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Evaluation of different sugarcane clones under third selection stage trial

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Abstract
Preliminary varietal selection stage is of great concern under variety development programme of sugarcane crop in Pakistan. Keeping in view this importance a field experiment was conducted at research area of Sugarcane Research Institute, Faisalabad, Pakistan during 2015-16. Thirty sugarcane clones were evaluated in randomized complete block design with three replications at third selection stage of variety development programme. The results revealed that in set-1, clone S2011-SL-392 super pass other clones having cane yield of 115.07 t ha^{-1} with sugar yield of 15.47 t ha^{-1} and in set-2, clone S2011-SL-809 gave higher cane yield of 145.93 t ha^{-1} with sugar yield of 18.88 t ha^{-1}. Out of thirty, ten clones were selected and promoted for further study on the basis of good performance. The remaining twenty clones were rejected due to disease susceptibility, pith and poor growth characteristics.

Keywords: sugarcane clone, standard variety, desirable character

Introduction
In Pakistan about 70% population is directly or indirectly related with agriculture for food and raw material for industrial Production. Agriculture plays central role in the economic growth and development of Pakistan. Being the dominant sector it contributes 19.5 percent to GDP, employs 42.3 percent of the country's labor force (Anonymous, 2017) [2]. Sugarcane crop occupies an important position in national economy in order to drive the large sugar industry. It also provides raw materials to chip board, paper and ethanol.

Its share in value added in agriculture and GDP is 3.4 and 0.7 percent respectively (Anonymous, 2017) [2]. Sugarcane is the main sugar-producing crop (Junejo *et al.,* 2010) [8]. The leading Sugarcane producing countries including Brazil as a major producer followed by India, China, Pakistan, Thailand and Mexico (FAO., 2010) [5]. It provides employment and by products for industrial sector. That is why, sugar industry is second to textile in Pakistan which is primarily based on the mercy sugarcane cultivation (Bahadar *et al., 2002*). It is also an important cash crop of Pakistan (Ahmad *et al.,* 1991) [1], which plays an important role in economic uplift of farmers. In Pakistan about 99% of the sugar is extracted from sugarcane to meet the demand at domestic level (Azam and Mukarram, 2010) [3].

The average per hectare yield (50.28 t ha^{-1}) in Pakistan is less than other major cane growing countries of the world (Sohu, *et al.,* 2008) [13]. Major reason for low yield is that our farmers do not have option regarding high yielding varieties (Majeedano, *et al.,* 2004) [12].

The high cane & sugar yielding sugarcane varieties and improved package of production technology have main role in overall producing of sugarcane and sugar production in the country (Heinz, 1987). Sugarcane highly complex genome, low fertility and large genotype x environment interactions make traditional varietal improvement and genetic studies difficult and laborious (Mendoza, 2000) [11].

Flowering and seed set under natural conditions of Pakistan is a very serious problem in sugarcane that hampers varietal improvement. In Pakistan the basic facilities for hybrid seed production and variety development are lacking. Though the coastal belt in Sindh, is endowed with specific climatic conditions where sugarcane plants flower. But at local spots where plants flower, non-synchronization in genotypes for cane flowering reduces the possibility of hybridization (Tiawari *et al.,* 2009) [15].

Therefore, sugarcane variety development in Pakistan is mainly based on import of germplasm from the cane breeding stations abroad and also through exotic or locally collected fuzz (Kaloi *et al.,* 2007) [7]. In most of the cane breeding programs large numbers of seedlings are grown from fuzz (true seed), selections are made in subsequent generations to obtain superior clones/genotypes for release as new varieties.

The development of new sugarcane varieties is not possible in Pakistan because of intricate flowering of the plant and non-availability of sugarcane breeding facility and acclimatization (Javid *et al.,* 2001) [7]. Thus the selection forms the base line to cane agronomist in Pakistan to develop new varieties. Potential of new genotypes needs to be tested in local environment before deciding to release as a new cultivar in a particular region (Khan *et al., 2000*) [10].

All the stages in varietal selection programme are important but establishment of a good nursery is of prime importance. Keeping in view the importance of nursery, the present study was conducted for the evaluation of qualitative and quantitative characteristics of sugarcane genotypes under the agro climatic condition of Faisalabad.

Materials and Methods
The comprehensive study was conducted during crop season 2015-16 at Sugarcane Research Institute, Faisalabad, Pakistan

to study yield and yield contributing factors and also different growth performing characters of different sugarcane clones under preliminary varietal selection stage of Nursery-iii. Two sets of preliminary varietal yield trial consisting of 30 genotypes and one standard variety CPF-247 was laid out in RCBD in three replications. Experiment was sown on 04-11-2013 with net plot size of 4 m x 3.6 m by keeping inter-row spacing of 120 cm. All the agronomic and cultural practices were applied as and when considered necessary during the course of study. The data of different yield parameters (number of canes per hectare, brix percentage and cane yield in tons per hectare) were determined at harvest while germination and tillering data were recorded at 45 and 90 days after planting. Different characters were also studied which includes pithiness, disease susceptibility, growth performance, secondary roots, presence of hollow stem. These parameters were studied visually at the maturity of crop. The brix reading was recorded by hand refract meter. The data was statistically analyzed as mentioned by Steel and Torrie (1984) [14] at probability 5% to compare their means.

