EVALUATION OF SOME NEW SUGARCANE VARIETIES FOR CANE YIELD AND QUALITY IN DIFFERENT AGRO-ECOLOGICAL ZONES OF SINDH

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ABSTRACT: A comparative study for cane yield and quality performance on five newly developed sugarcane varieties namely, HoTh-401, HoTh-409, HoTh-420, HoTh-432 and HoTh-438 against the standard variety Thatta-10 was conducted at three locations of Sindh viz., Matiari, Sanghar and Tando Allahyar. All the varieties showed variable genetic behavior for cane yield, CCS% and sugar yield at different locations. The overall calculated average results for all three locations revealed that HoTh-409 remained superior by producing maximum average cane yield against check variety Thatta-10. However, the variety HoTh-420 displayed almost equal performance for average cane yield against the check variety. Likewise, the rest of the varieties like HoTh-438, HoTh-432 and HoTh-401 exhibited comparable performance with regard to average cane yield but could not surpass the Thatta-10. The comparison of varietal means for commercial cane sugar percentage in all three locations indicated that the varieties HoTh-401, HoTh-438 and HoTh-409 remained best by producing maximum average CCS% against the Thatta-10. The comparison of varietals means for sugar yield indicated that the variety HoTh-409 remained best by producing maximum average sugar yield. While, the check variety Thatta-10 and HoTh-420 remained almost similar to each other in terms of this trait. This one year's study is not enough to judge the true potential of a variety. Therefore, it was suggested that the performance of these varieties should to be investigated under different agro-climatic conditions of Sindh for several years so as to extract the ample conclusions.

Key words: Sugarcane, varieties, cane yield, quality, agro-ecological of Sindh.

INTRODUCTION

Sugarcane (S*accharum officinarum*, L) is the major cash and industrial crop of Pakistan (Junejo *et al*., 2009). It is a source of raw material to sugar industry and generates employment for many people. Although, the survival of sugar industry in Pakistan totally depends upon cane cultivation (Junejo *et al*., 2010). The area under sugarcane cultivation in Pakistan has increased manifold and now it is being grown on area of 942,900 hectares with total annual production of 49,372,900 tones (Annual Report PASMA-SZ, 2010). Although the domestic sugarcane production has steadily increased during the last four decades (Bashir and Saeed, 2000) yet our national average cane yield is 52.40 t ha^{-1} and average sugar recovery is 9.05% (Annual Report PASMA-SZ, 2010), which is much lower than the production potential of 256 t ha^{-1} in existing domestic varieties (Gill, 1995). Besides so many factors, yield and production has become stagnant for last so many years due to our limited sources and other unfavorable factors (Jamil and Gopang, 2005), poor soil fertility, conventional sowing methods, low seed rate, poor quality seed, poor agro management, low yielding varieties in tonnage and quality (Ahmed, 1988) as well as their unsuitable behavior, which is deteriorating rapidly with the passage of time. (Usmanikhali *et al.,* 2005).

The promising varieties adapted to different climatic conditions have been evolved from time to time. Such varieties have a large adoptability than others and hence, are grown more widely through out the area (Baker, 1981 and Glaz, 1982). According to Fanguay and Giamalava (1973) out field test is the final stage of testing, carried out in several locations, with different soil types for selecting varieties with desirable characteristic. Miller (1971) and Freeman and Walker (1973) reported that varieties in selection stage-iv (final selection stage) are evaluated in the plant, first and second ratoon crop under different agro-climatic conditions and the most suitable one are considered for release for growers. Chattha *et al.* (2004) stressed to study the new genotypes under farmers condition before final recommendations. Similarly, Chohan *et al*. (2007) tested seven newly developed sugarcane varieties for cane yield and quality at different locations. They reported variable genetic behavior for all varieties under testing at different locations. Kaloi *et al*. (2007) conducted experiments on the performance of different sugar cane under agro-climatic conditions of Matiari, Sindh.

The old varieties are getting absolute, thus evaluation of new prodigious sugarcane varieties possessing higher cane and sugar yield potential is the

necessity of the time for the betterment of growers and millers. Keeping in view the basic and most important aspects of grower and millers, the study was conducted to evaluate the best suitable sugarcane varieties fro commercial cultivation in Sindh.

MATERIALS AND METDODS

This experiment was conducted at three locations of Sindh viz. Matiari, Tando Allahyar and Jhol district Sanghar during 2006-07 to study the cane yield and quality performance of five newly developed sugarcane varieties namely; HoTh-401, HoTh-409, HoTh-420, HoTh-432 and HoTh-438 against the standard variety Thatta-10. At each location the varieties were planted in 8 meters long, three rows at one meter row to row distance under randomized complete block design with three replications. Fertilizer and insect pest and disease control measures were taken as per recommendations (Junejo *et al*., 2009). All three rows from each plot were harvested for the record of cane yield data. Five harvested canes were then utilized for the record of data on commercial cane sugar percentage (CCS %) according to following formula given by Meade and Chen (1977).

$$CCS\% = \frac{3P}{2}\left(1-\frac{F+5}{100}\right)-\frac{B}{2}\left(1-\frac{F+3}{100}\right)$$

Where, "P" indicates Pol% in Juice, "B" Brix% in juice and "F" Fiber% in cane.

