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Evaluation of New Promising Sugarcane Clones under Agro-Ecological Conditions of Faisalabad, Pakistan

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Abstract: Quality of genotype has pivotal role in determining the cane and sugar yield of sugarcane. The inherent yield potential of a genotype is of prime importance for sustaining higher production. The study was conducted at Sugarcane Research Institute, Faisalabad to evaluate the performance of 12 promising sugarcane clones against check variety HSF-240 for the growing season 2017-18. The experiment was laid out in Randomized Complete Block Design with three replications. Results revealed a significant difference among the clones for agronomic attributes. S2006-US-658 superseded all the other clones including the check variety in terms of cane yield (140.23 t ha^{-1}). The sugar recovery was found maximum in S2003-US-633 (11.82%) while check variety exhibited sugar recovery of 11.33% under the agro-ecological conditions of Faisalabad.

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1. Introduction

In Pakistan, Sugarcane is an important cash crop as it contributes 2.9 % in agriculture's value addition and 0.5 percent in GDP (Gross Domestic Product) of the country. During 2018-19, its production has been decreased by 19.4 % (67.17 million tonnes) as compared to 83.33 million tonnes, achieved last year (2017-18). Its cultivation area has been shrunk by 17.9 % (from 1,343 thousand of last year to 1,102 thousand hectares) on account of water shortages. In addition, low economic returns, disposal problem of cane and payment difficulties also restricted the acreage of sugarcane which eventually decreased the production (Government of Pakistan, 2019).

The challenges faced by the crop include lower than average production per unit area, low sugar recovery and higher cost of production etc. Moreover, planting of traditional low yielding varieties rather than the advanced high yielding varieties is the root cause of lower cane and sugar yield. Variety is the main factor which is considered as responsible for increasing as well as decreasing the cane yield per unit area (Mian, 2006). The solution to the problem of low sugarcane yield and sugar recovery can be resolved to some extent by planting newly developed advanced sugarcane varieties (Chattha *et al.*, 2006). Significant efforts are being made to increase the cane production by introducing high yielding varieties along with the adoption of improved crop production techniques (Gill, 1995). Similarly, selection of a proper variety to be planted in a particular agro-ecological zone is pre-requisite to explore its quantitative and qualitative characteristics (Hassan *et al.* 2017).

So, the objective of the present study was to evaluate the yield and performance of promising sugarcane clones under the agro-climatic conditions of Faisalabad. This will also help in selection of the most suitable genotype meeting the industry needs.

2. Materials and Methods

Twelve promising sugarcane clones, viz; S2005-US-54, S2008-FD-19, S2008-M-34, S2008-AUS-130, S2008-AUS-133, S2009-SA-79, S2009-SA-111, SL 96-175, VMC 87-599, S2003-US-127, S2003-US-633, S2006-US-658 and one approved variety; HSF-240 were obtained from Sugarcane Research Institute (SRI), Ayub Agricultural Research Institute (AARI), Faisalabad. The crop was planted at 120cm apart deep trenches at farm area of SRI, AARI, Faisalabad in spring season, 2017. The experiment was laid out in Randomized Complete Block Design with three replications. Sugarcane seed was taken from healthy plant crop, cut and trashed manually. Seeding rate of 50,000 triple-budded setts per hectare was maintained at the time of planting. The fertilizer was applied at the recommended rate of 168-112-112 NPK Kg ha^{-1}. Standard plant protection measures were adopted and all the recommended agronomic practices were kept uniform for all the treatments.

Data regarding germination (%), tillering (tillers/plant), cane count (000 ha^{-1}), cane yield (t ha^{-1}) and sugar recovery (%) were recorded according to the standard procedures. Periodic juice analysis was done from mid-October, 2017 to mid-January, 2018 for sugar recovery evaluation at the Sugarcane Technology Laboratory-SRI, Faisalabad. The data recorded were subjected to statistical analyses as described by Freed (1990) by using Statistix 8.1 and Least Significant Difference (LSD) test at 5% probability level was used to rank all sugarcane clones (Steel *et al*. 1997). A correlation matrix of different yield contributing parameters was developed by using Microsoft Excel version 2016 to analyze the relationship among different parameters.

3. Results and Discussion

Germination (%)

Yield; the end stage of a crop, depends upon the germination (%) which ensures the required number of plants in a field. Maximum germination (58.07%) was expressed by S2003-US-633 followed by SL 96-175 (55.23%) while, minimum germination (41.03%) was expressed by S2008-M-34 (Table 1). However, S2006-US-658 showed 51.03% germination which is quite similar with the 52.0% germination (Sarwar *et al*. 2016).

