International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(2): 115-119

Received: 09-01-2020
Accepted: 13-02-2020

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Heterosis studies in CMS based and conventional hybrids for fibre quality in cotton (*G. hirsutum* L.) Over the environment's

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DOI: https://doi.org/10.22271/chemi.2020.v8.i2b.8755

Abstract
The present study comprised of three male sterile CMS lines, three maintainer lines and ten male fertile males (testers/ restorers) with three standard checks in two sets i.e. CMS and conventional thus making 60 F_1s (30 CMS and 30 conventional) using Line x Tester mating design. For the fibre properties, CAK 23B x R-2000-17-2 and CAK 53A x R-2000-23 for upper half mean length, CAK 53B x R 2000-23 and SRT-1A x R- 2000-23 for fibre strength hold promise for further evaluation and commercial exploitation of heterosis both in CMS and conventional system for high yield and fibre properties.

Keywords: Heterosis, CMS, conventional, cotton, fibre

Introduction
In cotton, different sources of male sterility are available. Out of which genetic male sterility (GMS) and cytopolasmic genetic male sterility (CGMS) are mainly used in both diploid and tetraploid species of cotton for hybrid development. Male sterility based cotton hybrids are blessed with cheaper and higher seed production. But both the male sterility system (GMS and CGMS) have low productivity than their fertile counterpart. Low productivity of lines developed from sterile cytoplasm in case of CGMS system may be explained with Plasmon sensitivity hypothesis, according to which the maternal cytoplasm provides an unstable substrate from paternal genes. There is a continuous need to evolve new hybrids which should exceed the existing hybrids in yield and fibre quality. Breeding of commercial hybrids has been proved to be the most important tool in increasing the yields of crop plants substantially within a short period.

Materials and Methods
The present study comprised of three male sterile CMS lines, three maintainer lines and ten male fertile males (testers/ restorers) with three standard checks in two sets i.e. CMS and conventional thus making 60 F_1s (30 CMS and 30 conventional) using Line x Tester mating design. These lines, testers and hybrids along with three checks were sown during *kharif*, 2016 at three locations *viz.*, Cotton Research Station, Nanded (L-1), Experimental farm of Department of Agricultural Botany, VNMKV, Parbhani (L-2) and Experimental farm, Agricultural Research Station, Badnapur (L-3). Observations were recorded on randomly selected five competitive plants from each replication for each genotype on ginning percentage, upper half mean length (mm), uniformity index (%), micronaire value (ug/inch) and fibre strength (g/tex). The mean square from line x tester design and the general combining ability (GCA) and specific combining ability (SCA) variance and effects were calculated as per procedure given by Kempthorne, 1957.

Results and Discussion
The experimental results revealed that the heterotic effect was high in the conventional than CMS for the traits like upper half mean length and fibre strength (g/tex). But among both the sets of crosses (thirty CMS and thirty conventional) the CMS cross CAK 53A x AKH 07 R possessed the highest heterosis over better parent and standard heterosis for the traits ginning percentage and the micronaire value.

Maximum positive significant crosses were found in conventional system than in CMS system. Similar results of significant desirable heterosis for fibre quality traits were also reported by Deosarkar *et al*. (2009) [1], Tuteja and Agrawal (2014) [10] and Sharma *et.al* (2016) [7].

In the CMS crosses, magnitude of heterosis was moderate over the better parent and standard check for the characters *viz*. fibre strength and low heterosis for the traits uniformity index and ginning percentage. Among the conventional crosses, higher heterotic effects were found for the trait fibre strength. Moderately observed for upper half mean length and micronaire value. Low heterotic effects were found for the ginning percentage and uniformity index. Heterosis for different traits in conventional hybrids were also reported by workers Deosarkar *et al*. (2009) [1], Patel *et al*. (2014) [5], Pushpam *et al*. (2015) [6] and Sharma *et al*. (2016) [7].

