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HETEROSIS AND LINE–TESTER ANALYSIS OF INTRA–*GOSSYPIUM BARBADENSE* L. HYBRIDS. I. YIELD, PLANT CANOPY AND EARLINESS

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ABSTRACT

In a 3 x 11 line–tester analysis, the extent of heterosis over midparent (MP), better parent (BP), commercial checks for yield and fibre quality was calculated in intra-*G. barbadense* L. hybrids. Lines and testers produced 51.8–69.7 g/plant seed cotton, and the eight top yielding hybrids 75.9–93.3 g/plant, nearly equalling that of interspecific hybrid DCH-32 (94.8 g). Ginning outturn of hybrids was 30.6–34.4% of the best line. The hybrids were 20–28 days earlier and showed similar plant canopy characters. Heterosis for seed cotton yield over the cultivars was 17.3-81.1%. Boll number/plant was determined by both additive and nonadditive gene actions while average boll weight was mostly controlled by additive gene action. Boll weight could be improved by inter se mating among selected plants in the segregating generations. The line BCS 9-70 and the testers TCS 30-6, TCS 3-5 and TCS 9-5 were high general combiners for yield, boll weight, ginning outturn, lint weight/100 seeds, and earliness. In a 5-location trial, the top yielding hybrids produced 80–100% higher yield than the cultivars and were equal to the commercial hybrid DCH-32.

Key words: Intra-barbadense hybrids, combining ability, yield, plant canopy, earliness.

The varieties of *G. barbadense* L. produce superfine, extra long, and best quality fibre. Cultivation of this cotton in India is of recent origin. Cotton growers in the hilly tracts of Karnataka and Kerala States started growing cv. S. I. Andrews in the early 1950s [1]. Development of the first Indian barbadense cv. Sujata was ushered in by Santhanam and Krishnamurthy [2], and a little later cv. Suvin was released for cultivation [3]. Cv. Suvin produces fibre matching the fibre quality of Egyptian cotton. But this variety has a crop duration of 220–230 days and gives only 26–28% ginning outturn (GOT). With the objective of increasing yield and reducing crop duration, heterosis for seed cotton yield, plant canopy, and earliness was studied in intra-barbadense hybrids. The eight top ranking hybrids were tested for yield at five locations.

MATERIALS AND METHODS

Two agronomic base varieties, S. I. Andrews and Suvin, and one promising strain, BCS 9-70, developed by composite crossing of F_1s followed by intermating selected progenies [4], were used as female lines. Eleven selected genotypes from germplasm of *G. barbadense*, including three Egyptian lines (PL-D6, PL-D2 and Giza 7), composite crossed selections, and three-way crossed selections were used as males for hybridisation. The 14 parental strains and 33 F_1 hybrids were grown at the Agricultural Research Station, Dharwad Farm, in RBD with three replications. Plot size was of 2 rows with 20 plants/row, spaced 90 cm between rows and 30 cm between plants, during crop season 1985, under irrigated conditions. For comparison, four rows of the interspecific commercial hybrid, DCH-32, were grown separately in a plot. Observations were recorded on 18 plants per row in each replication and also in the middle two rows of DCH-32. Data were recorded on seed cotton yield per plant (YLD), total number of bolls (BO), average weight of seed cotton/boll from 5 fully opened bolls (BWT), ginning outturn (GOT), lint weight/100 seeds (LWT), 100-seed weight (SWT), plant height (HT), number of monopodial branches (Mo), number of sympodial branches (SYM), total number of nodes on the main stem (Nodes), internodal length (INTL), days to first flower (DFL), and days to first boll opening (DBO). Mean values were worked out. Line–tester analysis for combining ability was carried out following Kempthorne [5] and Beil and Atkins [6]. Extent of heterosis over the respective midparental (MP), better parental (BP) values, yield check (S. I. Andrews) and fibre quality check (Suvin) were worked out. During 1986, multilocation trial for yield was conducted at 5 locations under irrigated conditions in 8-row plots, each row with 20 plants, and three replications.

RESULTS AND DISCUSSION

India is the only country where interspecific hirsutum–barbadense hybrids are grown commercially mainly to increase cotton productivity, but it involves heavy cost on inputs and also poses problems of fibre quality [7]. Therefore, the possibility of exploitation of heterosis in the intra- barbadense hybrids were explored.

