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SELECTION INDICES FOR CANE YIELD IN SUGARCANE

S. P. SINGH AND A. Q. KHAN*

Department of Genetics and Plant Breeding,
G. B. Pant University of Agriculture and Technology, Pantnagar 263 145

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ABSTRACT

Various selection indices were constructed for cane yield in a population of twenty two advanced sugarcane genotypes, tested in 4 location × 2 yearly environments. Cane yield contributing characters such as number of millable canes (NMC), stalk height, stalk thickness and stalk weight and the juice extraction per cent were used to estimate expected genetic gain from selection indices for cane yield, The selection index (SI) with NMC, stalk height, stalk weight and juice extraction per cent and cane yield itself had maximum genetic gain (18.47%) over straight selection. The genetic gain of SI with above five characters and cane thickness was 18. 44 percent. The genetic gains of SIs were very low with any five characters excluding NMC (1.20%) or cane yield (6.04%). SIS with both NMC and cane yield had 16.97 per cent genetic gain over straight selection. Thus NMC and cane yield should be included in SI for maximum cane yield. However, selection based on NMC, cane yield, stalk height, stalk weight and juice extraction percent was important for maximum improvement in cane yield.

Key words: Selection indices, cane yield, sugarcane

Selection of genotypes with improved cane yield is the most important objective of sugarcane breeding. But, the cane yield is determined by several developmental and morphological characters and is also highly influenced by environmental conditions. The other important characteristics looked for with cane yield is the juice extraction per cent cane which has direct bearing in sugar production per unit cane. Thus, it was important that the selection scheme should take into consideration the components of cane yield and the juice extraction per cent per cane for bringing improvement in cane yield. The present investigation was, therefore, undertaken to construct and determine efficient selection indices for cane yield in a population of advanced sugarcane genotypes tested over different environments.

*Corresponding Author

MATERIALS AND METHODS

The materials comprised of twenty two advanced sugarcane genotypes including two early and two mid-late maturing cultivars which were evaluated for cane yield and its component characters in eight environments, four each during 1993-94 and 1994-95 viz., irrigated and water-logging environments at Pantnagar (Nainital), irrigated at Nagina (Bijnor), and water-deficit environment at Modipuram (Meerut) in Uttar Pradesh. The experiments were planted in randomized block design with three replications. The plot size for each entry represented four rows of 2.5 meter length, spaced 75 cm apart from one another. Data were recorded on number of millable canes, stalk height, stalk thickness, stalk weight, juice extraction percent and cane yield. The data of eight environments were pooled after applying Bartlett's test of homogeneity of variances [1] to calculate phenotypic and genotypic variances among component characters and with cane yield to construct different selection indices according to Smith [2].

RESULTS AND DISCUSSION

Selection indices for cane yield based on combinations of different characters along with their expected genetic gain over straight selection are presented in Table 1 and 2. Selection index based on number of millable canes, stalk height, stalk weight, juice extraction per cent and the cane yield itself had maximum genetic gain of 18.47 per cent over straight selection for cane yield. When cane thickness was included in the selection index with the above five characters, the genetic gain was 18.44 per cent over straight selection. The slight decrease in the genetic gain in the above selection index could plausibly be due to nonsignificant correlation of cane thickness with cane yield.

Similarly, there were slight decreases in the genetic gains of selection indices based on any five characters excluding individually either stalk height, stalk weight or juice extraction per cent. However, the genetic gains of selection indices with any five characters excluding individually number of millable canes and cane yield were 1.20 and 6.04 percent, respectively which were very low. Further, the genetic gains of selection indices with any characters excluding both number of millable canes and cane yield were negative. When selection index was based on number of millable canes and cane yield, the genetic gain was 16.97 per cent. Thus, the inclusion of number of millable canes and the cane yield in the selection was utmost essential for seeking genetic improvement in cane yield.