By comparing both the sets by using different parameters based on CMS system and conventional method revealed that three crosses i.e. RT-1 x R 2000-17-2, CAK 53 x R-1044-13 and CAK 53 x R- 2000-23 were common for traits ginning percentage, micronaire value and upper half mean length in both CMS and conventional crosses.For the fibre properties, CAK 23B x R-2000-17-2 and CAK 53A x R-2000-23 for upper half mean length, CAK 53B x R 2000-23 and SRT-1A x R- 2000-23 for fibre strength hold promise for further evaluation and commercial exploitation of heterosis both in CMS and conventional system for high yield and fibre properties. Present findings were also in agreement with the results of Shinde *et al*. (2012) [8], Siwach and Sangwan (2014) [9], Patel *et al*. (2014) [5] and Kannan and Saravanan (2015) [2].

Table 1: Per cent heterosis pooled over environments over better parent (BPH), check hybrids PKV-Hy-4 (SH 1), NHH-206 (SH 2) and NHH-44 (SH 3)

Sr. No.	Crosses	Upper half mean length (mm)				Uniformity index (%)			
		BPH	SH 1	SH 2	SH 3	BPH	SH 1	SH 2	SH 3
1	CAK 53A X R-42-8	6.19 **	-3.11 **	-12.31 **	2.51 *	1.06	-1.09 *	-4.54 **	0.42
2	CAK 53A X R-2000-23	8.07 **	10.79 **	0.27	17.21 **	0.39	3.00 **	-0.6	4.56 **
3	CAK 53A X R- 2000-17-2	-0.09	10.19 **	-0.27	16.59 **	-0.39	3.44 **	-0.17	5.01 **
4	CAK 53A X R-2000-26	1.62	4.48 **	-5.44 **	10.54 **	-1.92 **	1.19 *	-2.34 **	2.73 **
5	CAK 53A X R-1044-13	3.27 **	6.50 **	-3.61 **	12.68 **	2.18 **	3.46 **	-0.15	5.03 **
6	CAK 53A X R-2000-21	-2.82 **	4.43 **	-5.49 **	10.49 **	1.02	2.31 **	-1.26 *	3.87 **
7	CAK 53A X R-23	9.96 **	13.86 **	3.05 **	20.47 **	1.11 *	3.58 **	-0.04	5.15 **
8	CAK 53A X R-53	4.21 **	6.55 **	-3.57 **	12.73 **	2.22 **	3.38 **	-0.23	4.95 **
9	CAK 53A X AKH-07R	11.91 **	6.94 **	-3.21 **	13.15 **	4.27 **	3.45 **	-0.15	5.03 **
10	CAK 53A X DHY-286-1R	4.02 **	3.50 **	-6.33 **	9.50 **	1.06	0.68	-2.83 **	2.21 **
11	CAK 53B X R-42-8	20.47 **	9.92 **	-0.52	16.29 **	5.76 **	3.52 **	-0.09	5.10 **
12	CAK 53B X R-2000-23	10.65 **	13.43 **	2.66 **	20.01 **	1.97 **	4.61 **	0.96	6.21 **
13	CAK 53B X R- 2000-17-2	-0.16	10.12 **	-0.34	16.51 **	-1.11 *	2.69 **	-0.89	4.26 **
14	CAK 53B X R-2000-26	0.57	3.40 **	-6.42 **	9.40 **	-0.90	2.25 **	-1.32 *	3.80 **
15	CAK 53B X R-1044-13	7.26 **	10.62 **	0.11	17.03 **	4.70 **	6.00 **	2.31 **	7.62 **
16	CAK 53B X R-2000-21	-2.43 **	4.85 **	-5.10 **	10.94 **	1.31 *	2.60 **	-0.98	4.16 **
17	CAK 53B X R-23	2.74 **	6.38 **	-3.72 **	12.55 **	1.94 **	4.43 **	0.79	6.02 **
18	CAK 53B X R-53	4.86 **	7.21 **	-2.97 **	13.43 **	1.71 **	2.86 **	-0.73	4.43 **