Tillers Per Plant

Tillering is one of the most fundamental characters of sugarcane which is widely admired by the farmers. Increased number of tillers leads to obtain enhanced cane yield and better ratooning ability of the crop (Islam *et al.* 2016). Observed data presented in Table 1 shows that there is significant difference among the sugarcane clones regarding the tillers per plant. Maximum number of tillers (2.12) were observed in S2006-US-658 while, S2008-M-34 and S2009-SA-79 both showed minimum number of tillers (0.91). However, S2008-AUS-133 and HSF-240 (Check) showed statistically similar number of tillers per plant which were 1.62 and 1.60 respectively.

Table 1: Data regarding yield and yield contributing parameters

Sr. No.	Clone/Variety	Germination (%)	Tillers/ Plant	Cane count (000 ha^{-1})	Cane yield (t ha^{-1})	Sugar recovery (%) (Oct-Jan)
1	S2005-US-54	50.33 bcd	1.41 ef	111.00 cd	102.37 cde	10.57
2	S2008-FD-19	52.10 abc	1.84 abc	142.97 a	122.57 b	11.00
3	S2008-M-34	41.03 e	0.91 h	87.43 e	79.13 gh	9.12
4	S2008-AUS-130	50.37 bcd	1.27 fg	103.80 d	95.40 def	10.06
5	S2008-AUS-133	48.50 cd	1.62 cde	105.47 cd	93.07 defg	9.92
6	S2009-SA-79	41.10 e	0.91 h	97.67 de	86.07 fgh	9.06
7	S2009-SA-111	49.17 bcd	1.04 gh	88.77 e	77.47 h	11.80
8	SL 96-175	55.23 ab	1.72 bcd	110.03 cd	104.73 cd	8.18
9	VMC 87-599	45.27 de	1.53 def	105.97 cd	89.60 efgh	9.39
10	S2003-US-127	53.43 abc	1.96 ab	128.10 b	112.53 bc	10.45
11	S2003-US-633	58.07 a	1.83 abcd	132.30 ab	116.00 bc	11.82
12	S2006-US-658	51.03 bcd	2.12 a	131.17 ab	140.23 a	8.62
13	HSF-240 (Check)	49.37 bcd	1.60 cde	118.80 bc	110.43 bc	11.33
LSD @ 5%		**6.33**	**0.307**	**14.74**	**14.02**	

Cane Count/ Millable Canes

Cane count or millable canes is a yield contributing factor (Junejo *et al.* 2010) because more the number of canes in a field more will be the yield obtained from that specific field. Maximum number of millable canes (142.97 thousand ha^{-1}) were observed from S2008-FD-19 (Table 1) which were significantly higher from all the other tested genotypes followed by S2003-US-633 (132.30 thousand ha^{-1}) and S2006-US-658 (131.17 thousand ha^{-1}). Minimum number of millable canes (87.43 thousand ha^{-1}) were recorded from S2008-M-34 which were statistically similar to the canes produced by S2009-SA-111 (88.77 thousand ha^{-1}). In present study, HSF-240 (Check) produced 118.80 (thousand ha^{-1}) millable canes as reported by Shahid *et al.* 2015 (118.65 thousand ha^{-1}).

