Bangladesh J. Sugarcane, 23 : 61-65 *July, 2001*

Factors Affecting Selection Rate at Seedling Stage of Sugarcane Breeding

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Received on 21.2.2001

ABSTRACT

An experiment on two factors - breeders and different cross combinations affecting selection rate at seedling stage of sugarcane breeding was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University during 1998-1999 cropping season. Among the breeders, a wide range of variation (21 - 61%) in respect of selection rate in original seedling was observed. It is evident from the variation that selector affects selection rate. This broad variation in selection rate is due to a wide freedom given to selectors in respect of choosing plant type and habit, vigour, stalk size, and other characters. Different cross combinations also affected selection rate. The highest number of selection (130) was recorded in cross number 4 and the lowest number (22) was found in cross number 10. All breeders showed strong agreement in selecting better ones and disagreement in selecting poor types in respect of cane yield

Key words: Sugarcane seedling, selection, rate.

INTRODUCTION

The first selection stage in many sugarcane breeding programmes based entirely on subjective visual evaluations. From a large number of populations, individual stool weighing and sugar analysis is impractical. In this perspective visual selection is a standard practice in many programmes especially in the early stages of sugarcane breeding. The unit of selection is one seedling, growing as a single stool. At this stage seedlings which lack of vigour, in adequate stalk diameter and length, few millable stalks and lack of solidness of stalk are eliminated (Warner, 1962). Of such defects, the most apparent is lack of vigour and this is responsible for elimination of a great majority of seedlings at first selection. Certain agronomic defects are often characteristic of particular crosses; for instance a very thin stalk with high tendency to lodge results that the cross as a whole is unattractive appearance.

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Other defects considered during rejection of seedlings are extreme growth cracking, germinated buds, bulging eye, excess adventitious roots, profuse tasselling etc. (Breaux, 1972). In Bangladesh, red rot is the most serious disease of sugarcane. Large number of seedlings especially in certain crosses are discarded due to their susceptibility to this disease. Some workers have suggested to make high percentage of selections at single stool stage in order to reduce number of good genotypes discarded for nongenetic factors. This argument implies that intense selection in single-stool plots is not sufficiently effective to offset the cost of replacing discarded seedlings (Lyrene, 1977). In Bangladesh, thousands of seedlings from true seeds are produced every year, which are planted in rows. One selector selects from each and every row. In the present experiment three breeders were allowed to evaluate same genotypes independently to investigate their agreement /disagreement about selected materials.

The purpose of the present study was to observe that how the selectors and different cross combinations exert influence on selection rate at early stage of sugarcane breeding.

MATERIALS AND METHODS

The study was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur during November 1998 to December 1999. The location of the site was at 24.00oN latitude and 90.25oE longitude with an elevation of 8.4 meter from sea level. One hundred sixty seedlings from each of the 10 intervarietal crosses namely I 123-84 x Co 640, CP 44-155 x Co 1148, Isd 16 x NSM, I 327-86 x I 226-83, Co 1148 x CP 44-101, Co 640 x CP 50-5, Co 1148 x Co 631, I 281-85 x CP 50-5, Isd 16 x CP 44-101 and Isd 28 x CP 44-154 were transplanted in the field during November 1998 according to method followed by Bangladesh Sugarcane Research Institute, Ishurdi, Pabna. A spacing of one miter between rows and 60 cm between stools within row were maintained. Standard variety was planted after every eight seedlings for getting an indication of soil fertility and Brix (%) variation but not for comparison purpose, since the standard was raised from cuttings but the experimental seedlings were from true seed. Irrigation, fertilization and intercultural operations were done as and when required.

At late November, three sugarcane breeders from Bangladesh Sugarcane Research Institute, Ishurdi, Pabna independently evaluated each stool according to his perception how it would be as a commercial variety. Evaluation was made on the basis of comparison of seedlings with one another. During selection, breeders considered different aspects like plant type and habit, vigour, stalk number per stool and stalk diameter, solidness of stalk, tasselling habit, erectness of canopy, shooting of buds, existence of aerial roots, growth split, bulging eyes, incidence of diseases specially red rot etc. Seedlings considered good in these aspects were cut to check the pipe and pithiness. After thorough visual evaluation, each of the breeders selected the stools crosswise for further evaluation in the next clonal stage. After harvesting, each of the selected stools was designated by their respective cane weight.