19	CAK 53B X AKH-07R	10.70 **	5.78 **	-4.26 **	11.92 **	3.36 **	2.54 **	-1.03 *	4.11 **
20	CAK 53B X DHY-286-1R	11.19 **	10.64 **	0.13	17.05 **	1.52 **	1.14 *	-2.39 **	2.68 **
21	CAK 23A X R-42-8	-7.32 **	-4.82 **	-13.85 **	0.71	-0.63	2.06 **	-1.50 **	3.62 **
22	CAK 23A X R-2000-23	4.10 **	6.91 **	-3.24 **	13.11 **	0.97	3.70 **	0.09	5.28 **
23	CAK 23A X R- 2000-17-2	-0.11	10.17 **	-0.29	16.56 **	0.69	4.56 **	0.92	6.16 **
24	CAK 23A X R-2000-26	-1.21	1.56	-8.08 **	7.45 **	-2.01 **	1.10 *	-2.43 **	2.64 **
25	CAK 23A X R-1044-13	1.74	4.93 **	-5.04 **	11.01 **	-1.59 **	1.08 *	-2.45 **	2.62 **
26	CAK 23A X R-2000-21	0.96	8.49 **	-1.81 *	14.79 **	-2.52 **	0.12	-3.37 **	1.65 **
27	CAK 23A X R-23	-9.15 **	-5.93 **	-14.86 **	-0.47	-0.24	2.46 **	-1.11 *	4.02 **
28	CAK 23A X R-53	-1.56	1.10	-8.50 **	6.96 **	-1.62 **	1.04	-2.48 **	2.58 **
29	CAK 23A X AKH-07R	-6.55 **	-4.03 **	-13.14 **	1.54	-4.10 **	-1.50 **	-4.94 **	0
30	CAK 23A X DHY-286-1R	9.71 **	12.67 **	1.97 *	19.21 **	-1.11 *	1.57 **	-1.98 **	3.11 **
31	CAK 23B X R-42-8	-0.53	2.15 *	-7.55 **	8.08 **	-2.68 **	-0.04	-3.53 **	1.48 **
Sr. No.	**Crosses**	**Upper half mean length (mm)**				**Uniformity index (%)**			
		BPH	**SH 1**	**SH 2**	**SH 3**	**BPH**	**SH 1**	**SH 2**	**SH 3**
32	CAK 23B X R-2000-23	4.83 **	7.66 **	-2.57 **	13.90 **	-0.12	2.59 **	-0.99	4.15 **
33	CAK 23B X R- 2000-17-2	4.21 **	14.93 **	4.02 **	21.60 **	0.94	4.82 **	1.17 *	6.42 **
34	CAK 23B X R-2000-26	9.73 **	12.82 **	2.10 *	19.36 **	1.41 **	4.62 **	0.97	6.22 **
35	CAK 23B X R-1044-13	9.96 **	13.40 **	2.63 **	19.98 **	-0.44	2.25 **	-1.31 *	3.81 **
36	CAK 23B X R-2000-21	-8.64 **	-1.82	-11.14 **	3.88 **	-1.96 **	0.69	-2.82 **	2.22 **
37	CAK 23B X R-23	-3.87 **	-0.46	-9.91 **	5.31 **	-0.04	2.67 **	-0.92	4.23 **
38	CAK 23B X R-53	0.24	2.95 **	-6.83 **	8.92 **	0.63	3.35 **	-0.25	4.93 **
39	CAK 23B X AKH-07R	4.51 **	7.33 **	-2.87 **	13.55 **	1.70 **	4.45 **	0.81	6.04 **
40	CAK 23B X DHY-286-1R	6.77 **	9.66 **	-0.76	16.02 **	0.90	3.63 **	0.02	5.21 **
41	SRT-1A X R-42-8	11.24 **	3.00 **	-6.78 **	8.97 **	1.75 **	0.61	-2.89 **	2.15 **
42	SRT-1A X R-2000-23	11.44 **	14.23 **	3.39 **	20.86 **	3.02 **	5.69 **	2.01 **	7.30 **
43	SRT-1A X R- 2000-17-2	-6.39 **	3.24 **	-6.56 **	9.23 **	-1.36 **	2.43 **	-1.14 *	3.99 **
44	SRT-1A X R-2000-26	-3.29 **	-0.57	-10.02 **	5.19 **	0.39	3.57 **	-0.04	5.15 **
45	SRT-1A X R-1044-13	-1.48	1.61	-8.04 **	7.50 **	-1.21 *	0.02	-3.47 **	1.54 **
46	SRT-1A X R-2000-21	-7.28 **	-0.36	-9.82 **	5.42 **	-0.16	1.12 *	-2.41 **	2.66 **
47	SRT-1A X R-23	-9.77 **	-6.57 **	-15.44 **	-1.15	0.50	2.95 **	-0.64	4.52 **

