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PERFORMANCE OF PROMISING SUGARCANE CLONE FOR YIELD AND QUALITY CHARACTERS II. STABILITY STUDIES

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Abstract

A new sugarcane clone AEC81-8415, generated from seed (fuzz) of a croos combination of NCo 310 x CP56-614, imported from ARS, USDA, Canal Point, Florida, USA, alongwith other genotypes was evaluated for the stability of its performance for three economic characters at three different locations in the province of Sindh for two consecutive years. Significant ($P \leq 0.01$) differences were observed in genotypes and locations x genotypes interactions for the three traits i.e. cane yield, CCS and sugar yield which indicated the presence of genetic variability amongst the genotypes and differential response of genotypes to environments. High mean performance of AEC81-8415 with 'b' values greater than 1.00 for cane and sugar yield while lesser than 1.00 for CCS (%) indicated its potential to take advantage of favourable environmental conditions for yield while unfavourable environmental conditions for quality characters.

Introduction

Estimation of stability of a new genotype for yield and quality traits is a pre-requisite in plant breeding programme prior to its release for commercial planting. Productivity of a genotype in favourable environments does not indicates its adaptability and stability whereas performance of a genotype in diverse environments is a true evaluation of its inherent potential for adaptativeness (Pandey *et al.,* 1981). Therefore varietal trials are normally conducted over various locations for different years before deciding the release of a new cultivar in a particular region (Narendra *et al.,* 1988; Bakhsh *et al.,* 1991; Basford & Cooper, 1998). Stability analyses of sugarcane cultivar performance tests conducted under different environments have been reported by many researchers (Pollock, 1975; Ruschel, 1977; Tai *et al.,* 1982; Kang & Millor 1984; Malligen *et al.,* 1990; Khan *et al.,* 1997).

Productivity stability is shown by some cane varieties in both predictable and unpredictable environments. In a predictable environment (i.e. climatic, soil type, day length and controllable variables such as fertilization, sowing dates and harvesting methods), a high level of genotype and environmental interaction is desirable so as to ensure a maximum yield or financial return whereas in an unpredictable environment (inter and intra-season fluctuation, fluctuation in quantity and distribution of rainfall and prevailing temperature), a low level of interaction is desirable so as to ensure maximum uniformity of performance over a number of locations or seasons (Khan, 1981).

After examining the stability of standard variety in varietal trials of sugarcane, Pollock (1975) and Ruschel (1977) suggested that clone selection against the average of several standard varieties was better than against a single one as the 'b' values were more precisely estimated when several rather than one standard variety was used to measure the effects of environment. The stability-variance parameters may also be used to compare stability of various experimental cultivars to that of a check. Selected cultivars should have high mean yields and low stability variance (Kang & Miller, 1984).

The performance of crop plants varies in different environments which indicates their adaptability to specific region or over wide areas. The objective of this study was, therefore, to estimate the stability and adaptability potential of new sugarcane clone AEC81-8415 by its performance under different agroclimatic conditions in the province of Sindh, Pakistan.

Material and Methods

True seed (fuzz) of different crosses of sugarcane was imported from USDA Canal Point, Florida, USA and grown at Nuclear Institute of Agriculture (NIA), Tandojam. The clone AEC81-8415 was selected on the basis of high cane and sugar yield from the seedlings of the cross NCo 310 x CP56-614. Two sugarcane clones AEC81-8415 and AEC80-2046 alongwith 4 commercial varieties viz., BL4, PR1000, BF129 and L116 were evaluated at 3 locations in the province of Sindh viz., Tandojam, Nawabshah and Moro for two consecutive years. The experimental layout was RCB design with 4 replications. The plot size was 8 x 10 with 8 meter long ten rows, one metre apart from each other. Three stools were randomly taken from each plot to determine sugar contents according to sugarcane laboratory Manual for Queensland Sugar Mills (*Anon.*, 1970) while three rows from each plot were harvested to record yield data.

The data were analysed as a split-split plot with locations as whole plots, genotypes as sub-plots and years as sub-subplots according to Steel & Torrie (1960). Stability parameters were estimated by using the methods of Eberhart & Russel (1966).

Results and Discussion

The mean squares (MS) for genotypes and locations x genotypes interaction were significant ($P \leq 0.01$) and locations, years, years x locations, years x genotypes and locations x years x genotypes interactions were non-significant for cane yield (t/ha). This indicated the presence of genetic variability in the genotypes and varied response of the genotypes to locations only for this trait. The mean squares for commercial cane sugar (CCS%) and sugar yield (t/ha) due to locations, years, genotypes, years x locations and locations x genotypes interaction were significant which reflected the presence of variability among genotypes and differential response of genotypes to various environments for these two characters (Table 1). Tai *et al.,* (1982) reported that mean square for cultivars x locations and cultivars x years were significant but were very much smaller than the mean squares for cultivars for all the seven traits. The cultivars x locations interactions mean square greatly exceeded the three factor i.e., cultivars x locations x years mean squares indicating that the differential response of the cultivars may be permanent characteristics for the locations.

