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VARIETAL DEVELOPMENT PROGRAM AT SUGARCANE RESEARCH INSTITUTE, FAISALABAD

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Abstract

To develop sugarcane varieties having maximum sugar recovery with more tonnage is the basic and primary objective of sugarcane research institute (SRI), Faisalabad. Two means are adopted for the evolution of new sugarcane variety, firstly by importing the stumps of sugarcane of commercial varieties, as direct introduction method and, secondly by evaluating the fuzz of sugarcane also importing from global breeding institutes. Twenty-four high yielding and disease resistant varieties have been developed so far at SRI, Faisalabad. Among theses, five sugarcane varieties viz. Triton, CP 43-33, CP 72-2086, CP 77-400 and CoJ 84 were developed by Direct Introduction. Recently, SRI, Faisalabad had also planned to pool 90 sugarcane varieties at Sugarcane Research Institute (SRI), Udawalave, Sri Lanka by contributing 30 varieties each of SRI, Faisalabad, SSRI, Jhang and SRI, Sri Lanka for crossing each other to create genetic variability. Fuzz of theses crosses were, then imported back to SRI, Faisalabad for evaluating the produce in the form of seedlings and clones after passing through an international track of research with the idea to create maximum genetic variability in the parentage of Pakistani sugarcane varieties in our own climatic conditions. Genetically improved variety is not only tolerant to disease and insect infestation but diverse parentage of the variety is widely adaptable for a varied range of soil and climatic conditions too. A research plan is being initiated to establish such infrastructure under which flower induction taken place and crosses may take place of sugarcane varieties with diverse origin in our own environment to cut down the foreign exchange consumed to import the sugarcane stumps and fuzz from global breeding institutes.

Key words: sugarcane, stumps, fuzz, diverse parentage, variety, cane yield, sugar recovery

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INTRODUCTION

Sugarcane (*Saccharrum officinarum* L.) is an important cash crop of many agricultural countries including Pakistan. It is a versatile crop and a rich source of food, fiber, fuels, chemicals and fertilizers (Leite, 2010). Every part of sugarcane plant from top to bottom is utilized in one form or the other, directly by mankind or the industry. The crop is of immense economic importance for the prosperity of the people. Its importance can be judged from the fact that sugarcane is cultivated in nearly 115 countries of the world and produces three forth of the total sugar in the world.

Sugarcane breeding program play an imperative role for the economic development of farmers. It delivers genotype with superior traits to meet new challenges under climate change era. The main objective of a varietal improvement program at SRI, Faisalabad is always to develop improved varieties with higher potential of cane and sugar yields per hectare (Jackson, 2005). An improved variety keep particular characteristics like tolerant to disease , insect infestation, lodging, drought and frost, however, it should be widely adaptable for a diverse range of soil and climatic conditions (Carvalho, 2010, Creste *et al*.2010).

Genetically improved sugarcane varieties regarding the involvement of quantitative and qualitative traits has been the prime and appreciated factor in the sugarcane growing community (Milligan *et al*.1990, Aitken *et al*. 2008). It has also paste the positive impact on the canvass of sugar industry. For variety development program, breeding efforts run at SRI, Faisalabad are earlier, encompass the local fuzz production, as compare to stumps (Katia et al. 2014) but local fuzz contributes a little for the evolution of sugarcane varieties. The main issue of the local fuzz production correlates the viability of fuzz due to non-availability of required climatic constituents like temperature, humidity and the duration of dark night during pollination of male and female part of the flower. Non-availability of sugarcane breeding facilities is another problem in Pakistan (Javed e*t al*. 2001). Therefore, outcome of the variety development program at SRI, Faisalabad on sugarcane are eventually the main result of exotic fuzz. Diversified paternity is another edge of fuzz received from global breeding institute for exploring the new horizon of yield potential after acclimatizing the genetic make-up in the new land (Pandey *et al*.,2000., Ragauskas *et al.*, 2006). Uptill now, SRI, Faisalabad has released 24 wide-ranging sugarcane varieties (Table 1) of high yielding with better sugar recovery (Jackson, 2005).