48	SRT-1A X R-53	-7.37 **	-5.29 **	-14.28 **	0.2	2.41 **	3.56 **	-0.05	5.14 **
49	SRT-1A X AKH-07R	-4.37 **	-8.62 **	-17.30 **	-3.32 **	-0.40	-1.18 *	-4.63 **	0.32
50	SRT-1A X DHY-286-1R	8.08 **	7.54 **	-2.67 **	13.78 **	3.88 **	3.49 **	-0.12	5.07 **
51	SRT-1B X R-42-8	20.49 **	11.55 **	0.96	18.03 **	3.45 **	2.30 **	-1.27 *	3.86 **
52	SRT-1B X R-2000-23	-0.95	1.54	-8.11 **	7.43 **	0.90	3.52 **	-0.09	5.10 **
53	SRT-1B X R- 2000-17-2	-9.78 **	-0.49	-9.94 **	5.28 **	-2.25 **	1.51 **	-2.03 **	3.06 **
54	SRT-1B X R-2000-26	8.47 **	11.52 **	0.93	17.99 **	0.30	3.47 **	-0.13	5.05 **
55	SRT-1B X R-1044-13	6.96 **	10.30 **	-0.17	16.70 **	1.05	2.31 **	-1.26 *	3.86 **
56	SRT-1B X R-2000-21	-14.63 **	-8.26 **	-16.97 **	-2.93 **	-2.31 **	-1.06	-4.51 **	0.45
57	SRT-1B X R-23	-4.64 **	-1.26	-10.63 **	4.47 **	-1.27 *	1.14 *	-2.38 **	2.68 **
58	SRT-1B X R-53	-2.03 *	0.17	-9.34 **	5.98 **	1.42 **	2.57 **	-1.01	4.13 **
59	SRT-1B X AKH-07R	7.30 **	2.54 **	-7.20 **	8.48 **	3.10 **	2.29 **	-1.28 *	3.85 **
60	SRT-1B X DHY-286-1R	11.37 **	10.81 **	0.29	17.24 **	3.79 **	3.40 **	-0.21	4.97 **
	S.E.±	0.25	0.25	0.25	0.25	0.44	0.44	0.44	0.44
	C.D. @ 5%	0.49	0.49	0.49	0.49	0.86	0.86	0.86	0.86