Exploitation of heterosis for commercial purposes involves identification of F_1 hybrids giving substantially higher yields than the check varieties. The YLD of 33 F_1 hybrids ranged from 32.8–93.8 g/plant, and therefore, data on only eight hybrids giving more than 25% higher YLD than cv. S. I. Andrews are presented (Table 1). BCS 9-70 and cv. S. I. Andrews gave more or less the same yield (59.7 g), while cv. Suvin gave significantly low yield. Suvin exhibited lowest GOT and was 5-10 days later in DFL and 6-20 days in DBO than the other two lines. The tester TCS 30-6 produced significantly the higher yield (69.7 g) and was statistically at par with YLD of TCS 9-5 and BCS 171-28. All the testers exhibited significantly higher GOT as compared to cv. Suvin and were equal or numerically superior to S. I. Andrews. The top eight ranking hybrids produced 75.9 (Suvin x TCS 9-5) to 93.8/plant (BCS 9-70 x TCS 30-6 and BCS 9-70 x TCS 3-5), and the YLD was nearly equal to that of check

hybrid, DCH-32 (94.8 g). The cross BCS 9-70 x TCS 30-6 also exhibited the highest GOT of 34.4% and was equal in this respect to the hybrid BCS 9-70 x BCS 171-2B. The eight hybrids had earlier DFL and DBO than compared to cv. Suvin. Almost all the hybrids were taller by 2 to 25 cm than the two cultivars, but for other plant canopy characters like number of monopodia and sympodia. Nodes and INTL, the hybrids were more or less comparable to the cultivars. This shows that intra-barbadense hybrids do not attain the huge plant structure as depicted by the interspecific hybrid DCH-32 (Table 1). Yet, the top yielding intra-barbadense hybrids produced nearly equal YLD. Huge plant canopy of the hybrid DCH-32 makes it cumbersome for crop management [7]. Therefore, intra-barbadense hybrids can be easily grown like true breeding cultivars, as plant canopy of such hybrids was similar to that of the former. The hybrids BCS 9-70 x TCS 30-6, BCS 9-70 x TCS 3-5, and BCS 9-70 x BCS 171-2B were shortest in duration

Table 1. Mean values of lines, testers and eight top ranking intra-barbadense F_1 hyb-

Parent or hybrid	Yield and yield components						
	YLD (g)	FLPT (no.)	BO (no.)	BWT (g)	GOT (%)	LW (g)	SW (g)
Lines:							
S.I. Andrews	59.6	47.5	25.2	3.1	32.5	4.2	10.1
Suvin	51.8	75.7	26.7	2.8	28.4	4.0	9.9
BCS 9-70	59.7	61.3	39.7	3.7	34.8	4.9	10.4
Testers:							
PL-D6	63.1	57.3	25.4	3.5	32.8	5.4	9.8
TCS 30-6	69.7	38.9	29.8	3.5	33.0	4.9	9.7
BCS 12-125	60.3	57.9	29.7	3.4	34.3	5.3	10.7
TCS 9-5	65.2	61.4	32.8	3.7	32.8	5.4	10.6
TCS 3-5	57.8	59.6	28.3	3.4	33.4	5.3	10.1
PL-D2	55.3	45.0	20.3	3.5	31.8	5.1	10.8
BCS 9-45	66.8	47.6	20.6	3.4	33.9	5.6	11.1
BCS 14-48	45.2	36.6	17.2	3.2	32.6	4.3	9.3
BCS 171-2B	67.3	34.6	19.0	3.0	34.1	5.8	10.8
BCS 180-42	46.7	55.5	24.8	3.2	32.1	5.0	10.2
Giza-7	56.8	71.3	26.7	3.0	33.5	5.3	11.6
CD at 5%	6.4	10.2	3.2	0.2	1.5	0.7	1.6
Hybrids:							
BCS 9-70 x TCS 30-6	93.8	63.8	37.6	3.0	34.4	4.7	10.2
BCS 9-70 x TCS 3-5	93.8	75.6	37.9	3.9	33.6	4.0	8.4
BCS 9-70 x TCS 9-5	86.5	86.8	29.8	4.1	32.8	4.6	9.3
S.I. Andrews x Giza-7	83.1	78.0	30.7	4.1	32.5	5.7	10.1
BCS 9-7 x BCS 171-2B	80.5	60.7	34.8	3.6	34.4	5.6	9.9
S.I. Andrews x TCS 9-5	79.9	69.5	32.0	4.1	33.8	6.7	12.2
BCS 9-70 x BCS 12-125	78.3	62.8	33.1	3.2	33.6	4.3	9.8
Suvin x TCS 9-5	75.9	66.7	29.0	3.4	30.3	4.8	10.4
CD at 5%	6.8	10.3	4.1	0.9	1.2	0.8	1.1
DCH-32 (interspecific check hybrid)	94.8	68.4	35.5	4.0	32.1	4.6	10.6