But the inclusion of other characters in selection index such as stalk height, stalk weight and juice extraction per cent which exhibited positive association with cane yield was also important for obtaining maximum genetic gain or success in

Table 1. Selection indices based on any one to three out of six characters with expected genetic gain over straight selection for cane yield

Selection indices I =	bi values	Expected genetic gain (%)	Expected genetic gain (%) over straight selection
b_1x_1	0.60	20.27	5.48
b_2x_2	0.66	0.23	–14.56
b_3x_3	0.69	0.18	–14.61
b_4x_4	0.67	0.18	–14.61
b_5x_5	0.30	0.02	–14.77
b_6x_6	0.53	14.79	0.00
$b_1x_1 + b_2x_2$	0.60, 0.27	20.31	5.52
$b_1x_1 + b_3x_3$	0.53, –19.15	20.65	5.86
$b_1x_1 + b_4x_4$	0.58, –9.45	20.36	5.57
$b_1x_1+b_5x_5$	0.58, –60.96	20.63	5.84
$b_1x_1+b_6x_6$	0.66, 0.45	31.76	16.97
$b_2x_2+b_3x_3$	0.66, 0.71	0.34	–14.45
$b_2x_2+b_4x_4$	0.67, 0.76	0.39	–14.40
$b_2x_2+b_5x_5$	0.67, –0.07	0.23	–14.56
$b_2x_2+b_6x_6$	14.12, 0.43	15.44	0.65
$b_3x_3+b_4x_4$	0.77, 0.66	0.36	–14.43
$b_3x_3+b_5x_5$	0.78, –0.27	0.19	–14.60
$b_3x_3+b_6x_6$	1.54, 0.53	14.82	0.03
$b_4x_4+b_5x_5$	0.69, 0.61	0.20	–14.59
$b_4x_4+b_6x_6$	0.55, 0.53	14.86	0.07
$b_5x_5+b_6x_6$	–23.49, 0.54	14.87	0.08
$b_1x_1+b_2x_2+b_3x_3$	0.50, 7.89, –24.07	20.80	6.01
$b_1x_1+b_2x_2+b_4x_4$	0.54, 10.69, –18.60	20.54	5.75
$x_1x_1+b_2x_2+b_5x_5$	0.57, 3.01, –64.27	20.68	5.89
$b_1x_1+b_2x_2+b_6x_6$	0.76, 22.98, 0.18	32.35	17.56
$b_1x_1+b_3x_3+b_4x_4$	0.53, –24.36, 6.92	20.59	5.80
$b_1x_1+b_3x_3+b_5x_5$	0.53, –14.55, –35.66	20.73	5.94
$b_1x_1+b_3x_3+b_6x_6$	0.46, –24.41, 0.64	31.95	17.16
$b_1x_1+b_4x_4+b_5x_5$	0.56, –6.95, –54.81	20.63	5.84
$b_1x_1+b_4x_4+b_6x_6$	0.32, –36.75, 0.90	31.87	17.08
$b_1x_1+b_5x_5+b_6x_6$	0.59, –83.12, 0.51	32.15	17.36
$b_2x_2+b_3x_3+b_4x_4$	0.62, 0.62, 0.90	0.54	–14.25

x_1 : NMC; x_2 : stalk height; x_3 : stalk thickness; x_4 : single cane weight; x_5 : juice extraction per cent; x_6 : cane yield

Table 2. Selection indices based on any three to six characters with expected genetic gain over straight selection for cane yield

