance for Randomized Block Design

Source of variation	d.f.	Days to 50% flowering	No. of sympodia/plant	No. of bolls/plant	Boll weight (g)	Plant height (cm)	Days to maturity	Seed cotton yield /plant (g)	Lint index	Seed index (g)
		Mean sum of squares								
Replications	1	15.55	0.275	6.545	0.004	44.84	12.37	0.936	0.007	0.036
Treatments	43	23.76**	3.943**	16.37**	0.045**	997.64**	44.01**	122.89**	0.046**	1.352**
Error	43	7.25	0.444	2.824	0.021	15.26	7.351	5.731	0.019	0.200

Source of variation	d.f.	Ginning out turn (%)	Upper half mean length (mm)	Fibre fineness (micronaire) (µg/inch)	Fibre strength (g/tex)	Uniformity ratio (%)
	Mean sum of squares					
Replications	1	1.550	2.635	0.045	3.180	2.556
Treatments	43	35.45**	5.545**	0.162**	4.701**	4.138**
Error	43	1.481	1.457	0.039	1.252	1.859

*, ** significant at 5% and 1% levels, respectively

Table.2 Estimates of heterosis in percentage over mid parent (M.P.), better parent (B.P.) and standard checks (S.C.) for yield and yield contributing characters

Sr no	Hybrids	Days to 50% flowering						No. of sympodia/plant					
		Mean	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**			**Mean**	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**		
					PKVDH1	**PKV Suvarna**	**NACH 12**				**PKVDH1**	**PKV Suvarna**	**NACH 12**
1	PA 740 x AKA 9703	71.50	-3.70	-5.92	0.00	-2.72	0.70	14.74	8.60	-7.47	3.55	25.86**	-0.94
2	PA 740 x JLA 505	72.00	-3.03	-5.26	0.70	-2.04	1.41	12.91	-10.05*	-18.95**	-9.30	10.24	-13.23**
3	PA 740 x RAC 024	70.50	-3.75	-4.73	-1.40	-4.08	-0.70	11.25	-16.46**	-29.43**	-21.03**	-4.01	-24.45**
4	PA 740 x AKA 7	76.00	5.19	4.83	6.29	3.40	7.04	12.82	-8.95*	-19.58**	-10.01*	9.39	-13.91**
5	PA 740 x PA 08	71.50	-3.70	-5.92	0.00	-2.72	0.70	13.94	1.79	-12.49**	-2.07	19.04**	-6.32
6	PA 740 x PhuleDhanwantary	74.50	3.11	2.76	4.20	1.36	4.93	13.28	-2.83	-16.63**	-6.71	13.40*	-10.75*
7	PA 760 x AKA 9703	75.00	-0.66	-1.32	4.90	2.04	5.63	14.49	11.84*	-1.39	1.79	23.73**	-2.62
8	PA 760 x JLA 505	75.00	-0.66	-1.32	4.90	2.04	5.63	12.45	-9.43*	-15.34**	-12.61*	6.23	-16.39**
9	PA 760 x RAC 024	78.00	4.70	4.00	9.09*	6.12	9.86*	13.01	1.30	-11.50*	-8.64	11.05	-12.60**