rids in respect of yield components, plant canopy and earliness characters

Plant canopy characters					Earliness characters	
HL (cm)	Nodes (no.)	Intl (cm)	MO (no.)	Sym (no.)	DFL (no.)	DBO (no.)
111	20.5	5.0	2.0	17.8	71.6	132.3
91	22.8	4.3	3.3	18.8	76.7	138.1
101	19.8	5.2	2.9	15.7	66.7	118.7
102	20.9	5.0	2.9	16.6	74.2	131.1
113	23.7	4.9	2.8	20.6	72.6	130.3
70	19.0	3.8	3.0	14.7	77.0	137.2
106	20.4	5.4	2.9	18.3	75.6	132.4
103	20.6	4.9	3.2	16.6	74.1	131.3
84	18.5	4.8	2.9	14.3	74.9	128.4
97	20.1	4.8	2.6	18.5	72.7	129.8
86	19.3	5.0	2.0	16.3	75.3	131.3
80	17.5	4.5	2.0	15.4	74.0	130.6
99	21.9	4.6	2.7	18.2	73.3	130.0
111	21.0	5.9	2.3	18.2	72.9	131.0
5.6	1.1	0.6	0.7	1.2	1.4	1.3
113	21.6	5.1	3.9	18.2	70.0	120.7
114	20.2	5.7	3.6	16.6	70.8	125.8
122	21.2	5.9	3.2	17.4	73.7	126.5
126	20.6	6.4	3.3	17.3	72.3	130.1
82	17.8	4.7	2.2	16.4	64.4	122.6
122	23.2	5.2	3.0	19.5	77.5	130.5
101	22.7	4.7	3.8	17.4	67.8	128.0
114	20.2	4.0	2.6	18.3	71.0	129.7
9.5	2.6	0.8	0.6	1.4	1.9	2.1
158	28.9	8.5	3.8	25.8	69.4	134.7

having DBO 120–125. Considering yielding ability, smaller plant canopy structure and crop duration, it was found necessary that the hybrids involving BCS 9-70 in cross combinations with TCS 30-6, TCS 3-5 and TCS 9-5 could be tested on a large scale for increasing productivity of barbadense cottons in India and such hybrids could replace DCH-32, which is cultivated with heavy expenditure on inputs in South India.

Heterosis for YLD over MP, BP and cvs. S. I. Andrews and Suvin exhibited by the eight hybrids was very high, ranging between 26.7–59.6% over MP, 16.4–57% over BP, 27.3–57.4% over cv. S. I. Andrews, and as high as 46.5–81.0% over cv. Suvin (Table 2). Marani [8] reported 21.6% heterosis for YLD in intra-barbadense crosses. The study of F_1 gives a broad idea about the nature of gene action. The eight hybrids listed revealed nonadditive gene action for YLD. But in respect of BO and BWT, the gene action for the hybrids BCS 9-70 x TCS 30-6, BCS 9-70 x TCS 3-5, and S. I. Andrews x TCS 9-5 was additive since the values did not differ significantly from the respective MP values. In respect of BWT all the hybrids, except S. I. Andrews x Giza 7, showed additive gene action as the values were statistically at the same level as their MP values. Thus BWT

Table 2. Heterosis of intra-barbadense hybrids

Hybrid	Flowering points				Days to flowering			
	MP	BP	CC_1	CC_2	MP	BP	CC_1	CC_2
BCS 9-70 x TCS 30-6	27.3*	4.1	34.3	-15.7*	—0.2	-0.8	0.56	-5.13
BCS-9-70 x TCS 3-5	25.1*	23.3*	59.2*	-0.1	-2.9*	-4.4*	-1.12	-7.69*
BCS 9-70 x TCS 9-5	41.5*	41.4*	82.7*	14.7*	0.7	-2.5*	2.93*	-3.91
S.I. Andrews x Giza-7	31.3*	9.4*	64.2*	3.0	0.7	-0.8	0.98	-5.74*
BCS 9-70 x BCS 171-2B	26.6*	-1.0	27.8*	-19.8*	-2.0	-3.5*	-0.28	-6.91*
S.I. Andrews x TCS 9-5	27.6*	13.2*	46.3	8.2	-2.8*	-5.4*	-0.14	-6.78*
S.I. Andrews x BCS-12-125	19.2*	8.5	32.2*	-17.0*	4.64*	1.0	8.66*	1.43
Suvin x TCS 9-5	-2.7	-11.9*	40.4*	-11.9*	-6.8*	-7.4*	-0.84	-7.43*