Table 1 : Characteristics of Sugarcane Varieties developed by SRI, Faisalabad

S.No.	Variety	Year of Approval	Potential yield tons/ha	Sugar Recovery (%)	Parentage	Developed by	
						Fuzz	Stump
1	CoL 29	1954	70	10.10	---	Fuzz	--
2	CoL44	1954	75	8.93	---	Fuzz	--
3	CoL54	1963	75	9.63	---	Fuzz	--
4	BL19	1966	85	9.49	---	Fuzz	--
5	BL4	1968	85	10.34	PoJ 2878	Fuzz	--
6	L116	1973	75	10.81	CoL 29	Fuzz	--
7	L118	1975	83	8.23	S 230	Fuzz	--
8	Triton	1983	85	10.10	Co 270 x Eros	--	Direct Introduction
9	BF 162	1990	90	10.35	Co 1001	Fuzz	--
10	CP 43-33	1996	80	11.69	Co 281 x CP 1165	--	Direct Introduction
11	CP 72-2086	1996	85	12.35	CP 62-374 x CP 63-588	--	Direct introduction
12	CP77-400	1996	90	11.90	CP 66-315 x CP 71-5400	--	Direct Introduction
13	CoJ 84	2000	90	9.80	Introduction	--	Direct Introduction
14	SPF213	2000	90	10.50	SP 70-1006	Fuzz	--
15	CPF237	2000	95	12.50	86. P-19 x CP 70-1133	Fuzz	--
16	HSF240	2002	95	11.70	CP 43-33 x S. 95 – HS-102	Fuzz	--
17	SPF234	2002	100	11.60	SP 71- 8210 x SP 71 - 6180	Fuzz	--
18	SPF245	2004	100	11.00	G 6888	Fuzz	--
19	HSF 242	2006	102	12.50	SPH- 89-2085	Fuzz	--
20	CPF 243	2006	102	12.55	LCP 81-10 x CP- 80-1827	Fuzz	--
21	CPF 246	2011	105	12.15	US 90-1093 x CP- 81-14257	Fuzz	--
22	CPF 247	2011	105	12.25	P 87 -1628 x CP 84-1198	Fuzz	--
23	CPF 248	2013	112	12.71	CP 89-879 x CP 90-956	Fuzz	--
24	CPF 249	2016	116	12.46	CP 87-1628 x CP 84-1198	Fuzz	--

MATERIAL AND METHODS

Breeding program at SRI, Faisalabad is responsible to deliver genotype with superior traits responding to new challenges that occasionally arise. (Creste *et al*.2010). Diversification in the parentage of sugarcane varieties is essential to utilize maximum genetic potential of yield and yield related traits. For obtaining diversified parents, SRI, Faisalabad interacted with global sugarcane breeding institutes in order to get fuzz of different cross combinations or sugarcane stumps or setts (Gazaffi *et al*.2010). On request basis and or sometimes on bilateral agreements, germplasm of sugarcane varieties are exchanged with well reputed sugarcane breeding institutes of the world as enlisted below:

i) Bureau of Sugarcane Experiment Station (BSES), Meringa, Australia

ii) West Indies Central Sugarcane Breeding Station (WCSBS), Barbados

iii) Camemo Breeding Station (CBS), Cooper soaker/Camemo, Brazil

iv) Sugarcane Breeding Institute (SBI), Coimbatore, India.

v) Indonesian Sugar Research Institute (ISRI), Pasuruwan, Indonesia

vi) Mauritius Sugar Industry Research Institute (MSIRI), Mauritius

vii) South African Sugar Association Experiment Station (SASES), Durban, South Africa

viii) Sugarcane Field Station (SFS), Canal Point, America

ix) Sugar Research Centre (SRC), Houma, Louisiana, America

x) Hainen Sugarcane Breeding Station (HSBS), Hainen, China

xi) Sugarcane Research Institute (SRI), Udawalave, Sri Lanka

Stepwise procedure to develop sugarcane variety

Following step wise procedure for cane varietal development program is being followed at Sugarcane Research Institute, Faisalabad to evolve new sugarcane varieties.

Step I: Collection of Fuzz

Sugarcane true seeds (fuzz) are collected from both indigenous (Sugarcane Breeding Sub-Station, Murree) and exotic sources (America, West Indies, South Africa, Brazil, Mauritius, Sri Lanka etc.).

Step II: Sowing of Fuzz

Fuzz is sown on fine raised seed beds. The seed beds are kept moist at favorable temperature (20 to 30°C) and germination completes within 4-10 days. (Marcos Filho (1986), Borges and Rena (1993). Each cross is numbered. After 6-8 weeks, nursery is ready for singling.

Step III: Singling of Seedlings

Seedlings are shifted in small earthen pots or polythene bags. Every individual seedling is given due importance due to polygenic in nature as no one knows which would become a variety in future. Each seedling is kept in this form for about 3 months.