10	PA 760 x AKA 7	72.50	-1.36	-3.33	1.40	-1.36	2.11	12.22	-9.20*	-16.87**	-14.19**	4.31	-17.90**
11	PA 760 x PA 08	70.50	-6.62*	-7.24	-1.40	-4.08	-0.70	11.07	-15.42**	-24.73**	-22.30**	-5.55	-25.66**
12	PA 760 x PhuleDhanwantary	74.50	1.36	-0.67	4.20	1.36	4.93	13.52	3.56	-8.03	-5.06	15.41*	-9.17
13	PA 848 x AKA 9703	68.50	-9.87**	-9.87*	-4.20	-6.80	-3.52	11.72	-7.15	-16.46**	-17.66**	0.09	-21.23**
14	PA 848 x JLA 505	72.00	-5.26	-5.26	0.70	-2.04	1.41	10.30	-23.21**	-26.65**	-27.70**	-12.12*	-30.84**
15	PA 848 x RAC 024	73.00	-2.67	-3.95	2.10	-0.68	2.82	15.16	21.22**	8.05	6.50	29.45**	1.88
16	PA 848 x AKA 7	65.00	-12.16**	-14.47**	-9.09*	-11.56**	-8.45*	12.19	-7.09	-13.11*	-14.36**	4.10	-18.07**
17	PA 848 x PA 08	64.00	-15.79**	-15.79**	-10.49*	-12.93**	-9.86*	11.67	-8.47	-16.85**	-18.05**	-0.38	-21.60**
18	PA 848 x PhuleDhanwantary	72.00	-2.70	-5.26	0.70	-2.04	1.41	14.04	10.36*	0.04	-1.40	19.85**	-5.68
19	PA 828 x AKA 9703	76.00	0.33	0.00	6.29	3.40	7.04	13.13	3.90	-6.58	-7.79	12.08*	-11.79*
20	PA 828 x JLA 505	68.00	-10.23**	-10.53**	-4.90	-7.48	-4.23	11.21	-16.45**	-20.24**	-21.28**	-4.31	-24.69**
21	PA 828 x RAC 024	68.50	-8.36*	-9.27*	-4.20	-6.80	-3.52	13.58	8.47	-3.38	-4.63	15.92**	-8.77
22	PA 828 x AKA 7	63.50	-13.90**	-15.89**	-11.19**	-13.61**	-10.56*	13.55	3.12	-3.63	-4.88	15.62*	-9.00
23	PA 828 x PA 08	70.00	-7.59*	-7.89*	-2.10	-4.76	-1.41	13.26	3.88	-5.69	-6.92	13.15*	-10.95*
24	PA 828 x PhuleDhanwantary	66.50	-9.83**	-11.92**	-6.99	-9.52*	-6.34	13.62	6.97	-3.09	-4.35	16.26**	-8.50
25	PAIG 77 x AKA 9703	72.50	-4.92	-5.23	1.40	-1.36	2.11	14.39	10.44*	-3.00	1.02	22.79**	-3.36
26	PAIG 77 x JLA 505	74.50	-2.30	-2.61	4.20	1.36	4.93	14.28	3.44	-3.71	0.28	21.90**	-4.06
27	PAIG 77 x RAC 024	75.50	0.33	-1.31	5.59	2.72	6.34	13.94	8.00	-6.00	-2.11	18.99**	-6.35
28	PAIG 77 x AKA 7	75.00	1.01	-1.96	4.90	2.04	5.63	14.54	7.49	-1.99	2.07	24.07**	-2.35
29	PAIG 77 x PA 08	74.00	-2.95	-3.27	3.50	0.68	4.23	11.95	-9.07	-19.39**	-16.05**	2.05	-19.68**
30	PAIG 77 x PhuleDhanwantary	69.00	-7.07*	-9.80*	-3.50	-6.12	-2.82	15.33	16.84**	3.37	7.65	30.86**	2.99
	S.E.±	72.42	2.406	2.778	2.778	2.778	2.778	13.13	0.583	0.673	0.673	0.673	0.673

