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Selection Indices in Sugarcane Breeding

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ABSTRACT

Among the various selection indices developed in a study of 20 biparental crosses of seedlings for cane yield per clump on the basis of discriminant function analyses, the index involving three characters viz. number of millable cane, length of cane and yield of cane per clump resulted highest gain (100.96%) over straight selection. Thus the selection indices which were considered to identify the character association over straight selection may be useful during selection in the original seedling stage in breeding programme for high yield.

INTRODUCTION

Selection is the key tool in any plant breeding programme for effective and desired improvement. Production of hybrids and selection from subsequent generations have become an established technique of great interest in sugarcane breeding. A substantially large number of seedlings per cross are needed for selection and the establishment of clones. Quantitative characters like cane yield is associated with other component characters, which are influenced to varying degrees by the fluctuation in environmental conditions (Chaugale, 1967). Thus, selection based on a single character can always be misleading.

A problem generally faced by the breeders in the selection breeding programme is that of selecting a component character among a number of components which would give maximum genetic advance through selection. In such cases, multiple selection criteria based on the discriminant function would be more desirable when a combination of two or more characters are involved. Yield per clumps being an independent character was studied as an index. The use of selection index technique would serve two fold purpose, namely to bring about the genetic progress simultaneously in several characters and to improve the yield through selection for relatively more heritable yield contributing characters. The technique of discriminant function analysis was first evolved by Fisher (1936) and was adopted for plant selection by Smith (1936). However, little informatijon on these aspects are available for sugarcane. Workers like Miller *et al.* (1978); Shaw (1982) and Punia *et al.* (1982) used this method in sugarcane.

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MATERIALS AND METHODS

Materials used in the study were obtained from the Germplasm Bank of Bangladesh Sugarcane Research Institute (BSRI), Ishurdi, Pabna. Seedlings of twenty biparental crosses were planted in the experimental field of BSRI, Ishurdi, Pabna in a randomized block design with three replications. Seedlings from each cross were transplanted in the plots having lines of five metre length with 45 cm spaced in three rows. In each row thirteen seedlings were transplanted and each cross was represented by 117 seedlings in nine rows. Normal dose of fertilizers were applied. Necessary intercultural operations were done as and when necessary.

From the growing phase to harvest, data on different paramaters were collected from thirty clumps selected randomly from each plot.

1. Tiller per clump (TC)	:	Tillers were counted after 150 days of planting from 10 randomly selected clump from each plot.
2. Number of millable cane (NMC)	:	Millable cane stalks were counted after 300 days of planting.
3. Percent Brix (Brix%)	:	Percent brix was measured in 15 days before harvest, using a Hand Refractrometer.
4. Cane length (CL)	:	Ten cane stools were selected randomly from each plot and the length of individual cane was measured from the bottom to the top using a metre tape.
5. Cane diameter (CD)	:	The diameter of cane stalks, measured from the middle using a slide caliper for each plot which were also used for height measurement.
6. Yeild per clump (YPC)	:	From each plot 10 random clumps were selected, harvested and yield per clump were recorded.

The collected data were analysed following the statistical method of Fisher and his associates.

The phenotypic and genotypic variance and covariance as obtained were used for developing discriminant function using different character combinations, according to method developed by Fisher (1936) and Smith (1936). Yield per clump was also included as one of the independent character as suggested by Robinson *et al* (1951). The expected genetic advance from straight selection [GA(S)] and from the discriminant function [GA(D)] was calculated as follows:

$$GA(S) = (Z/P)\ (g_{yy})/(t_{yy})^{1/2}$$

$$GA\ (D) = (Z/P) \times (b_1 g_{1y}\ b_2 g_{2y} + \ldots\ldots\ b_n g_{ny})^{1/2}$$

Where,

Z/P=the selection differential in standard units for the present study it was 2.06 at 5% level of selection (Lush, 1949).

g_{yy} and t_{yy} = the genotypic and phenotypic variance of character.

b_1, b_2.......b_n = the relative weight for each character.

g_{1y}, g_{2y}......g_{ny} = the genotypic covarance of independent character with y.