Sugar Yield was calculated as

$$\text{Sugar Yield} = \frac{\text{Cane yield X CCS\%}}{100}$$

The data collected was subjected to statistical analysis using ANOVA through MSTAT-C (1991) micro computer statistical programme, Michigan State University, USA.

RESULTS AND DISCUSSION

Analysis of variance for individual trials at each location revealed that there were highly significant ($P \leq 0.01\%$) differences among the sugarcane varieties for cane yield in all locations (Table-1).

Means of cane yield of all varieties at each location in Table-2 revealed that all the varieties performed variably under new set of agro-climatic conditions. The variety HoTh-409 remained superior by producing statistically highest cane yield in all three locations. While, cane yield in HoTh-420 and HoTh-438 varieties remained almost matching with check variety at Ferozuddin Shah agricultural farm. Moreover, the varieties HoTh-420 and HoTh-438 showed satisfactory performance at Muhammad Hassan Keerio agricultural farm and remained statistically on par with check variety in terms of cane yield. In case of Anwar Ali Bachani agricultural farm, the yield performance of variety HoTh-402 remained better against the check variety, while, the varieties HoTh-432 and HoTh-438 were statistically on par with check variety in terms of cane yield.

The analysis of variance regarding comparison of means for cane yield in all three locations revealed that there were highly significant ($P \leq 0.01\%$) for cane yield. The interaction of locations and varieties (AxB) remained non significant (Table-1). The comparison of varietal means for cane yield in all three locations (Fig-2) indicated that the variety HoTh-409 gave 143.77 t ha^{-1} average cane yield relative to check variety Thatta-10 (118.55 t ha^{-1}). While, the varieties HoTh-420 and HoTh-438 by producing statistically on par average cane yield of 117.96 and 112.88 t ha^{-1}, respectively, remained almost equal to check variety.

In case of commercial cane sugar percentage the analysis of variance for individual trials at each location revealed that the differences in varietal treatments could not reach the level of significance at Ferozuddin Shah agricultural farm and Muhammad Hassan Keerio agricultural farm. While, the differences with regard to CCS% were highly significant ($P \leq 0.01\%$) at Anwar Ali Bachani agricultural farm (Table-1).

Means of CCS% of all varieties at each location in Table-2 revealed that at Ferozuddin Shah agricultural farm the trend of increased results for CCS% was observed by different varieties except HoTh-432, which remained almost equal to check variety Thatta-10 in terms of this trait. While, at Muhammad Hassan Keerio agricultural farm the CCS% of varieties was almost satisfactory and comparable to check variety. Moreover, the varieties HoTh-401, HoTh-409, HoTh-432 and HoTh-438 produced statistically maximum CCS% against the check variety at Anwar Ali Bachani agricultural farm, while at the same location the variety HoTh-420 was statistically at par with check variety in terms of CCS%.

The analysis of variance regarding comparison of means for CCS% in all three locations revealed that non significant differences were observed amongst the varietal treatments for this trait. The interaction of locations and varieties (AxB) remained non significant (Table-1).

The comparison of varietal means for commercial cane sugar percentage in all three locations (Fig-2) indicated that the variety HoTh-401 remained on top with the average CCS of 14.13% followed by HoTh-438 and HoTh-409 with average CCS of 13.86 and 13.84%, respectively; against the check variety Thatta-10 which gave average CCS of 13.74%. While, rest of the varieties HoTh-420 and HoTh-432 displayed satisfactory results with average CCS of 13.63 and 13.48%, respectively; but could not beat Thatta-10.

The higher cane yield and sugar content in the varieties might be due to the heavy bearing tendency of these varieties and their adoptability to agro-climatic conditions of the area. In addition to that, the inherent

genetic make up of a variety might have contributed towards higher and lower cane yield and sugar content. Genetically improved varieties might have ability to produce satisfactory results for per hectare yield and sugar percentage under given set of environmental conditions. EL-Geddway, *et al.* (2002) stated that sugarcane varieties are greatly affected by genetic make up. According to Keerio, *et al,* (2003) unless the genetic potentialities of a variety are high, mere provisions of growing conditions such as manuring, irrigation etc. will not lead to appreciable improvement in cane or sugar content. The results are in agreement with the finding of Chohan *et al.* (2007) and Kaloi *et al.* (2007) who reported variable genetic behavior of different promising sugar cane varieties for cane yield and quality performance at different location of Sindh.