Table 1 Continue…

Sr. No.	Crosses	Micronaire value (ug/in)				Fibre strength (g/tex)			
		BPH	SH 1	SH 2	SH 3	BPH	SH 1	SH 2	SH 3
1	CAK 53A X R-42-8	10.32 **	15.81 **	4.72	17.43 **	-2.07	-8.88 **	-11.30 **	3.93 *
2	CAK 53A X R-2000-23	-5.44	-0.74	-10.24 **	0.65	11.07 **	3.35 *	0.60	17.88 **
3	CAK 53A X R- 2000-17-2	-7.80 *	1.33	-8.37 *	2.75	-8.91 **	-3.75 **	-6.30 **	9.79 **
4	CAK 53A X R-2000-26	-22.06 **	-18.18 **	-26.01 **	-17.03 **	2.99 *	-4.17 **	-6.72 **	9.30 **
5	CAK 53A X R-1044-13	-9.90 **	-5.42	-14.48 **	-4.1	5.78 **	-1.57	-4.18 **	12.27 **
6	CAK 53A X R-2000-21	-16.17 **	-7.78 *	-16.61 **	-6.49	3.60 *	-0.44	-3.08 *	13.56 **
7	CAK 53A X R-23	12.29 **	20.20 **	8.69 *	21.88 **	4.09 **	0.07	-2.59	14.14 **
8	CAK 53A X R-53	-20.28 **	-0.69	-10.20 **	0.70	5.81 **	4.72 **	1.93	19.44 **
9	CAK 53A X AKH-07R	-23.66 **	2.51	-7.31 *	3.95	0.35	-2.65	-5.24 **	11.03 **
10	CAK 53A X DHY-286-1R	-34.45 **	-3.84	-13.05 **	-2.50	11.12 **	3.39 *	0.65	17.93 **
11	CAK 53B X R-42-8	16.80 **	22.61 **	10.87 **	24.33 **	7.10 **	-0.34	-2.99 *	13.67 **
12	CAK 53B X R-2000-23	-9.20 *	-4.68	-13.81 **	-3.35	29.30 **	20.31 **	17.12 **	37.23 **
13	CAK 53B X R- 2000-17-2	-8.43 *	0.64	-9.54*	2.05	-1.75	3.82 **	1.06	18.42 **
14	CAK 53B X R-2000-26	-5.77	-1.08	-10.56 **	0.30	-2.76	-9.52 **	-11.92 **	3.20 *
15	CAK 53B X R-1044-13	-8.49 *	-3.94	-13.14 **	-2.60	14.03 **	6.10 **	3.29 *	21.02 **
16	CAK 53B X R-2000-21	-4.16	5.42	-4.68	6.89	1.95	-2.02	-4.62 **	11.76 **
17	CAK 53B X R-23	-0.37	6.65	-3.56	8.14 *	3.19 *	-0.80	-3.43 *	13.15 **
18	CAK 53B X R-53	-21.35 **	-2.02	-11.40 **	-0.65	1.12	0.08	-2.58	14.15 **
19	CAK 53B X AKH-07R	-21.50 **	5.42	-4.68	6.89	3.35 *	0.26	-2.40	14.35 **
20	CAK 53B X DHY-286-1R	-17.06 **	21.67 **	10.02 **	23.38 **	13.81 **	5.90 **	3.09 *	20.79 **
21	CAK 23A X R-42-8	23.98 **	24.29 **	12.38 **	26.02 **	-13.84 **	-14.24 **	-16.52 **	-2.19
22	CAK 23A X R-2000-23	1.67	1.92	-7.84 *	3.35	-0.43	-0.89	-3.52 *	13.05 **
23	CAK 23A X R- 2000-17-2	-9.86 **	-0.94	-10.42 **	0.45	0.73	6.45 **	3.62 **	21.41 **
24	CAK 23A X R-2000-26	15.22 **	17.44 **	6.19	19.08 **	-1.35	-1.81	-4.42 **	11.99 **