Hybrid	Seed cotton yield				Lint weight			
	MP	BP	CC_1	CC_2	MP	BP	CC_1	CC_2
BCS 9-70 x TCS 30-6	45.0*	34.6*	57.4*	81.1*	-5.0	-5.0	11.9	17.5
BCS-9-70 x TCS 3-5	59.7*	57.1*	57.4*	81.1*	-2.1	-2.4*	-4.8	0.0*
BCS 9-70 x TCS 9-5	38.5*	32.7*	45.1*	67.0*	-10.5	-14.8*	9.5	15.0
S.I. Andrews x Giza-7	42.8*	39.4*	39.4*	60.4*	-20.0*	7.5*	35.9*	42.5*
BCS 9-70 x BCS 171-2B	26.8*	19.6*	35.1*	55.4*	2.7	-3.4	33.3*	40.0*
S.I. Andrews x TCS 9-5	28.0*	22.5*	34.1*	54.2*	39.5*	24.1*	59.5*	50.0*
S.I. Andrews x BCS-12-125	30.6*	29.8*	31.4*	51.2*	9.5	-18.9*	2.4	7.5
Suvin x TCS 9-5	29.7*	16.4*	27.3*	46.5	2.1	-11.1	14.3	20.0*

could be improved by component breeding in such hybrid derivatives with further selection for high yielding pure lines. Such selections are likely to be more fruitful if one or two cycles of intermating within families is resorted to [10–12] in filial generations of BCS 9-70 x TCS 30-6 and BCS 9-70 x TCS 3-5 so that both the main YLD components, viz., BO and BWT, could be improved as gene action in respect of both component characters was additive.

The three top yielding hybrids involved BCS 9-70 as the female parent and TCS 30-6, TCS-3-5 and TCS 9-5 as males. These four lines showed high per se performance in YLD amongst all the parents. Therefore, these lines may be chosen as possible parent for exploitation of heterosis as well as for barbadense improvement by component breeding and selection. Mathapati [4] found Giza 7 to be a good combiner but it figured in only one of the eight high yielding hybrids in this study.

BCS 9-70 showed the highest positive general combining ability (gcs) effect for YLD, BO, GOT and LWT, and highest negative effect for the two earliness characters (Table 3).

for yield, yield components and earliness

Days to boll opening				Number of Bolls				Average boll weight			
MP	BP	CC_1	CC_2	MP	BP	CC_1	CC_2				
0.93	0.31	-1.21	-5.35	8.2	-5.3*	49.2*	40.8	16.7	18.9	-3.2	7.1
-3.23	-0.42*	-4.91*	-8.91*	11.7	-4.3	50.7	42.2*	9.9	5.4	25.8	39.3*
-0.08	-1.44	-1.36	-5.50*	-17.8*	-24.9*	18.2*	11.6	10.8	10.8	32.3	46.4
-1.22	-1.66*	-1.66*	-5.79*	18.3*	15.0	21.8*	15.0	34.4*	32.3*	32.3*	46.4
-1.62*	-2.30*	-3.55*	-7.60	18.6*	-12.3*	38.1*	30.3*	-2.7	-2.7	16.1	38.6
-1.44	-1.44	-1.36	-5.50*	10.3	-2.4	27.0*	19.8*	20.6	10.8	32.3*	46.4*
0.0	-3.06*	0.53	-3.69*	20.6*	11.4	31.3*	24.0*	-1.5	-5.9	3.2	14.3
4.14*	-6.08*	-1.97*	-6.08*	-2.5	-11.6	15.1	8.6	4.6	-8.1	9.7	21.4