The expected gain from the discriminant function over straight selection was calculated for all the function as follows:

Expected gain (%) = ([GA (D) / GA(S)] - 1) x 100.

RESULTS AND DISCUSSION

In developing selection indices, the six character were included of which cane yield per clump (YPC) was taken as the independent character (Table 1).

Table 1. Expected gain in percent in YPC over straight selection from the use of various selection indices in sugarcane.

Selection index	Expected gain(%)	Selection index	Expected gain(%)
1 TC	-.98	1+5+6	38.90
2 NMC	-46.37	2+3+4	46.89
3 CL	-53.83	2+3+5	-46.94
4 CD	34.83	2+3+6	100.96
5 Bix	-67.51	2+4+5	42.68
6 YPC	-8.17	2+4+6	61.59
1+2	0.05	2+5+6	-4.52
1+3	-12.40	3+4+5	45.72
1+4	75.54	3+4+6	69.16
1+5	4.21	3+5+6	7.80
1+6	35.05	4+5+6	75.49
2+3	-58.04	1+2+3+4	81.27
2+4	-32.95	1+2+3+5	12.34
2+5	-73.85	1+2+3+6	47.62
2+6	-10.21	1+2+4+5	68.93
3+4	42.04	1+2+4+6	100.66
3+5	-43.54	1+2+5+6	43.43
3+6	2.79	1+3+4+5	63.64
4+5	44.14	1+3+4+6	84.81
4+6	61.73	1+3+5+6	31.00
5+6	-2.59	1+4+5+6	93.24
1+2+3	11.13	2+3+4+5	44.44
1+2+4	65.78	2+3+4+6	68.05
1+2+5	5.67	2+3+5+6	6.06
1+2+6	33.67	2+4+5+6	64.82
1+3+4	60.38	3+4+5+6	72.25
1+3+5	-6.57	1+2+3+4+5	75.13
1+3+6	26.91	1+2+3+4+6	95.06
1+4+5	78.99	1+2+3+5+6	51.63
1+4+6	90.49	1+3+4+5+6	87.64
		2+3+4+5+6	71.17
		1+2+3+4+5+6	97.74

The range of expected gain (%) over the straight selection varied from 0.05 to 100.96%. A markedly large expected gain was obtained when more than one character were involved in the discriminant function. When individual character was considered separately, only the cane diameter (CD) showed the highest positive expected gain (34.34%). But others showed negative expected gain in the function.

In the discriminant function analysis, cane yield per clump (YPC) gave a comparatively lower negative expected gain, but in combination with two or more characters showed the highest expected gain. The expected gain of YPC indicated that it itself is not a complex character contributing higher yield, rather it depends on other component character for higher yield.

When the index included two characters such as YPC and CD, higher expected gain (62.73%) was indicated than those indices which included TC and YPC, NMC and YPC, CL and YPC with values of 35.05, -10.21 and 2.79%, respectively. The highest expected gain was obtained when three characters (NMC, CL and YPC) were included and the gain was 100.96%. The expected gain of 100.66% was obtained when four characters such as TC, NMC, CL, CD and YPC were involved in an index, which were more or less similar to that of the three characters combination in the indices. When indices contained five or six characters such as TC, NMC, CL, CD and YPC or TC, NMC, CL, CD, Brix and YPC were calculated, expected gains were 95.06% and 97.74%, respectively.

Miller *et al.* (1978) reported expected genetic advance based on cane yield, number of millable cane and brix % for tonnes sugar per hectare to be 92%. Punia *et al.* (1982) developed an index involving tillers, millable cane, diameter of cane, stalk weight and yield per clump which gave maximum expected gain of 17.77% over straight selection.

Thus, it may be concluded that for positive response in selecting high yielding clones, emphasis should be given on the consideration of number of millable cane, length of cane and yield per clump during original seedling stage of breeding programme.

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