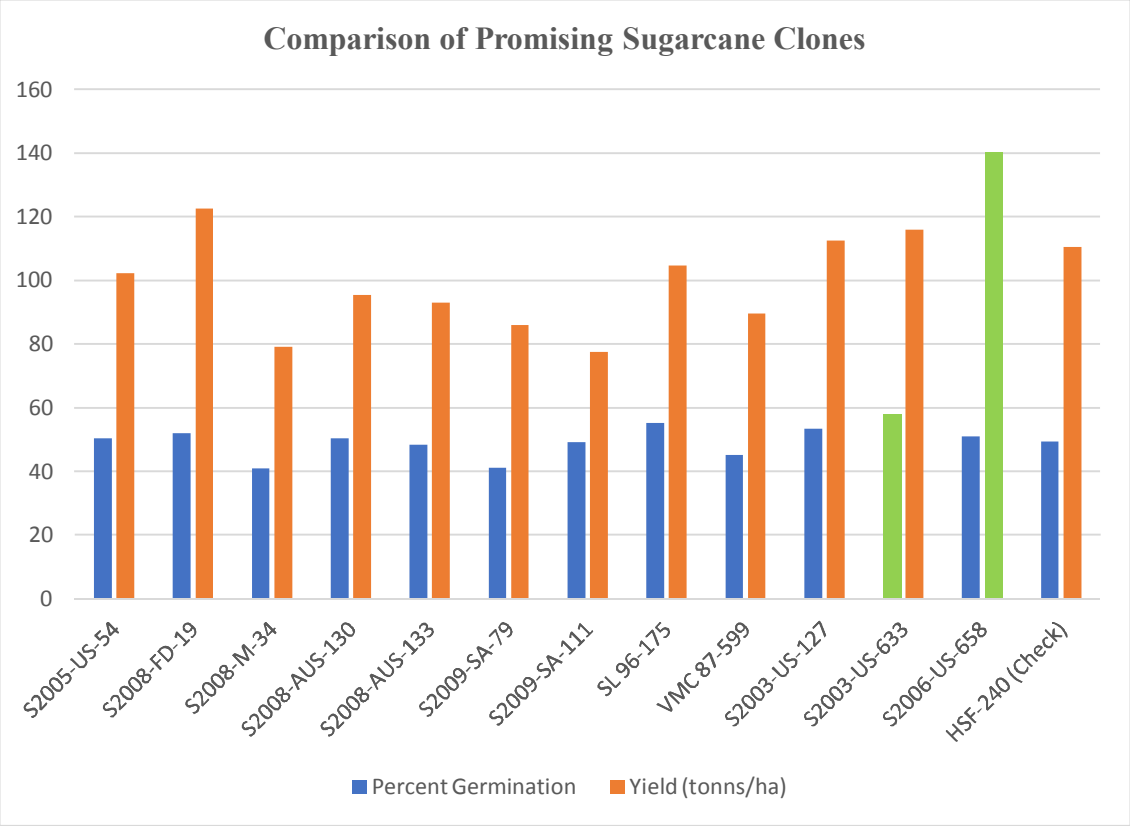

Fig 1. Comparison of promising sugarcane clones

Cane Yield

All the scientific developments in the agriculture and its sub-sectors are primarily focused on enhancing the obtained farm yield which eventually benefits the farmers as well as the economy of a country. From the observed data (Table 1), it is evident that maximum cane yield was observed for S2006-US-658 (140.23 t ha^{-1}) while minimum cane yield was observed for S2009-SA-111 (77.47 t ha^{-1}). It is noteworthy to mention here that maximum and minimum cane yield recorded in the present study were statistically different from yield of all other clones tested in the trial. The genetically improved sugarcane clones may have ability to produce better results regarding cane yield and sugar contents under given set of environmental conditions (Arain *et al.* 2011). So higher cane yield by genotype S2006-US-658 may be attributed to its improved genetic makeup and its better adaptability potential under the agro-ecological conditions of Faisalabad. However, cane yield expressed by S2008-FD-19 (122.57 t ha^{-1}) is near to the cane yield 126.5 t ha^{-1} (Sarwar *et al.* 2016). Similarly, in case of S2003-US-633, cane yield obtained (116.00 t ha^{-1}) is close to the cane yield 118.87 t ha^{-1} (Sarwar *et al.* 2019). S2003-US-127 expressed 112.53 t ha^{-1} cane yield which is near to the 109.9 t ha^{-1} (Sarwar *et al.* 2018).

Sugar Recovery (%)

Sugar recovery and sugar yield are the principal attributes that make sugarcane a valuable crop. Maximum sugar recovery (11.82 %) was recorded for S2003-US-633 while minimum sugar recovery (8.18 %) was found from SL 96-175. The inherent genetic makeup of a genotype might have contributed towards higher and lower sugar contents. El-Geddaway *et al.* (2002) reported that sugarcane varieties are greatly affected by genetic makeup. According to Keerio *et al.* (2003) unless the genetic potential of a variety is not high, mere provisions of growing conditions such as fertilizer, irrigations etc. will not lead to the significant improvement in cane or sugar yield.

Table 2: Correlation matrix of yield contributing parameters

	Germination	Tillers / Plant	Cane Count	Cane Yield	Sugar Recovery
Germination	1				
Tillers/Plant	0.739671	1			
Cane Count	0.681259	0.878819	1		
Cane Yield	0.632762	0.88709	0.917671	1	
Sugar Recovery	0.354866	0.026892	0.23253	0.011422	1

It is evident from Table 2 that germination (%) has strong relation with tillers/plant. Similarly, more the tillers per plant, more will be the cane count resulting in higher cane yield. Cane count has very strong relationship with the obtained cane yield.

4. Conclusion

The selection of better site specific genotype in terms of higher cane production along with higher sugar recovery might play vital role in prosperity of farmers as well as industrialists. This study provides sufficient information regarding the response of various sugarcane genotypes under agro-ecological conditions of Faisalabad. Results unveiled that S2006-US-658 produced maximum cane yield (140.23 t ha^{-1}) while S2003-US-633 exhibited maximum sugar recovery (11.82 %) as compared to all other genotypes including check variety. Hence, these two genotypes may be preceded further for variety development studies.

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