25	CAK 23A X R-1044-13	18.91 **	23.89 **	12.03 **	25.62 **	-6.82 **	-7.25 **	-9.71 **	5.79 **
26	CAK 23A X R-2000-21	-3.49	6.16	-4.01	7.64	7.30 **	6.80 **	3.97 **	21.82 **
27	CAK 23A X R-23	3.45	10.74 **	0.13	12.29 **	1.95	1.48	-1.22	15.74 **
28	CAK 23A X R-53	-11.82 **	9.85 *	-0.67	11.39 **	9.71 **	9.20 **	6.30 **	24.56 **
29	CAK 23A X AKH-07R	-6.93 *	24.98 **	13.01 **	26.72 **	-3.62 *	-4.07 **	-6.62 **	9.42 **
30	CAK 23A X DHY-286-1R	-11.18 **	30.30 **	17.82 **	32.12 **	7.24 **	6.75 **	3.91 **	21.75 **
31	CAK 23B X R-42-8	2.51	2.76	-7.08 *	4.20	4.02 **	3.53 *	0.78	18.09 **
Sr. No.	**Crosses**	**Micronaire value (ug/in)**				**Fibre strength (g/tex)**			
		BPH	**SH 1**	**SH 2**	**SH 3**	**BPH**	**SH 1**	**SH 2**	**SH 3**
32	CAK 23B X R-2000-23	0.15	0.39	-9.22 **	1.8	-0.43	-0.89	-3.52 *	13.05 **
33	CAK 23B X R- 2000-17-2	-7.58 *	1.58	-8.15 *	3.00	-4.48 **	0.94	-1.75	15.13 **
34	CAK 23B X R-2000-26	5.46	7.49	-2.81	8.99 *	4.53 **	4.04 **	1.28	18.67 **
35	CAK 23B X R-1044-13	-24.11 **	-20.94 **	-28.51 **	-19.83 **	14.95 **	14.41 **	11.38 **	30.50 **
36	CAK 23B X R-2000-21	2.87	13.15 **	2.32	14.74 **	2.4	1.92	-0.78	16.25 **
37	CAK 23B X R-23	1.01	8.13 *	-2.23	9.64 *	2.41	1.93	-0.77	16.27 **
38	CAK 23B X R-53	-21.43 **	-2.12	-11.49 **	-0.75	9.23 **	8.73 **	5.84 **	24.01 **
39	CAK 23B X AKH-07R	-23.00 **	3.40	-6.5	4.85	7.64 **	7.14 **	4.29 **	22.20 **
40	CAK 23B X DHY-286-1R	-14.44 **	25.52 **	13.50 **	27.27 **	-0.24	-0.70	-3.34 *	13.26 **
41	SRT-1A X R-42-8	7.76 *	27.98 **	15.72 **	29.77 **	7.90 **	-3.72 **	-6.28 **	9.81 **
42	SRT-1A X R-2000-23	-9.04 **	8.03 *	-2.32	9.54 *	24.58 **	14.30 **	11.26 **	30.37 **
43	SRT-1A X R- 2000-17-2	-8.88 **	8.23 *	-2.14	9.74 *	-12.96 **	-8.02 **	-10.46 **	4.91 **
44	SRT-1A X R-2000-26	-10.87 **	5.86	-4.28	7.34	-2.8	-10.24 **	-12.62 **	2.38
45	SRT-1A X R-1044-13	-8.83 **	8.28 *	-2.09	9.79 *	6.11 **	-5.32 **	-7.83 **	8.00 **
46	SRT-1A X R-2000-21	-13.60 **	2.61	-7.22 *	4.05	-3.69 *	-7.44 **	-9.90 **	5.57 **
47	SRT-1A X R-23	2.70	21.97 **	10.29 **	23.68 **	-6.13 **	-9.76 **	-12.15 **	2.93

