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HETEROSIS IN SUGARCANE

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ABSTRACT

High heterosis over better parent and standard variety for quantitative and juice quality characters in 24 crosses among eight lines and three testers of sugarcane was observed for all the characters, except sucrose content in juice and purity coefficient. Heterosis for stalk weight ranged from –21.3 to 69.6% over better parent and from -11.8 to 57.8% over standard variety. High standard heterosis over variety Co 1148 was observed only in four crosses, viz. Co 7314 X Co 775, Co 7314 X Co 1148, PoJ 2878 X Co 775 and Q 68 X Co 775, because these combinations produced 14 genotypes showing maximum superiority (51.8% for stalk weight and 24.4% for sucrose content) over the standard variety. These combinations can be exploited for heterosis breeding evolving varieties directly from these heterozygous clones.

Key words: Heterosis, sugarcane.

A study was conducted to determine the genetic control of yield characters and estimate the degree of heterosis for various yield and sugar characters in sugarcane. Bhagyalakshmi et al. [1] also conducted this type of study in sugarcane.

MATERIALS AND METHODS

Eight lines of sugarcane, viz. Co 7004, Co 7314, Co 7717, CoS 659, BO 70, CP 44/101, POJ 2878, Q 68 and three testers, viz. Co 775, Co 1148 and Co 6904 were randomly selected on the basis of diversity, phenotypic performance as well as nature of flowering from the germplasm maintained at the Sugarcane Breeding Institute, Coimbatore. Thus, 24, line x tester crosses were made during October-November, 1979, at Coimbatore. The seedlings were raised in January and Fabruary, 1980, and transplanted during August, 1980. Thirty seedlings per cross/parent line were transplanted at 90 x 60 cm distance in three-row plots of 6.0 x 2.7 m size replicated four times in randomized block design. Thus, a total of 1050 seedlings were maintained in each replication of 35 treatments (11 parents + 24 F_1). Twenty seedlings were randomly tagged in each plot. Thus total 80 seedlings per treatment were used for recording observations on millable canes/clump, internodes/cane, stalk weight, stalk girth, kg-brix, sucrose content in juice, purity coefficient, invert sugar ccs/cane and fibre percent. In this study the variety Co 1148 was used as the standard check for estimating standard heterosis. This variety occupies major sugarcane area in North India.

RESULTS AND DISCUSSION

Heterosis in terms of percentage deviation from better parent and standard heterosis values were computed for all the measured traits (Table 1). Heterosis over the better parent and standard variety, respectively, ranged from -17.1 to 91.1 and -30.9 to 19.3% for millable canes/clump, -4.9 to 50.5 and -18.6 to 12.2% for internodes/cane, -21.3 to 69.6 and -11.8 to 57.8% for stalk weight, -19.8 to 16.0 and -4.0 to 25.4% for stalk girth, 21.9 to 252.0 and -21.9 to 41.9% for kg-brix, -21.4 to 9.0 and -10.0 to 22.8% for sucrose content in juice, -8.2 to 4.9 and 2.4 to 5.1% for purity coefficient, -37.6 to 68.8 and -47.1 to 44.8% for invert sugar, -35.1 to 81.1 and -20.2 to 68.6 for ccs/cane and -13.3 to 14.3 and -10.6 to 22.7% for fibre per cent.

Table 1. Number of heterotic crosses, range and mean heterosis, and best heterotic crosses for various characters in sugarcane

Character		No. of significant heterotic crosses (at 1 %)	Range of heterosis (%)	Character mean heterosis (%)	Best heterotic cross
Millabel canes/clump	BP	20	-17.1–91.1	30.6	POJ 2878 x Co 775
	SV	10	-30.9–19.3	-4.8	Q 68 x Co 1148
Internodes/cane	BP	15	-4.9–50.5	13.3	Q 68 x Co 775
	SV	3	-18.6–12.2	-3.0	BO 70 x Co 1148
Stalk weight	BP	16	-21.3–69.6	20.9	Q 68 x Co 775
	SV	16	-11.1–57.8	7.5	POJ 2878 x Co 775
Stalk girth	BP	8	-19.8–16.0	1.1	Co 7004 x Co 6904
	SV	18	-4.0–25.4	7.9	POJ 2878 x Co 775
Kg-brix	BP	18	-21.9–252.0	69.9	CP 44/101 x Co 775
	SV	9	-21.9–41.9	1.7	POJ 2878 x Co 775
Sucrose content	BP	2	-21.4–9.0	6.6	CP 44/101 x Co 6904
	SV	17	-10.0–22.8	6.6	CP 44/101 x Co 6904
Purity coefficient	BP	3	-8.2–4.9	-3.0	Co 7717 x Co 775
	SV	13	-2.4–5.1	2.5	Q 68 x Co 775
Invert sugar	BP	18	-37.6–68.8	11.4	POJ 2878 x Co 6904
	SV	7	-47.1–44.8	-9.0	CP 44/101 x Co 6904
Ccs/cane	BP	16	-35.1–81.1	21.8	CP 44/101 x Co 6904
	SV	20	-20.2–68.6	14.6	POJ 2878 x Co 775
Fibre content	BP	16	-13.3–14.3	4.5	POJ 2878 x Co 6904
	SV	18	-10.6–22.7	8.2	POJ 2878 x Co 6904

BP—heterosis over better parent; SV—heterosis over standard variety.