Sr	**Hybrids**	**No. of bolls/plant**	**Boll weight (g)**

no		Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% standard heterosis over			Mean	M.P. Heterosis (%)	B.P. Heterosis (%)	% standard heterosis over		
					PKVDH1	PKV Suvarna	NACH 12				PKVDH1	PKV Suvarna	NACH 12
1	PA 740 x AKA 9703	18.50	7.25	0.00	15.63	-5.13	-15.91	2.50	17.55**	17.14*	10.89	12.13	1.22
2	PA 740 x JLA 505	16.00	0.00	0.00	0.00	-17.95	-27.27**	2.20	4.27	3.29	-2.22	-1.12	-10.75
3	PA 740 x RAC 024	22.50	45.16**	40.63**	40.63**	15.38	2.27	2.73	31.01**	27.93**	21.11**	22.47**	10.55
4	PA 740 x AKA 7	18.50	-3.90	-17.78*	15.63	-5.13	-15.91	2.22	0.91	-2.20	-1.33	-0.22	-9.94
5	PA 740 x PA 08	17.00	4.62	3.03	6.25	-12.82	-22.73**	2.15	-1.15	-3.15	-4.44	-3.37	-12.78*
6	PA 740 x PhuleDhanwantary	16.50	3.13	3.13	3.13	-15.38	-25.00**	2.31	5.48	2.67	2.67	3.82	-6.29
7	PA 760 x AKA 9703	19.00	15.15	2.70	18.75	-2.56	-13.64	2.13	2.77	0.71	-5.33	-4.27	-13.59*
8	PA 760 x JLA 505	18.50	21.31*	15.63	15.63	-5.13	-15.91	2.25	9.22	7.66	0.00	1.12	-8.72
9	PA 760 x RAC 024	18.50	25.42*	23.33	15.63	-5.13	-15.91	2.24	1.10	10.10	-0.67	0.45	-9.33
10	PA 760 x AKA 7	18.00	-2.70	-20.00*	12.50	-7.69	-18.18*	2.02	-6.05	-11.01	-10.22	-9.21	-18.05**
11	PA 760 x PA 08	24.00	-54.84**	45.45**	50.00*	23.08*	9.09	2.32	9.41	4.73	3.33	4.49	-5.68
12	PA 760 x PhuleDhanwantary	20.00	31.15**	25.00*	25.00*	2.56	-9.09	2.64	23.60**	17.56*	17.56*	18.88**	7.30
13	PA 848 x AKA 9703	25.00	44.93**	35.14**	56.25**	28.21**	13.64	2.16	-4.10	-9.79	-3.78	-2.70	-12.17
14	PA 848 x JLA 505	16.00	0.00	0.00	0.00	-17.95	-27.27**	2.00	-11.14	-16.88*	-11.33	-10.34	-19.07**
15	PA 848 x RAC 024	17.00	9.68	6.25	6.25	-12.82	-22.73**	2.07	-6.55	-13.75*	-8.00	-6.97	-16.02*
16	PA 848 x AKA 7	17.00	-11.69	-24.44**	6.25	-12.82	-22.73**	2.13	-8.99	-11.46	-5.56	-4.49	-13.79*
17	PA 848 x PA 08	20.00	23.08*	21.21	25.00*	2.56	-9.09	2.15	-6.71	-10.21	-4.22	-3.15	-12.58*
18	PA 848 x PhuleDhanwantary	26.00	62.50**	62.50**	62.50**	33.33**	18.18*	2.24	-3.66	-6.67	-0.44	0.67	-9.13
19	PA 828 x AKA 9703	19.50	16.42	5.41	21.88	0.00	-11.36	2.22	3.13	1.14	-1.11	0.00	-9.74
20	PA 828 x JLA 505	21.00	35.48**	31.25**	31.25**	7.69	-4.55	2.25	5.13	2.50	0.22	1.35	-8.52
21	PA 828 x RAC 024	21.50	43.33**	43.33**	34.38**	10.26	-2.27	2.29	8.27	4.09	1.78	2.92	-7.10
22	PA 828 x AKA 7	14.00	-37.78**	-37.78**	-12.50	-28.21**	-36.36**	2.27	1.57	0.00	0.89	2.02	-7.91
23	PA 828 x PA 08	17.50	6.06	6.06	9.38	-10.26	-20.45*	2.03	-8.37	-8.78	-10.00	-8.99	-17.85**
24	PA 828 x PhuleDhanwantary	19.50	21.88	21.88	21.88	0.00	-11.36	2.30	3.15	2.00	2.00	3.15	-6.90
25	PAIG 77 x AKA 9703	23.00	24.32*	24.32*	43.75**	17.95	4.55	2.08	-2.00	-2.35	-7.56	-6.52	-15.62*
26	PAIG 77 x JLA 505	20.00	25.00*	25.00*	25.00*	2.56	-9.09	2.22	5.21	4.23	-1.33	-0.22	-9.94
27	PAIG 77 x RAC 024	19.00	26.67*	26.67*	18.75	-2.56	-13.64	2.29	10.10	7.51	1.78	2.92	-7.10
28	PAIG 77 x AKA 7	18.00	-20.00*	-20.00*	12.50	-7.69	-18.18*	2.17	-1.59	-4.63	-3.78	-2.70	-12.17
29	PAIG 77 x PA 08	17.00	3.03	3.03	6.25	-12.82	-22.73**	2.16	-0.69	-2.70	-4.00	-2.92	-12.37
30	PAIG 77 x PhuleDhanwantary	16.00	0.00	0.00	0.00	-17.95	-27.27**	2.17	-0.91	-3.56	-3.56	-2.47	-11.97
	S.E.±	18.50	1.488	1.718	1.718	1.718	1.718	2.220	0.129	0.149	0.149	0.149	0.149