48	SRT-1A X R-53	-10.60 **	11.38 **	0.71	12.94 **	-7.55 **	-8.50 **	-10.93 **	4.37 **
49	SRT-1A X AKH-07R	-11.12 **	19.36 **	7.93 *	21.03 **	-4.67 **	-7.53 **	-9.98 **	5.47 **
50	SRT-1A X DHY-286-1R	-14.04 **	26.11 **	14.03 **	27.87 **	15.26 **	2.85 *	0.12	17.31 **
51	SRT-1B X R-42-8	12.28 **	33.35 **	20.58 **	35.21 **	12.40 **	0.29	-2.37	14.39 **
52	SRT-1B X R-2000-23	2.86	22.17 **	10.47 **	23.88 **	9.25 **	0.24	-2.43	14.33 **
53	SRT-1B X R- 2000-17-2	-17.79 **	-2.36	-11.71 **	-1.00	-6.00 **	-0.67	-3.31 *	13.29 **
54	SRT-1B X R-2000-26	-7.84 *	9.46 *	-1.02	10.99 **	9.49 **	1.11	-1.57	15.33 **
55	SRT-1B X R-1044-13	-13.44 **	2.81	-7.04 *	4.25	23.75 **	10.42 **	7.49 **	25.95 **
56	SRT-1B X R-2000-21	0.79	19.70 **	8.24 *	21.38 **	-2.85	-6.63 **	-9.11 **	6.50 **
57	SRT-1B X R-23	4.36	23.94 **	12.07 **	25.67 **	-3.62 *	-7.34 **	-9.80 **	5.69 **
58	SRT-1B X R-53	4.07	29.66 **	17.24 **	31.47 **	-3.29 *	-4.29 **	-6.83 **	9.17 **
59	SRT-1B X AKH-07R	-18.38 **	9.61 *	-0.89	11.14 **	-0.48	-3.46 *	-6.03 **	10.11 **
60	SRT-1B X DHY-286-1R	-13.53 **	26.85 **	14.70 **	28.62 **	16.36 **	3.83 **	1.08	18.43 **
	S.E.±	0.13	0.13	0.13	0.13	0.40	0.40	0.40	0.40
	C.D. @ 5%	0.26	0.26	0.26	0.26	0.78	0.78	0.78	0.78