Results and Discussion

In set-I, 15 clones along with check variety CPF-247 were studied, among them 4 clones i.e. S2011-Fd-22, S2011-Fd-25, S2011-SL-62 and S2011-SL-392 were selected and promoted to semi-final varietal trial for further study on the basis of good performance. Clone S2011-SL-392 gave higher cane yield of 115.07 t ha^{-1} with sugar yield of 15.47 t ha^{-1} followed by S2011-SL-62 with cane yield of 102.57 t ha^{-1} and sugar yield of 12.59 t ha^{-1}. Moreover, clone S2011-Fd-22 and S2011-Fd-25 showed good results of 100.80 and 100.53 t ha^{-1} cane yield with 10.85 and 11.24 t ha^{-1} sugar yield, respectively. These results are in line with Javid *et al.,* (2001) [7].

In set-II, 15 entries along with check variety CPF-247 were studied. Out of which 6 clones i.e. S2011-SL-809, S2011-ESR-97-41, S2011-PSR-97-45, S2011-VMC-88-354, S2011-87-599 and S2011-M2238-89 were selected and promoted to semi-final varietal trial for further study on the basis of good performance. The clone S2011-SL-809 gave higher cane yield of 145.93 t ha^{-1} with 18.88 t ha^{-1} sugar yield followed by S2011-M2238-89 and S2011-VMC-88-354 having cane yield of 125.63 and 120.73 t ha^{-1} with 16.08 and 14.66 t ha^{-1} sugar yield, respectively. Similarly clones S2011-ESR-97/41, S2011-PSR97-45 and S2011-87-599 showed good results having cane yield of 108.70, 119.43 and 113.90 t ha^{-1} with 13.41, 14.79 and 12.95 t ha^{-1} sugar yield as against 119.86 t ha^{-1} cane yield with 12.72 t ha^{-1} sugar yield was showed by check variety CPF-247. These results are in line with Javid *et al.,* (2001) [7].

In good agronomic practices, the growth performance is character that affects the yield of cane crop. Growth habits, erectness, internodal length, girth of cane, length of cane and stooling depends upon genetic make-up which may be detected by overall performance of clone. In set-I, clones S2011-SL 392, S2011-SL 62, S2011-Fd 25, S2011-Fd 22 and in set-I, clones S2011-SL 809, S2011-ESR 97-41, S2011-PSR 97-45, S2011-VMC 88-354, S2011-VMC 87-599, S2011-M 2238-89 in set-II showed good growth performance than others. These results are at par with the fi ⌈iawari *et al.,* (2009) [15].

Hollow stem of cane is negative character, leads to lodging, disease infestation and lowers the cane weight and quality. In the trial eight clones were rejected due to pithiness. The secondary roots spoil the quality of cane as well as lower the growth speed and deteriorate crop stand. Two clones S2011-SL 353 and S2011-M 1400-86 were rejected due to carrier of this bad character. These results are in line with Javid *et al.,* (2001) [7].

In the trial seven clones were rejected due to attack of red rot and one clone is rejected due to presence of smut. The splits on the stem of cane deteriorate cane quality as well as tissues due to increase in transpiration rate. Four clones showed splits / cracks and were rejected. These results are in line with the findings of Tiawari *et al.,* (2009) [15].

Lodging exerts harmful effects on sugar yield, spoils cane quality, brix % and growth of cane crop. Two clones S2011-SL 145 & S2011-SL 36 in set-I showed low resistance to lodging and were rejected. These results are at par with the findings of Tiawari *et al.,* (2009) [15].

Table 1: Results of preliminary varietal trial (nursery-iii)