Sr no	Hybrids	Plant height (cm)						Seed cotton yield/plant (g)					
		Mean	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**			**Mean**	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**		
					PKVDH1	**PKV Suvarna**	**NACH 12**				**PKVDH1**	**PKV Suvarna**	**NACH 12**
1	PA 740 x AKA 9703	131.13	-22.20**	-31.33**	-17.49**	-7.56*	-10.82**	32.15	42.60**	36.32**	36.81**	3.88	-21.20**
2	PA 740 x JLA 505	123.35	-11.15**	-15.59**	-22.38**	-13.04**	-16.11**	22.69	2.24	-0.85	-3.43	-26.67**	-44.38**
3	PA 740 x RAC 024	137.95	1.13	-5.61*	-13.20**	-2.75	-6.18*	36.50	59.48**	50.39**	55.32**	17.93*	-10.54
4	PA 740 x AKA 7	161.55	10.28**	10.01**	1.65	13.88**	9.87**	33.60	4.83	-21.13**	42.98**	8.56	-17.65**
5	PA 740 x PA 08	180.11	38.88**	23.24**	13.33**	26.97	22.49**	30.80	38.77**	34.59**	31.06**	-0.48	-24.51**
6	PA 740 x PhuleDhanwantary	184.38	31.17**	26.16**	16.02**	29.98**	25.39**	23.89	5.30	0.06	1.68	-22.79**	-41.43**
7	PA 760 x AKA 9703	177.64	-4.20*	-6.97**	11.78**	25.23**	20.81**	29.80	29.61**	26.35*	26.81*	-3.72	-26.96**
8	PA 760 x JLA 505	143.85	-7.62**	-20.05**	-9.49**	1.40	-2.17	25.70	13.49	12.28	9.36	-16.96*	-37.01**
9	PA 760 x RAC 024	175.61	14.56**	-2.39	10.50**	23.80**	19.43**	32.40	38.85**	33.50**	37.87**	4.68	-20.59**
10	PA 760 x AKA 7	154.05	-5.71*	-14.38**	-3.07	8.59**	4.76	25.50	-21.54**	-40.14**	8.51	-17.61*	-37.50**
11	PA 760 x PA 08	134.53	-8.22**	-25.23**	-15.35**	-5.17	-8.51**	41.70	84.17**	82.22**	77.45**	34.73**	2.21
12	PA 760 x PhuleDhanwantary	151.01	-4.09	-16.06**	-4.98	6.45*	2.70	24.78	7.09	3.77	5.45	-19.94*	-39.26**
13	PA 848 x AKA 9703	176.00	-6.91**	-7.83**	1.074**	24.07**	19.70**	42.90	83.26**	81.90**	82.55**	38.61**	5.15
14	PA 848 x JLA 505	175.00	9.83**	-6.50**	10.11	23.37**	19.02**	23.53	2.03	1.27	0.13	-23.97**	-42.33**