Table 1 Continue…

Sr. No.	Crosses	Ginning percentage			
		BPH	SH 1	SH 2	SH 3
1	CAK 53A X R-42-8	1.75	8.22 **	3.99 *	4.50 *
2	CAK 53A X R-2000-23	5.82 **	7.87 **	3.66 *	4.16 *
3	CAK 53A X R- 2000-17-2	-4.21 *	-2.34	-6.16 **	-5.70 **
4	CAK 53A X R-2000-26	4.26 *	6.29 **	2.13	2.63
5	CAK 53A X R-1044-13	-1.97	-0.06	-3.97 *	-3.5
6	CAK 53A X R-2000-21	0.73	7.11 **	2.93	3.43
7	CAK 53A X R-23	-1.68	4.27 *	0.19	0.68
8	CAK 53A X R-53	-5.05 **	0.54	-3.39	-2.91
9	CAK 53A X AKH-07R	8.83 **	11.10 **	6.76 **	7.28 **
10	CAK 53A X DHY-286-1R	5.52 **	7.57 **	3.37	3.87 *
11	CAK 53B X R-42-8	3.43	10.00 **	5.70 **	6.22 **
12	CAK 53B X R-2000-23	0.59	2.55	-1.46	-0.98
13	CAK 53B X R- 2000-17-2	0.22	2.17	-1.82	-1.34
14	CAK 53B X R-2000-26	5.29 **	7.34 **	3.14	3.64
15	CAK 53B X R-1044-13	-5.21 **	-3.37	-7.15 **	-6.69 **
16	CAK 53B X R-2000-21	1.86	8.32 **	4.09 *	4.60 *
17	CAK 53B X R-23	0.67	6.76 **	2.58	3.08
18	CAK 53B X R-53	0.67	6.60 **	2.43	2.93
19	CAK 53B X AKH-07R	3.77 *	5.93 **	1.79	2.29
20	CAK 53B X DHY-286-1R	0.92	2.88	-1.14	-0.65
21	CAK 23A X R-42-8	-1.99	4.28 *	0.21	0.69
22	CAK 23A X R-2000-23	1.75	8.25 **	4.02 *	4.53 *
23	CAK 23A X R- 2000-17-2	-7.50 **	-1.58	-5.42 **	-4.96 **
24	CAK 23A X R-2000-26	3.27	9.88 **	5.59 **	6.10 **
25	CAK 23A X R-1044-13	-6.58 **	-0.6	-4.49 *	-4.02 *
26	CAK 23A X R-2000-21	-0.51	5.85 **	1.71	2.21
27	CAK 23A X R-23	-4.54 *	1.56	-2.4	-1.93
28	CAK 23A X R-53	-7.04 **	-1.09	-4.96 **	-4.49 *
29	CAK 23A X AKH-07R	-5.12 **	0.95	-2.99	-2.52
30	CAK 23A X DHY-286-1R	2.51	9.07 **	4.81 **	5.32 **
31	CAK 23B X R-42-8	0.98	7.44 **	3.24	3.74 *
Sr. No.	**Crosses**	**Ginning percentage**			
		BPH	**SH 1**	**SH 2**	**SH 3**
32	CAK 23B X R-2000-23	3.46	10.08 **	5.78 **	6.29 **
33	CAK 23B X R- 2000-17-2	-5.16 **	0.91	-3.04	-2.56
34	CAK 23B X R-2000-26	-1.44	4.87 *	0.77	1.26
35	CAK 23B X R-1044-13	-0.61	5.75 **	1.62	2.12
36	CAK 23B X R-2000-21	2.81	9.39 **	5.11 **	5.63 **
37	CAK 23B X R-23	0.87	7.33 **	3.13	3.64
38	CAK 23B X R-53	2.08	8.61 **	4.36 *	4.87 **
39	CAK 23B X AKH-07R	-4.17 *	1.96	-2.02	-1.54
40	CAK 23B X DHY-286-1R	2.22	8.76 **	4.51 *	5.02 **
41	SRT-1A X R-42-8	1.65	8.11 **	3.89 *	4.39 *
42	SRT-1A X R-2000-23	0.92	6.39 **	2.24	2.73
43	SRT-1A X R- 2000-17-2	3.86 *	9.50 **	5.22 **	5.73 **
44	SRT-1A X R-2000-26	4.48 *	10.15 **	5.85 **	6.37 **
45	SRT-1A X R-1044-13	-0.58	4.82 *	0.72	1.21
46	SRT-1A X R-2000-21	-3.13	3.01	-1.02	-0.53
47	SRT-1A X R-23	-6.63 **	-0.99	-4.86 **	-4.39 *

48	SRT-1A X R-53	-6.09 **	-0.57	-4.45 *	-3.99 *
49	SRT-1A X AKH-07R	-3.00	2.26	-1.74	-1.26
50	SRT-1A X DHY-286-1R	2.18	7.73 **	3.52	4.02 *
51	SRT-1B X R-42-8	-2.25	3.96 *	-0.1	0.39
52	SRT-1B X R-2000-23	4.30 *	9.96 **	5.66 **	6.18 **
53	SRT-1B X R- 2000-17-2	4.50 *	10.17 **	5.86 **	6.38 **
54	SRT-1B X R-2000-26	1.07	6.56 **	2.39	2.89
55	SRT-1B X R-1044-13	2.11	7.65 **	3.44	3.95 *
56	SRT-1B X R-2000-21	2.51	9.00 **	4.74 *	5.25 **
57	SRT-1B X R-23	-4.47 *	1.31	-2.65	-2.17
58	SRT-1B X R-53	3.32	9.40 **	5.13 **	5.64 **
59	SRT-1B X AKH-07R	-5.17 **	-0.02	-3.93 *	-3.46
60	SRT-1B X DHY-286-1R	-0.16	5.26 **	1.14	1.64
	S.E.±	0.69	0.69	0.69	0.69
	C.D. @ 5%	1.36	1.36	1.36	1.36

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