Lint %				100-seed weight			
MP	BP	CC_1	CC_2	MP	BP	CC_1	CC_2
1.47	-1.14	5.84*	21.1	1.5	-1.9	1.0	3.0
-1.46	-3.44*	3.38	18.3*	-18.0*	-19.2*	-16.8*	-15.1
-2.95	-5.74*	0.92	15.5*	-11.4*	-12.3*	-7.9	-6.1
4.54*	2.98	6.15*	21.5*	-6.9	-12.9*	0.0	2.0
0.14	-1.14	5.84*	21.1*	0.5	-4.8	-2.0	0.0
3.52	3.04	4.00*	19.0*	17.3*	14.0*	20.8*	23.2*
0.59	-2.04	3.38	18.3*	-5.3	-7.5	-3.0	-1.0
2.28	-4.57	-3.69*	10.2*	1.5	-1.9	3.0	5.0

This line was involved in 5 of the 8 top yielding hybrids. Thus, BCS 9-70 was identified as a good general combiner for exploitation of heterosis as also for use in breeding programmes aimed at improvement of *G. barbadense*. The fibre quality check variety Suvin was a poor general combiner for most of the characters studied, as was also reported earlier [4]. The tester TCS 9-5 exhibited highest positive gca effects for YLD, FLPT, BO, BWT, GOT, LWT and SWT. It also showed negative gca effects for DFL and DBO. It occurred as one of the parents in the three top yielding hybrids. Therefore, it can be concluded that TCS 9-5 is a very good general combiner for yield, yield components, and earliness. Similarly, TCS 30-6 and TCS 3-5 also displayed positive gca effects for YLD, BO, GOT and LWT. It is pertinent to note that these three testers were involved in the three top yielding hybrids out of the 33 studied. Thus, strains having positive gca effects for YLD, BO, BWT and GOT are expected to produce high performing hybrids. TCS 9-5 as a male parent in combination with the low-gca cv. Suvin produced the 8th ranking hybrid. This means that at least one of the parents in a promising hybrid combination should possess high gca.

For almost all the characters studied, the ratio $\frac{2\sigma^2 gca}{2\sigma^2 gca + \sigma^2 sca}$ was less than 0.5, showing predominance of nonadditive gene action in intra-barbadense hybrids. But a few cross combinations may show exception to this general principle.

Table 3. General combining ability effects of lines and testers in *G. barbadense* for yield, yield components and earliness

Line or tester	Yield and yield components							Earliness	
	YLD	FLPT	BO	BWT	GOT	LW	SW	DFL	DBO
Lines:									
S.I. Andrews	2.20	0.40	0.30	0.27	0.23	0.04	0.01	0.10	1.25
Suvin	–11.80	0.66	–3.25	–0.30	–0.72	–0.26	0.28	2.30	3.06
BCS 9-70	9.51	–0.26	+3.55	0.03	0.49	0.30	–0.29	–2.40	–1.81
SEgi ±	0.50	0.41	0.20	0.17	0.11	0.06	0.14	0.11	0.10
Testers:									
PL-D6	–5.90	–1.29	–2.83	0.24	0.01	0.06	0.43	0.34	1.00
TCS 30-6	4.50	–5.14	0.33	–0.26	1.04	0.44	–0.15	–0.86	–0.14
BCS 12-125	7.61	–0.54	3.30	0.08	1.31	0.01	–0.17	1.53	1.30
TCS 9-5	16.77	14.46	3.58	0.59	1.36	0.55	0.44	–0.49	–0.24
TCS 3-5	–0.49	4.98	1.32	0.03	1.27	–0.09	–0.47	0.95	0.15
PL-D2	–5.33	6.95	1.10	–0.09	–0.48	0.38	0.34	–1.25	–1.55
BCS 9-45	–3.69	–5.21	1.69	–0.10	–1.03	–0.01	–0.42	–1.38	–1.49
BCS 14-48	–5.60	4.07	0.30	–0.08	–0.51	–0.76	0.09	0.01	0.32
BCS 171-2B	–5.77	–2.57	0.08	–0.39	–2.62	–0.27	–0.14	1.27	2.28
BCS 180-42	–9.61	–14.09	–6.04	–0.01	–0.86	–0.57	–0.58	0.48	–1.72
Giza 7	–3.35	–1.61	–2.84	–0.01	0.64	0.27	–0.26	1.39	0.95
SEgi ±	1.12	0.91	0.45	0.04	0.25	0.13	0.32	0.25	0.23
$\frac{2\sigma^2 gca}{2\sigma^2 gca + \sigma^2 sca}$	0.29	0.98	0.46	0.34	0.27	0.99	0.85	0.43	0.21

The important yield component, BWT, showed the least sca effects (Table 4), except in one of the top yielding hybrids. These hybrids also showed high BWT in addition to having high BO, indicating that BWT was not related negatively with BO (Table 1). Secondly, it was seen that BWT did not exhibit significant heterosis over MP values. It could be also seen that BWT in the hybrids studied was, in most cases, controlled by additive gene action (Table 2). Therefore, BWT in *G. barbadense* could be increased without affecting BO by resorting to suitable breeding method [12].