S. No.	Variety/clone	Germination %	Tillers per plant	Cane count (000 ha^{-1})	Cane yield (t ha^{-1})	CCS %	Sugar Yield (tha^{-1})	Remarks
1.	S2011-Fd 22	51.70 bc	0.92 ab	103.30 bcde	100.80 bcd	10.77 e	10.85	Selected & promoted
2.	S2011-Fd 25	56.66 ab	0.65 abcd	94.43 de	100.53 bcd	11.18e	11.24	Selected & promoted
3.	S2011-SL 36	55.06 ab	0.51 bcd	103.47 bcde	92.07 cd	13.75a	12.66	Rejected due to pith, smut & lodging
4.	S2011-SL 57	59.56 ab	0.48 cd	125.47 abc	116.60 abc	11.24de	13.11	Rejected due to red rot
5.	S2011-SL 62	59.06 ab	0.87 abc	101.07 de	102.57 bcd	12.27cd	12.59	Selected & promoted
6.	S2011-SL 145	53.03 abc	0.55 bcd	117.97 abcd	107.20 bcd	13.02abc	13.96	Rejected due to high smut & lodging
7.	S2011-SL 146	52.93 abc	0.31 d	95.50 de	86.27 d	12.31cd	10.62	Rejected due to high splits.
8.	S2011-SL 237	64.90 a	0.49 cd	133.75 a	138.80 a	13.21abc	16.34	Rejected due to red rot
9.	S2011-SL 257	53.50 ab	0.58 bcd	127.73 ab	99.70 bcd	12.40 bc	12.36	Rejected due to red rot
10.	S2011-SL 328	62.47 ab	0.60 bcd	86.30 e	101.40 bcd	12.31 cd	12.48	Rejected due to red rot
11.	S2011-SL 339	62.26 ab	0.51 bcd	114.63 abcd	109.67 bcd	12.93abc	14.18	Rejected due to high pith
12.	S2011-SL 353	63.47 ab	0.47 cd	98.30 de	110.70 bcd	12.89abc	14.27	Rejected due to high pith and aerial roots
13.	S2011-SL 361	40.40 c	1.05 a	119.50 abcd	118.97 abc	13.11abc	15.60	Rejected due to high pith & splits
14.	S2011-SL 392	51.36 bc	0.85 abc	118.33 abcd	115.07 abc	13.44ab	15.47	Selected & promoted
15.	S2011-SL 406	60.80 ab	0.56 bcd	120.97 abc	120.37 ab	10.80e	13.00	Rejected due to high splits & spines
16.	CPF 247 (Check)	63.26 ab	0.65 abcd	107.57 abcde	124.27 ab	13.45ab	16.71	Check
	LSD VALUE	12.77	0.42	26.04	26.97	1.08	-	

Table 2: Results of preliminary varietal trial

S. No.	Variety / clone	Germination %	Tillers per plant	Cane count (000 ha^{-1})	Cane yield (t ha^{-1})	CCS %	Sugar Yield (tha^{-1})	Remarks
1.	S2011-SL 360	60.63 a	0.60 ab	120.83 ab	121.80 abc	11.77	14.34	Rejected due to smut
2.	S2011-SL 620	63.60 a	0.57 abc	107.33 abc	91.30 cd	11.63	10.62	Rejected due to red rot
3.	S2011-SL 724	60.60 a	0.50 abcd	70.80 d	65.27 d	10.42	6.80	Rejected due to split and growth habit
4.	S2011-SL 809	61.10 a	0.45 abcd	136.03 a	145.93 a	12.94	18.88	Selected & promoted
5.	S2011-SL 873	59.83 a	0.43 bcd	129.40 ab	125.60 abc	12.21	15.34	Rejected due to high pith
6.	S2011-ESR 97-41	51.37 a	0.41 bcd	99.03 bcd	108.70 bc	12.34	13.41	Selected & promoted
7.	S2011-VMC 95-09	36.40 b	0.48 abcd	108.27 abc	114.07 abc	10.74	12.25	Rejected due to pith
8.	S2011-PSR 97-45	52.13 a	0.69 a	110.53 abc	119.43 abc	12.38	14.79	Selected & promoted
9.	S2011-VMC 87-95	61.66 a	0.57 abcd	118.00 abc	118.70 abc	12.28	14.58	Rejected due to red rot
10.	S2011-VMC 88-354	60.46 a	0.61 ab	104.40 bc	120.73 abc	12.14	14.66	Selected & promoted
11.	S2011-VMC 86-550	61.53 a	0.27 cd	107.17 abc	113.90 abc	13.50	15.38	Rejected due to red rot
12.	S2011-VMC 84-947	60.80 a	0.43 abcd	90.27 cd	125.67 ab	11.38	14.30	Rejected due to high pith
13.	S2011-VMC 87-599	63.43 a	0.41 abcd	110.53 abc	113.90 abc	11.37	12.95	Selected & promoted
14.	S2011-M 1400-86	52.47 a	0.36 bcd	104.83 bc	113.90 abc	12.47	14.20	Rejected due to pith, splits & aerial roots
15.	S2011-M 2238-89	55.26 a	0.70 a	112.43 abc	125.63 ab	12.80	16.08	Selected & promoted
16.	CPF 247 (Check)	62.90 a	0.47 abcd	105.47 bc	119.86 abc	12.72	15.25	Standard
	LSD VALUE	14.72	0.32	30.49	32.66	NS	-	

Conclusion

In the preliminary varietal trial thirty clones were studied. Ten clones were selected and promoted for further study in semifinal varietal trial under variety development programme. The remaining twenty clones were rejected due to smut, red rot, pith, lodging and poor growth habits.

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