15	PA 848 x RAC 024	138.53	-11.72**	-25.99**	-12.83**	-2.34	-5.79*	23.44	-1.34	-3.44	-0.28	-24.28**	-42.56
16	PA 848 x AKA 7	178.92	7.13	-4.41*	12.58**	26.13**	21.68**	22.68	-31.12**	-46.77**	-46.77**	-3.51	-44.42**
17	PA 848 x PA 08	136.50	-9.12**	-27.07**	-14.11**	-3.77	-7.17*	35.10	52.21**	51.07**	51.07**	49.36**	-13.97*
18	PA 848 x PhuleDhanwantary	143.14	-11.14**	-23.52**	-9.93**	0.91	-2.65	52.20	121.59**	118.59**	118.59**	122.23**	27.94**
19	PA 828 x AKA 9703	157.55	0.93	-17.49**	-0.87	11.06**	7.15*	31.50	35.05**	33.56**	33.56**	34.04**	-22.79**
20	PA 828 x JLA 505	129.76	2.68	-1.33	-18.35**	-8.53**	-11.75**	39.60	72.34**	71.69**	71.69**	68.51**	-2.94
21	PA 828 x RAC 024	176.81	42.63**	39.57**	11.25**	24.64**	20.25**	41.90	77.04**	72.64**	72.64**	78.30**	2.70
22	PA 828 x AKA 7	146.01	8.93**	-0.57	-8.13**	2.93	-0.70	23.60	-28.14**	-44.61**	-44.61**	0.40	-42.17**
23	PA 828 x PA 08	190.24	62.27**	56.91**	19.71**	34.11**	29.38**	27.00	17.52	17.06	17.06	14.89	-33.82**
24	PA 828 x PhuleDhanwantary	169.53	32.32**	25.58**	6.67*	19.51**	15.29**	36.80	56.78**	54.10**	54.10**	56.60**	-9.80
25	PAIG 77 x AKA 9703	177.17	15.96**	-7.21**	11.48**	24.90**	20.49**	45.60	95.56**	93.34**	93.34**	94.04**	11.76
26	PAIG 77 x JLA 505	158.13	28.48**	20.24**	-0.50	11.47**	7.54**	25.20	9.71	10.09	9.33	7.23	-38.24**
27	PAIG 77 x RAC 024	150.44	24.68**	18.76**	-5.34*	6.05*	2.31	27.90	17.92	14.96	14.96	18.72	-31.62**
28	PAIG 77 x AKA 7	188.10	43.87**	28.09**	18.36**	32.60**	27.92**	22.92	-30.24**	-46.24**	-46.24**	-2.55	-43.87**
29	PAIG 77 x PA 08	143.01	25.52**	24.75**	-10.01**	0.82	-2.74	30.80	34.10**	33.62**	33.62**	31.06**	-24.51**
30	PAIG 77 x PhuleDhanwantary	134.31	7.60*	-0.51	-15.49**	-5.32	-8.66**	28.00	19.33*	17.25	17.25	19.15	-31.37**
	S.E.±	153.76	3.445	3.978	3.978	3.978	3.978	29.74	2.116	2.443	2.443	2.443	2.443