From the overall considerations, it could be concluded that intra-barbadense hybrids BCS 9-70 x TCS 30-5 and BCS 9-70 x TCS 3-5 would produce substantially high yields of cotton, matching the interspecific hybrid DCH-32 in productivity.

Therefore, a 5-location intra-barbadense hybrid trial was conducted to confirm the yielding ability and stability of the chosen hybrids. On an average of 5-locations, three

Table 4. Specific combining ability effects of eight top ranking intra-*G. barbadense* hybrids for yield, yield components and earliness characters

Hybrid	Sca effects for various characters								
	YLD	FLPT	BO	BWT	GOT	LW	SW	DFL	DBO
BCS 9-70 x TCS 30-6	15.8	9.3	6.98	–0.07	–0.53	–0.51	0.48	2.22	2.15
BCS 9-70 x TCS 3-5	20.8	11.0	6.36	–0.29	–0.60	–0.68	–0.99	–2.79	–2.74
BCS 9-70 x TCS 9-5	–3.8	12.7	–4.03	0.24	–0.42	–0.73	–1.08	1.52	2.05
S.I. Andrews x Giza-7	20.3	20.8	7.18	0.60	1.65	0.31	0.24	0.81	0.13
BCS 9-70 x BCS 171-2B	12.8	3.7	4.45	0.73	0.13	1.06	0.21	–2.90	–3.40
S.I. Andrews x TCS 9-5	–3.0	–4.5	2.05	–0.07	1.36	0.99	1.58	1.82	1.53
BCS 9-70 x BCS 12-125	–2.8	3.7	0.48	–0.15	0.37	0.51	0.11	3.63	2.88
Suvin x TCS 9-5	6.8	–8.3	1.97	–0.17	–0.94	–0.27	–0.48	–3.34	–3.58
S.E.	1.6	1.3	0.64	0.54	0.35	0.18	0.45	0.35	0.33

hybrids, i.e. BCS 9-70 x TCS 30-6, BCS 9-70 x TCS 3-5 and BCS 9-70 x TCS 9-5, produced 80–100% higher yield than cv. S. I. Andrews as well as cv. Suvin (Table 5). The yield of these hybrids was nearly equal to that of the widely cultivated commercial *G. hirsutum* x *G. barbadense* hybrid DCH-32. The first two intra-barbadense hybrids were also stable in yielding ability, as they gave highest yields at all the five locations. These hybrids can push up the production of *G. barbadense* in India.

Table 5. Yield performance of intra-barbadense cotton hybrids in multilocation trials

Hybrid	Yield of seed cotton at different locations (g/ha)					
	Dharwad	Hanumana-matti	Shimoga	Bidar	Siruguppa	Mean
BCS 9-70 x TCS 30-6	21.6	24.8	18.6	20.3	29.9	23.0
BCS 9-70 x TCS 3-5	21.8	23.6	16.5	19.8	29.1	22.2
BCS 9-70 x TCS 9-5	22.0	20.4	16.8	19.2	24.6	20.6
S.I. Andrews x Giza 7	16.5	19.8	15.1	14.7	21.8	17.6
BCS 9-70 x BCS 171-2B	17.6	20.7	17.2	18.4	22.7	19.3
S.I. Andrews x TCS 9-5	17.2	17.5	14.3	16.9	202.5	17.3
BCS 9-70 x BCS 12-125	18.5	19.5	16.2	16.4	23.6	18.8
Suvin x TCS 9-5	15.4	17.2	13.6	14.8	21.1	16.4
Cv. Suvin (check)	11.8	12.3	10.6	9.3	12.8	11.4
Cv. S.I.Andrews (check)	12.1	122.6	13.7	10.9	11.8	12.3
Hy. DCH-32 (check)	22.8	25.1	20.0	20.3	30.4	23.7
C.D. at 5%	3.5	2.9	4.0	1.9	5.5	—

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