Table 1. Pooled analysis of variance for 3 traits of 6 sugarcane clones grown at 3 locations for 2 years.

Parameters	d.f	Cane yield (t/h) MS	CCS (%) MS	Sugar yield (t/h) MS
Locations (L)	2	1054.09 ns	243.72**	592.47**
Error (a)	4	1796.34	2.864	27.740
Year (Y)	1	46.008 ns	48.709**	134.090*
Y x L	2	521.989 ns	76.668**	156.97**
Error (b)	6	951.994	0.142	17.154
Genotype (G)	5	14314.29**	6.641**	60.795**
L x G	10	503.483**	2.762**	9.558**
Y x G	5	56.395 ns	0.537 ns	2.235 ns
L x Y x G	10	180.586 ns	0.318 ns	1.330 ns
Error (c)	60	118.652	0.348	2.921

CCS= Commercial Cane Sugar, MS = Mean square; * = Significance at 5% level; ** = Significance at 1% level.

Table 2. Pooled mean performance for 3 traits of 6 sugarcane clones grown at 3 locations for 2 years.

Clone	Cane yield (t/h)	C.C.S (%)	Sugar yield (t/h)
AEC81-8415	176.38 a	09.03 ab	16.08 a
AEC80-2046	99.79 d	10.10 a	10.50 bc
BF 129	137.8 bc	09.11 ab	12.20 bc
PR 1000	124.1 cd	08.43 b	09.46 c
BL 4	160.5 ab	08.74 b	13.70 ab
L 116	111.7 d	10.14 a	11.10 bc

Different letters show significant differences at P≤0.05.

Table 3. Regression coefficient 'b' and variance due to deviation from regression 'S^2d' for 3 traits of 6 sugarcane clones grown at 3 locations for 2 years.

Clone	Cane yield (t/h)		C.C.S.(%)		Sugar yield (t/h)	
	b	S^2d	b	S^2d	b	S^2d
AEC81-8415	1.206	0.024	0.689	0.107	1.364.	0.006
AEC80-2046	0.168	0.009	1.156	0.055	0.742	0.122
BF 129	0.279	0.007	0.962	0.054	0.895	0.051
PR 1000	0.285	0.001	1.003	0.068	0.632	0.330
BL 4	0.321	0.262	0.972	0.039	1.160	0.010
L 116	0.567	0.005	0.940	0.016	0.683	0.037

Significant (P≤0.05) differences were recorded among genotypes for the mean performance of all the 3 traits. The genotype AEC81-8415 was superior to all the entries except BL4 for cane and sugar yield but at par with them in CCS (%). It produced 176.38(t/ha), 9.03 (%) and 16.08 (t/h) cane yield, CCS and sugar yield respectively (Table 2).

Regression coefficient 'b' is a measure of stability in crop plants (Finaly & Wilkinson, 1963). Other researchers (Eberhart & Russel, 1966; Paroda & Hayes, 1971) suggested that both regression coefficient 'b' and deviation from regression coefficient

'S^2d' may be taken into consideration in identifying a stable genotype. Regression coefficient 'b' values for cane yield, CCS and sugar yield were 1.206, 0.689 and 1.364 respectively while deviation from regression coefficient 'S^2d' values were 0.024, 0.107 and 0.006 for the above mentioned three characters respectively for clone AEC81-8415 (Table 3). A cultivar with 'b' value less than 1.0 has above average stability and is specially adapted to low-performing environments, a cultivar with 'b' value greater than 1.0 has below average stability and is specially adapted to high performing environments and a cultivar with 'b' value equal to 1.0 has average stability and is well or poorly adapted to all environments depending on having a high or low mean performance (Finlay & Wilkinson, 1963) but a cultivar with $b = 1.00$ and $S^2d = 0.00$ may be defined as stable (Eberhart & Russel, 1966). The 'b' values being greater than 1.00 for cane and sugar yield while lesser than 1.00 for CCS percentage indicated the potential of AEC81-8415 to take advantage of favourable environments for the former two characters while to take advantage of unfavourable environments for the latter one character. Tai *et al.*, (1982) reported that the cultivar CP70-1133 had highest means of tonnes cane per hectare (TCH) and tonnes sugar per hectare (TSH) and was found relatively stable for these two characters as both the characters have b=1.05 and 'S^2d' = 0.12. This cultivar, however, had 'b' values less than 1.00 for brix(%), sucrose(%), purity(%) and sugar per tonne. Though this cultivar did not produce high sugar content, yet the stability parameters and mean performance for TCH and TSH indicated as the best choice for its release to the sugar industry.

On the basis of high mean performance for cane yield and sugar content and estimates of stability parameters, it may be concluded that the clone AEC81-8415 has good adaptation potential under favourable as well as unfavourable environments.

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