Sr no	Hybrids	Seed index(g)						Lint index					
		Mean	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**			**Mean**	**M.P. Heterosis (%)**	**B.P. Heterosis (%)**	**% standard heterosis over**		
					PKVDH1	**PKV Suvarna**	**NACH 12**				**PKVDH1**	**PKV Suvarna**	**NACH 12**
1	PA 740 x AKA 9703	5.34	14.36	5.64	22.50*	4.92	-17.16*	3.70	3.65	1.37	0.27	2.78	1.51
2	PA 740 x JLA 505	4.35	-0.57	-13.76	0.00	-14.36	-32.38**	3.53	-0.35	-2.08	-4.07	-1.67	-2.88
3	PA 740 x RAC 024	5.47	21.69*	8.32	25.60*	7.57	-15.06*	3.85	11.05**	10.33*	4.34	6.95	5.63
4	PA 740 x AKA 7	5.28	-5.29	-13.44	21.24	3.83	-18.01*	3.41	-5.47	-8.58*	-7.46	-5.15	-6.32
5	PA 740 x PA 08	5.07	9.86	0.40	16.42	-0.29	-21.27**	3.50	-0.50	-1.41	-5.02	-2.64	-3.85
6	PA 740 x PhuleDhanwantary	4.49	-3.34	-11.09	3.10	-11.70	-30.28**	3.60	3.45	3.16	-2.44	0.00	-1.24
7	PA 760 x AKA 9703	5.07	18.87	18.46	16.42	-0.29	-21.27**	3.63	3.13	-0.41	-1.49	0.97	-0.27
8	PA 760 x JLA 505	4.85	21.86*	14.12	11.37	-4.62	-24.69**	3.60	2.78	-0.28	-2.31	0.14	-1.10
9	PA 760 x RAC 024	5.37	31.14**	26.35*	23.31*	5.60	-16.61**	3.68	7.68*	6.98	-0.14	2.36	1.10
10	PA 760 x AKA 7	4.38	-15.27	-28.11**	0.69	-13.77	-31.91**	3.62	1.61	-2.95	-1.76	0.70	-0.55
11	PA 760 x PA 08	6.55	55.28**	54.00**	50.29**	28.71**	1.63	3.85	10.87**	8.45*	4.48	7.09	5.77
12	PA 760 x PhuleDhanwantary	4.54	6.83	6.71	4.13	-10.82	-29.58**	3.59	4.52	3.46	-2.71	-0.28	-1.51
13	PA 848 x AKA 9703	6.55	51.68**	50.46**	50.29**	28.71**	1.63	4.00	13.54**	9.88*	8.68*	11.40**	10.03*
14	PA 848 x JLA 505	4.26	5.71	-2.07	-2.18	-16.22	-33.85**	3.60	2.42	-0.42	-2.44	0.00	-1.24
15	PA 848 x RAC 024	4.33	4.46	-0.46	-0.57	-14.85	-32.76**	3.62	5.55	5.09	-1.90	0.56	-0.69
16	PA 848 x AKA 7	4.31	-17.61*	-29.43**	-1.15	-15.34	-33.15**	3.54	-0.84	-5.09	-3.93	-1.53	-2.75
17	PA 848 x PA 08	5.33	24.97*	22.53*	22.39*	4.82	-17.24*	3.68	5.75	3.66	-0.14	2.36	1.10
18	PA 848 x PhuleDhanwantary	6.52	51.80**	49.89**	49.71**	28.22**	1.24	4.10	19.27**	18.33**	11.26**	14.05**	12.64**
19	PA 828 x AKA 9703	5.28	27.72**	23.25*	21.13	3.74	-18.09*	3.67	1.66	0.69	-0.41	2.09	0.82
20	PA 828 x JLA 505	6.04	57.09**	51.76**	38.69**	18.78*	-6.21	3.67	2.16	1.66	-0.41	2.09	0.82
21	PA 828 x RAC 024	6.13	54.92**	54.15**	40.87**	20.65*	-4.74	3.89	10.91**	8.81*	5.56	8.21*	6.87
22	PA 828 x AKA 7	4.02	-20.24*	-34.10**	-7.69	-20.94*	-37.58**	3.44	-5.68	-7.64	-6.51	-4.17	-5.36
23	PA 828 x PA 08	4.48	9.80	7.18	2.87	-11.90	-30.43**	3.50	-1.75	-2.10	-5.02	-2.64	-3.85
24	PA 828 x PhuleDhanwantary	5.46	32.73**	28.66*	25.26*	7.28	-15.30*	3.71	5.40	3.78	0.68	3.20	1.92
25	PAIG 77 x AKA 9703	6.55	53.51**	53.15**	50.52**	28.91**	1.79	3.51	-1.61	-3.57	-4.61	-2.23	-3.43
26	PAIG 77 x JLA 505	5.02	25.85*	17.72	15.15	-1.38	-22.13**	3.84	8.16*	6.51	4.34	6.95	5.63
27	PAIG 77 x RAC 024	4.63	12.93	8.69	6.31	-8.95	-28.11**	3.55	2.31	1.43	-3.66	-1.25	-2.47
28	PAIG 77 x AKA 7	3.84	-25.87*	-37.05**	-11.83	-24.48*	-40.37**	3.47	-4.15	-7.10	-5.97	-3.62	-4.81
29	PAIG 77 x PA 08	5.06	19.79*	18.66	16.07	-0.59	-21.51**	3.67	4.26	3.52	-0.27	2.23	0.96
30	PAIG 77 x Phuledhanwantary	5.16	21.41*	21.13	18.48	1.47	-19.88**	3.61	3.52	3.00	-2.17	0.28	-0.96
	S.E.±	4.952	0.401	0.463	0.463	0.463.	0.463	3.621	0.121	0.140	0.140	0.140	0.140