Step IV: Shifting seedlings in field

Well-developed seedlings from these pots or bags are transplanted in the field along with check varieties (PxP and RxR 1.2m). All the cultural and agronomic measures are kept alike during the crop season. Seedlings from each cross are demarcated.

Step V: Seedling selection

First stage of selection is started in September next year. Robust and phenotypically superior plants are selected keeping in view, the quality parameters as tillering, stalk diameter, inter-nodal length, absence of aerial roots, pith and free of diseases and insect pests. Brix percentage is also recorded with hand refracto-meter from top, middle and bottom. Selected superior plants are allotted selection numbers accordingly and promoted to Nursery-I for further study and evaluation.

Step VI: Nursery-I

Each selected clone is planted in a single row (4m x 1.2m)following augmented design along with checks after 20 clones. In next autumn selection of clones are made keeping in view the desirable characters, such as growth vigor, erectness, resistance to frost, lodging, insect pests, diseases and brix percentage. After comparing the quantitative and qualitative characters, selected clones are promoted to Nursery-II.

Step VII: Nursery-II

At this stage clones are sown in two rows with plot size of 4m x 2.4m. Same selection procedure is adopted next year for Nursery-II and selected clones are promoted to Nursery-III.

Step VIII: Nursery-III (Preliminary varietal trial)

Selected clones from Nursery-II are planted in three rows laid out in Randomized Complete Block Design (RCBD), having plot size of 4m x 3.6m with three replications. Data regarding germination percentage, number of tillers per plant, number of mill able canes and cane yield are recorded. Cane juice analysis is conducted in SRI laboratory at harvest for sugar

recovery. A thorough pathological study against diseases (whip smut, red stripe, pokkah boeng and sugarcane rust) is made. While artificial inoculation is done to check resistance against major disease red rot. Similarly entomological studies against major insect pests, especially the borers, are also made. On the basis of data collected, selected lines are promoted to Semifinal varietal trial.

Step IX: Semi-final Varietal Trials

Plantation at this stage is made in plots 32 m^2 with 5 repeats using RCBD in spring.(three repeats for data collection and 2 for periodic juice analysis). Data on same aspects are collected while for quality evaluation, analysis of cane juice is carried out in laboratory from October to March on monthly basis. Selected elite lines are promoted to final varietal trial.

Step X: Final Varietal Trials

At this stage same procedure is adopted but analysis of cane juice is carried out in laboratory from October to March fortnightly. Early, medium and late maturing varieties are got identified. Selected advance lines are used for National Uniform Varietal Yield Trials (NUVYT) and Zonal Trials at different localities to evaluate site specific performance. Taxonomic, agronomic (drought resistance, ratooning potential, fertilizers, planting dates, planting geometry, intercropping etc.) and other relevant studies are also conducted during the course of study. After being successful from all these stages variety approval case is submitted to concerned govt. organization to release variety for general sowing by the farmers. It takes 10-12 years for variety evolution.