RESULTS AND DISCUSSION

A wide range of variations in respect of selection rate in seedling by different breeders were observed (Table 1). The breeder X made the highest per cent of selections while the lowest per cent was recorded by the breeder Z. The breeder Y selected 47.48 per cent of total seedlings. From all the crosses, except cross -1, breeder X made the highest number of selections. In cross -1, breeder Y selected the highest number of selections. In all crosses, the breeder Z made the lowest number of selections. Skinner (1971) reported 20-30% selection rate in seedling stage. Watkins (1965) suggested that in original seedlings selection rate should be 20%. According to Ortiz (1984), 20-25% of selection at seedling stage was the most effective. Bhagyalakshmi and Ethirajan (1988) also proposed 25% selection at original seedling stage.

Table 1 Seedlings selection rate by different breeders based on visual observation from original seedlings

Cross number	Total seedlings planted	Total seedlings survived	Number of seedlings selected by breeders			Total seedlings selected
			X	Y	Z	
1	160	145	100	106	24	112
2	160	153	101	76	33	103
3	160	131	88	55	14	88
4	160	157	128	98	50	130
5	160	154	129	101	58	129
6	160	136	83	63	22	82
7	160	118	78	50	39	82
8	160	122	71	59	31	75
9	160	142	55	38	17	60
10	160	134	21	15	9	22
Total	1600	1392	854	661	297	883
%			61.35	47.48	21.34	63.43

X, Y, Z = Breeders

These data provided strong evidence that selector affects selection. This broad variation in selection rate is due to a wide freedom permitted to selectors with respect to choice of plant type and habit, vigour, stalk size, and other characteristics. Mariotti (1977) also observed this type of variation in respect of selection rate among the breeders.

There were also wide ranges of variation among the crosses in respect of selection rate. The highest number of selections were recorded in cross number 4 while the lowest was in cross number 10 (Table 1). Among 10 crosses, cross - 4 and 5 were found better by all the breeders in respect of contributing more number of superior progenies while cross -10 was considered as less performer to all the breeders in respect of producing promising progenies. Pandey (1989) observed varying performance in respect of producing superior progenies in different crosses. Tai and Miller (1989) also reported some cross combinations to produce higher rates of acceptable clones than that of other cross combination.

Selection efficiency could be enhanced by exploitation of better crosses of commercial importance. Since individual seedlings or genotypes arising from the crosses of several sets of heterozygous parent represent distinct commercial varieties, it is necessary to consider them crosswise as well as totality of genotypes from all crosses for the purpose of economic breeding programmes. Data on the number of selections made by different breeders in respect of cane yield per stool are summarised in Table 2. When the selected seedlings were denoted with their respective cane yield, the breeder X selected the highest number of seedlings with lower yield which was followed by breeder Y. Minimum number of lower yielding seedlings were selected by the breeder Z.

Table 2. Number of selections by different breeders and their estimated yield of seedling stage

Cane yield (kg/stool)	Number of stools selected by different breeders		
	X	Y	Z
0.5- 5.0	246	174	16
5.01-10.0	409	315	139
10.01 and above	199	172	142
Total	854	661	297

X, Y, Z = Breeders

It is apparent that selectors might differ in the importance they give to different characters. Some more emphasise on stalk number while others do so on stalk diameter. These results indicate that the mental picture of individual selector for a "better type" is not fixed and precise, and that it might vary considerably. Discarding a reasonable percent of seedlings could enhance selection efficiency by evaluation of their yield component and other ancillary characters. The results suggest that efficiency of visual selection at seedling stage could be increased through avoiding variable selection criteria, which are followed by different selectors. To make selection more efficient, there should be a fair agreement among the breeders in respect of defined level of different selection criteria. The coincidence of breeders in selecting the same seedling and their corresponding yield are shown in Table 3. Out of 196 stools with the maximum cane yield of 10.01 kg per stool and above, 122 stools were selected by all of the three breeders. On the other hand, they commonly selected only 9 clones out of 263 stools with low yield (0.5-5.0 kg/stool). It was observed that out of 196 stools with the highest yield only 12 stools were selected by an individual breeder while out of 263 clones with the poorest performance in respect of cane yield, 111 stool were selected by an individual breeder. The results indicate the existence of strong agreement among all three breeders in selecting better ones and show strong disagreement in selecting the poor types. The results also show that there should be a reasonably good agreement between two or more selectors working independently. Lyrene (1977) also gave similar opinion.

Table 3. Breeders coincidence in selecting same seedlings on the basis of visual observation and their estimated yield

Cane yield (kg/stool)	Number of selections by one, two and three breeders			
	1	2	3	Total
0.5- 5.0	111	143	9	263
5.01-10.0	83	198	115	396
10.0 <	12	62	122	196

It is occasionally cited in literature (Ram, 1999; Skinner *et al.*, 1987; Ladd *et al.*, 1974) that evaluation of sugarcane at seedling stage have little value because they depend on so heavily on whim of one particular selector. The information presented in the Table 2 indicated that single stool selection is not entirely whimsical at least with the seedlings showing better performance.

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