These branches provide structural arrangements or nodes for fruiting points which are finally converted into productive open bolls after floral shedding. As far as plant height is concerned, out of 30 crosses, the cross combination PA 828 x PA 08 recorded highest significant positive heterosis over mid and better parent, while the cross combination PA 828 x PA 08 recorded standard heterosis over three standard checks. These findings are in accordance with the results obtained by Dawod *et al.,* (2010), Guvercin (2011), Patel *et al.,* (2011), Jaiwar *et al.,* (2012), Kumar *et al.,* (2013).

For number of bolls per plant, positive heterosis is desirable. Out of 30 crosses, ten crosses displayed significant positive heterosis over PKVDH-1, while three crosses each exhibited significant positive heterosis over check PKV Suvarna. The cross combination PA 848 x PhuleDhanwantary exhibited maximum positive heterosis over mid parent, better parent and standard checks. Heterosis for this trait was reported by the earlier workers Tuteja *et al.,* (2011), Balu *et al.,* (2012) Jaiwar *et al.,* (2012), Sekhar *et al.,* (2012), Kumar *et al.,* (2013) and Singh *et al.,* (2013).

For the boll weight, positive heterosis is desirable. The cross combination PA 740 x RAC 024 exhibited maximum positive heterosis over mid parent, better parent and standard checks PKVDH 1 and PKV Suvarna. Out of 30 crosses, three crosses were found superior over mid parent, three over better parent and two over standard check PKVDH1 and PKVSuvarna for boll weight. Heterosis for this trait was also reported by the earlier workers, Tuteja *et al.,* (2011), Balu *et al.,* (2012) Jaiwar *et al.,* (2012), Sekhar *et al.,* (2012) and Singh *et al.,* (2013).

For the seed index, positive heterosis is desirable. Out of 30 crosses, fifteen crosses were found positively superior over mid parent, ten over better parent, eleven over standard check PKVDH 1 and six over standard check PKV Suvarna for seed index. The cross combination PA 828 x JLA 505 and PA 828 x RAC 024 exhibited maximum positive significant heterosis over mid parent, better parent respectively. The cross combination PAIG 77 x AKA 9703 exhibited maximum positive significant heterosis over standard check. Heterosis for this trait was reported by the earlier workers Khalid Hussain *et al.,* (2009), Tuteja *et al.,* (2011) and Balu *et al.,* (2012).

For lint index heterosis in positive direction is desirable. The cross combination PA 848 x Phuledhawantary exhibited maximum positive heterosis over mid parent and better parent. Out of thirty crosses, seven crosses recorded positive heterosis over mid parent, five over better parent and eight crosses over standard checks PKVDH 1. The crosses PA 848 x Phuledhawantary recorded highest significant positive heterosis over the checks PKVDH 1, PKV Suvarna and NACH 12. Similar results were obtained by Guvercin (2011).

The cross combination PA 848 x PhuleDhanwantary (121.59 %) displayed significantly positive average heterosis for seed cotton yield per plant followed by PAIG 77 x AKA 9703 (95.56 %) and PA 760 x PA 08 (84.17 %). In case of better parent heterosis, the cross PA 848 (118.59 %) recorded highest significant positive heterosis followed by the crosses PAIG 77 x AKA 9703 (93.34 %) and PA 760 x PA 08 (82.22 %). The cross PA 848 x PhuleDhanwantary displayed the highest significant positive heterosis over the standard check PKVDH 1 (118.59 %), PKV Suvarna (122.23 %) and NACH 12 (27.94 %). The range of heterosis over check PKV Suvarna was -26.67 per cent (PA 740 x JLA 505) to 122.23 per cent (PA

848 x Phule Dhanwantary). Heterosis for seed cotton yield and other related characters in arboreum cotton has also been reported earlier by Patel *et al.*, 2010, Jaiwar *et al.*, 2012, Kumar 2013 and Singh *et al.*, 2013.

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