As regards the sugar yield the analysis of variance for individual trials at each location in Table-1 revealed that there were highly significant ($P \leq 0.01\%$) differences among the sugarcane varieties for sugar yield at Ferozuddin Shah agricultural farm and Anwar Ali Bachani agricultural farm. While, significant ($P \leq 0.05\%$) differences existed at Muhammad Hassan Keerio agricultural farm.

Sugar yield is the function of the cane yield and corresponding recoverable sugar percentage. Means of sugar yield of all varieties at each location in Table-2 revealed that at Ferozuddin Shah agricultural farm the variety HoTh-409 remained on top by producing statistically maximum sugar yield. While the varieties HoTh-401, HoTh-420 and HoTh-432 produced next better sugar yield against the check variety Thatta-10. At the same location the variety HoTh-438 was statistically at par with check variety in terms of this trait. At Muhammad Hassan Keerio agricultural farm the varieties HoTh-409, HoTh-420 and HoTh-438 exhibited comparatively better results against the check variety in terms of sugar yield. While, at Anwar Ali Bachani agricultural farm the variety HoTh-409 maintained its superiority by producing statistically highest sugar yield. Moreover, rest of the varieties in the trial produced statistically at par sugar yield against check variety.

The analysis of variance regarding comparison of means for sugar yield in all three locations revealed that there were highly significant ($P \leq 0.01\%$) differences amongst the varietal treatments for this trait. The interaction of locations and varieties (AxB) remained non significant (Table-1).

The comparison of varietal means for sugar yield data in all three locations (Fig-3) indicated that the variety HoTh-409 remained statistically superior with maximum average sugar yield of 19.92 t ha^{-1} against the check variety Thatta-10 which produced average sugar yield of 16.28 t ha^{-1}. While, the variety HoTh-420 produced average sugar yield of 16.07 t ha^{-1} and remained statistically at par with check variety. In contrast, rest of the varieties could not surpass the check variety in terms of this trait. The higher and lower sugar yield in varieties was due to the higher and lower average cane yield and relatively more or less recoverable sugar percentage. The variety HoTh-401 despite the highest average CCS% produced relatively less sugar yield due to the lowest average cane yield. In contrast, the variety HoTh-409 on account of highest average cane yield and reasonable CCS% produced highest average sugar yield.

The cane yield per hectare is a product of well coordinated inter play of genetic as well as environmental factors towards the growth and development of the plant. Highest cane and sugar yield in HoTh-409 might be due to its inherent genetic potential and more efficient utilization of available resources towards its economic production.

Table-1 Mean square values and their significance from analysis of variance for cane yield, CCS% and sugar yield of different sugarcane varieties at different locations of Sindh.

Ferozuddin Shah agricultural farm, Matiari				
Source	**Df**	**Cane yield**	**CCS%**	**Sugar Yield**
Replications	2	197.167	0.149	0.311
Factor A (Varieties)	5	689.167**	0.193 NS	13.981**
Error	10	63.033	0.132	3.255
Hassan Keerio agricultural farm, Jhole, district Sanghar				
Source	**Df**	**Cane yield**	**CCS%**	**Sugar Yield**
Replications	2	208.500	0.922	3.701
Factor A (Varieties)	5	664.633 **	0.239 NS	13.673*
Error	10	62.633	0.853	1.843
Anwar Ali Bachani agricultural farm, Tando Allahyar				
Source	**Df**	**Cane yield**	**CCS%**	**Sugar Yield**
Replications	2	84.389	1.195	1.264
Factor A (Varieties)	5	817.256**	0.677**	16.312**
Error	10	43.389	0.219	1.182
Pooled data of all three locations				
Source	**Df**	**Cane yield**	**CCS%**	**Sugar Yield**
Replications	2	144.907	0.029	2.731
Factor A (Locations)	2	968.352	0.880	27.453
Factor B (Varieties)	5	1995.141**	0.444 NS	37.756**
AB	10	107.374 NS	0.341 NS	3.051 NS
Error	34	71.437	0.459	1.984

*Significant
**Highly significant

This indicates its potential to have a positive impact on cane productivity. The other varieties like HoTh-401, HoTh-420 and HoTh-438 also showed reasonable performance in terms of cane and sugar yield against check variety Thatta-10. This one year's study is not sufficient to draw out the substantial conclusions. Thus it was suggested that the potential of these varieties need to be testes under different agro-climatic conditions of Sindh for several years to draw out substantial conclusions.

Table-2 Performance of different promising sugarcane varieties at different locations of Sindh.