Selection indices I =	bi values	Expected genetic gain (%)	Expected genetic gain (%) over straight selection
$b_2x_2+b_3x_3+b_5x_5$	0.65, 0.88, –0.81	0.35	–14.44
$b_2x_2+b_3x_3+b_6x_6$	15.11, –2.89, 0.43	15.49	0.70
$b_2x_2+b_4x_4+b_5x_5$	0.64, 0.83, 0.13	0.41	–14.38
$b_2x_2+b_4x_4+b_6x_6$	17.81, –8.19, 0.44	15.63	0.84
$b_2x_2+b_5x_5+b_6x_6$	15.83, –36.44, 0.42	15.61	0.82
$b_3x_3+b_4x_4+b_5x_5$	0.82, 0.69, –0.03	0.38	–14.41
$b_3x_3+b_4x_4+b_6x_6$	3.32, –1.59, 0.54	14.89	0.10
$b_3x_3+b_5x_5+b_6x_6$	5.92, –34.18, 0.53	14.94	0.15
$b_4x_4+b_5x_5+b_6x_6$	2.22, – 24.55, 0.53	14.94	0.15
$b_1x_1+b_2x_2+b_3x_3+b_4x_4$	0.49, 8.68, –22.79, –1.39	20.72	5.93
$b_1x_1+b_2x_2+b_3x_3+b_5x_5$	0.50, 8.05, –19.40, –37.05	20.89	6.10
$b_1x_1+b_2x_2+b_3x_3+b_6x_6$	0.57, 22.07, –22.61, 0.38	32.50	17.71
$b_1x_1+b_3x_3+b_4x_4+b_5x_5$	0.53, –17.85, 4.18, –32.48	20.65	5.86
$b_1x_1+b_3x_3+b_4x_4+b_6x_6$	0.29, –20.61, –21.75, 0.89	31.96	17.17
$b_1x_1+b_3x_3+b_5x_5+b_6x_6$	0.48, –14.13, –67.44, 0.62	32.16	17.37
$b_1x_1+b_2x_2+b_4x_4+b_5x_5$	0.51, 12.93, –17.84, –62.11	20.88	6.09
$b_1x_1+b_2x_2+b_4x_4+b_6x_6$	0.29, 26.38, –52.12, 0.79	32.59	17.80
$b_1x_1+b_4x_4+b_5x_5+b_6x_6$	0.08, –54.11, –98.52, 1.19	32.39	17.60
$b_1x_1+b_2x_2+b_5x_5+b_6x_6$	0.69, 24.49, –90.23, 0.24	32.81	18.02
$b_2x_2+b_3x_3+b_4x_4+b_5x_5$	0.62, 0.74, 0.89, –0.39	0.55	–14.24
$b_2x_2+b_3x_3+b_4x_4+b_6x_6$	18.33, 6.90, –13.62, 0.45	15.69	0.90
$b_2x_2+b_3x_3+b_5x_5+b_6x_6$	15.64, 1.94, –39.13, 0.42	15.65	0.86
$b_2x_2+b_4x_4+b_5x_5+b_6x_6$	18.63, –6.46, –32.02, 0.43	15.76	0.97
$b_3x_3+b_4x_4+b_5x_5+b_6x_6$	11.63, –5.99, –39.11, 0.55	15.04	0.25
$b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6$	20.93, 19.74, –21.98, –57.95, 0.46	15.99	1.20
$b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5$	0.49, 11.06, –13.44, –7.67, –44.18	20.83	6.04
$b_1x_1+b_2x_2+b_3x_3+bx_4x_4+b_6x_6$	0.27, 24.99, –15.68, –39.76, 0.79	32.61	17.82
$b_1x_1+b_3x_3+b_4x_4+b_5x_5+b_6x_6$	0.08, –0.86, –52.81, –97.00, 1.19	32.33	17.54
$b_1x_1+b_2x_2+b_4x_4+b_5x_5+b_6x_6$	0.02, 29.62, –73.99, 112.77, 1.11	33.26	18.47
$b_1x_1+b_2x_2+b_3x_3+b_5x_5+b_6x_6$	0.61, 23.85, –10.53, –78.32, 0.33	32.78	17.99
$b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6$	–0.01, 31.04,11.93,–85.83,–129.44,1.16	33.23	18.44

x_1 : NMC; x_2: stalk height; x_3: stalk thickness; x_4: single cane weight; x_5: juice extraction per cent; x_6 cane yield

selection for cane yield. The slight decrease in the genetic gains of selection indices by excluding any of the above individual yield contributing character was plausibly due to the very low positive correlation of stalk height (0.169) and low negative correlations of stalk weight (–0.296) and juice extraction per cent (–0.203) with number of millable canes. Nonetheless, it was important that the selection index be based on number of millable canes, stalk height, stalk weight and juice extraction per cent and cane yield itself for maximum improvement in cane yield. The present results were in general agreement with those of other workers [3-5].

From the above results, it was evident that number of millable canes and cane yield itself were the most important for bringing improvement in cane yield. The selection based on five characters, number of millable canes, stalk height, stalk weight, juice extraction per cent and cane yield itself would result in maximum improvement in cane yield. It may, therefore, be suggested that the selection for cane yield be based on number of millable canes, stalk height, stalk weight, juice extraction per cent and cane yield itself.

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