Out of the 24 crosses, 20 and 10 crosses for millable cane/clump, 15 and 3 crosses for internodes/cane, 16 crosses each for stalk weight, 8 and 18 crosses for stalk girth, 18 and 9 crosses for kg-brix, 2 and 17 crosses for sucrose content in juice, 3 and 13 crosses for purity coefficient, 18 and 7 crosses for invert sugar, 16 and 20 crosses for ccs/cane and 16 and 18 crosses for fibre per cent showed significantly superior heterosis over the better parent and standard variety, respectively. The cross-combinations in which one of the exotic parents, viz. POJ 2878, CP 44/101 and Q 68, was involved, showed maximum

heterosis for most of the characters. Bhagyalakshmi [1] and Rao [2] also observed similar trend in their studies on the progenies of crosses between commercial varieties and the wild species.

In practice, heterosis can be useful only with marked superiority over the commercial check. When compared with the most popular variety Co 1148 on the basis of per se performance for stalk weight and sucrose content in juice, only four crosses (Co 7314 x Co 775, Co 7314 x Co 1148, POJ 2878 x Co 775 and Q 68 x Co 775) were found to be superior over the standard variety. Generally high yield potential is negatively correlated with sucrose content in the juice, but in this study 4 out of 14 crosses (Co 7314 x Co 775, Co 7314 x Co 1148, POJ 2878 x Co 775, and Q 68 x Co 775) combined high yield with sucrose content in the juice. The cane yield and sucrose content in the juice increased in these crosses from 17.06 to 51.76 and 9.01 to 24.39% over the standard check (Co 1148), respectively (Table 2).

Table 2. High yielding stocks from promising crosses in sugarcane

Cross	Name of genotype	Stalk weight (kg)	Increase over standard variety (%)	Sucrose content (%)	Increase over standard variety (%)
Co 7314 x Co 775	s. 2805/79	2.72	51.76	15.67	9.76
	s. 348/79	1.79	26.65	17.31	18.31
	s. 360/49	1.87	29.79	16.00	11.63
		1.53	16.53	14.15	0.07
F_1 mean of the cross Co 7314 x Co 1148	s. 1021/79	2.16	34.43	15.54	9.01
	s. 2927/79	2.02	34.90	16.94	16.53
	s. 29/79	1.72	23.75	17.39	18.69
	s. 1032/79	1.73	24.24	16.10	12.56
		1.58	16.74	14.73	4.01
F_1 mean of the cross POJ 2878 x Co 775	s. 438/79	2.28	42.41	17.20	17.79
	s. 481/79	2.25	41.64	16.63	14.04
	s. 2329/79	2.20	40.32	16.89	16.28
	s. 2325/79	2.10	37.48	16.64	15.02
		2.01	34.55	15.68	9.82
F_1 mean of the cross Q 68 x Co 775	s. 412/79	1.67	21.52	17.40	18.74
	s. 3151/79	1.59	17.58	18.13	22.00
	s. 2410/79	1.58	17.06	18.70	24.39
F_1 mean of the cross		1.57	15.21	16.39	13.73

s—Shahjahanpur seedling.

Since different crosses showed heterosis for different sets of characters, it is very difficult to combine a large number of characters in single cross. But the possibility of combining more characters in one cross can increase if a large number of crosses are made.

Heterosis for all the characters over the better parent was observed only in three crosses, i.e. Co 7717 x Co 775, CP 44/101 x Co 6904, and Q 68 x Co 775, except for sucrose content in the juice in cross Co 7717 x Co 775, for stalk girth and purity coefficient in cross CP 44/101 x Co 6904, and sucrose content in the juice and fibre content in cross Q 68 x Co 775. The crosses Co 7717 x Co 775, Bo 70 x Co 775 and Bo 70 x Co 6904 showed high standard heterosis for all the characters, except for kg-brix and invert sugar in cross Co 7717 x Co 775, for stalk girth and invert sugar in Bo 70 x Co 775, and for invert sugar in Bo 70 x Co 6904.

In general, the crosses Co 7717 x Co 775, Co 7717 x Co 1148, CP 44/101 x Co 6904, and Bo 70 x Co 775 gave appreciable heterosis for yield and sugar contributing characters, hence would be exploited for heterosis breeding and evaluated for their performance in commercial cultivation for yield and quality.

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