Variety	Ferozuddin Shah agricultural farm, Matiari			Hassan Keerio agricultural farm, Jhole, district Sanghar			Anwar Ali Bachani agricultural farm, Tando Allahyar		
	Cane yield (t ha^{-1})	CCS (%)	Sugar Yield (t ha^{-1})	Cane yield (t ha^{-1})	CCS (%)	Sugar Yield (t ha^{-1})	Cane yield (t ha^{-1})	CCS (%)	Sugar Yield (t ha^{-1})
HoTh-401	98.00^{d}	13.84	13.56^{b}	100.33^{bc}	13.75	13.79^{bc}	109.00 ^{c}	14.81^{a}	16.14^{b}
HoTh-409	143.00^{a}	13.82	19.76^{a}	133.33^{a}	13.55	18.06 ^{a}	155.00 ^{a}	14.16^{ab}	21.94^{a}
HoTh-420	117.33^{bc}	13.95	16.36^{b}	111.55^{b}	13.62	15.19^{b}	125.00 ^{b}	13.34^{b}	16.67^{b}
HoTh-432	108.66^{cd}	13.32	14.47^{b}	89.33 ^{c}	13.04	11.64^{c}	117.33 ^{bc}	14.08^{ab}	16.52^{b}
HoTh-438	120.33^{bc}	13.97	16.81^{ab}	104.33^{b}	13.77	14.36^{b}	114.00 ^{bc}	13.84^{ab}	15.77^{b}
Thatta-10	123.66 ^{b}	13.56	16.76^{ab}	114.0^{b}	13.78	15.70^{ab}	118.00 ^{bc}	13.90^{b}	16.40^{b}
CV %	6.70	2.65^{NS}	11.08	7.27	6.80^{NS}	9.18	5.35	3.33	6.31
LSD-0.05%	14.44		3.28	14.40		2.47	11.98	0.85	1.97
LSD-0.01%	20.54		4.66	20.48		NS	17.05	1.21	2.81

Note: Means followed by the same letter in a column do not differ significantly at 0.05% level of probability.

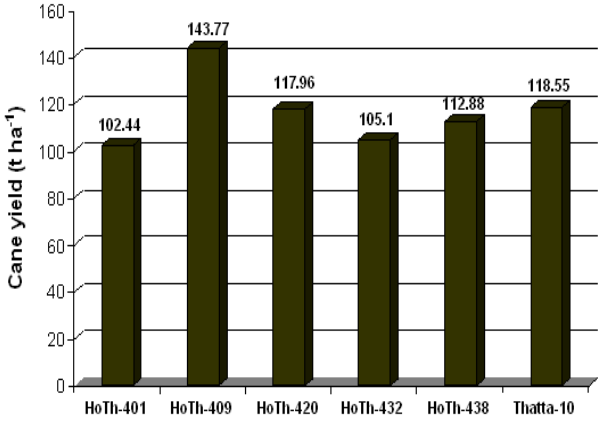

Fig. 1 Average cane yield of different sugarcane varieties in all three loactions of Sindh during 2006-07

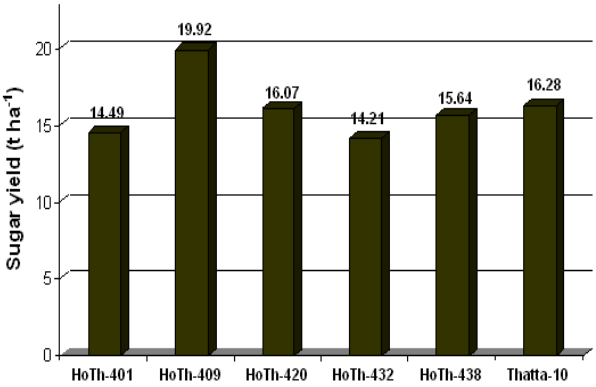

Fig. 3 Average sugar yield of different sugarcane varieties in all three loactions of Sindh during 2006-07

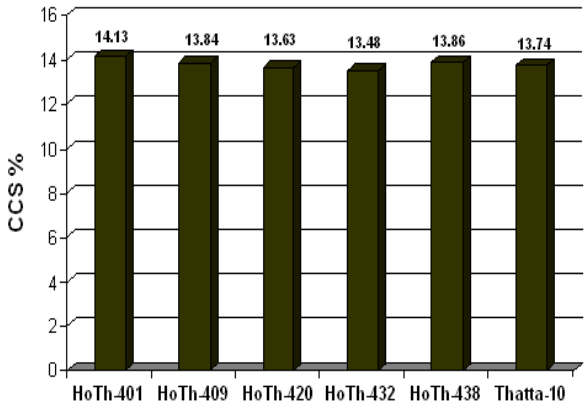

Fig-2. Average commercial cane sugar percentage of different sugarcane varieties in all three loactions of Sindh during 2006-07

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