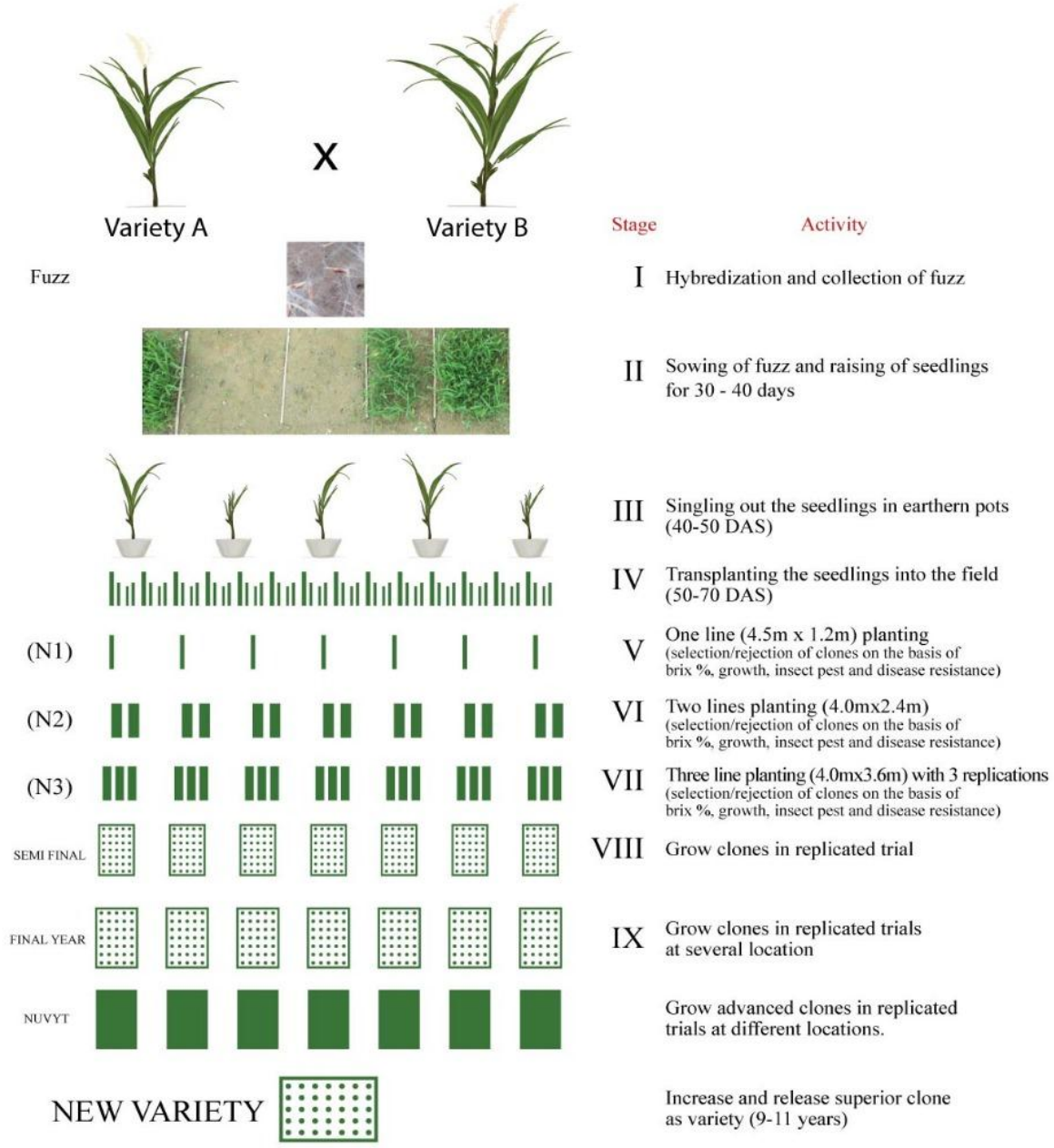

Fig. 1 Diagrammatical procedure to evolve sugarcane variety at SRI, Faisalabad

Result And Discussion

Raising fuzz, growing seedlings and clones are the continuous and basic procedures for the varietal developmental program at SRI, Faisalabad. Following table depicts the volume of research being carried at the institute.

Table 2: Volume and promotion of research for varietal development program at SRI, Faisalabad.

Year	Seedling	Nursery I	Nursery II	Nursery III	Semi-Final	Final	List of clones at Final stage
2011-12	5263	-	-	-	-	-	
2012-13	23536	1425	-	-	-	-	
2013-14	64340	977	140	-	-	-	
2014-15	24050	2574	355	43	-	-	
2015-16	20396	638	610	34	-	-	
2016-17	12608	313	113	125	14	-	
2017-18	21784	311	70	34	7	8	S 2012 SL-443 S 2012 M-1362 S 2012 M-1379
2018-19	-	-	-	-	16	2	S 2013 M-45 S 2013 M-133

NOTE: Semi-final & Final stages are spring planted

Out-come of Varieties crossed at SRI, Sri Lanka

Fuzz established at Sri Lankan's environment by the crossing of Pakistani with Sri Lankan's commercial sugarcane varieties has been raised at the farm areas of SRI, Faisalabad since 2013-14. Seedlings developed from such fuzz were then transplanted into the field.

Among 20,396 seedlings, three hundred and thirteen (313) healthy & phenotypically superior plants were earmarked and selected to promote to next evaluating stage (N I) of variety development program, keeping in views the quality parameters as well as their vigor, plant height, tillering stalks diameter, inter-nodal length, aerial roots, fiber percentage, tolerant to disease & insect pests during 2017-18. Brix percentage was also recorded with the help of Hand Refracto-meter. Selection number was also allotted to the selected superior plants (313) accordingly. (Table 3)

Table 3: Characteristics of superior plants /selected in the seedlings and promoted to Nursery-I during October/November, 2017.

S. No	Code No.	Parentage	Potted seedlings shifted into the field during Feb/Mar., 2017	Selected superior plant during Oct/Nov, 2017	Brix%		Selection Number allotted (SLF. 2017 …)
					Min	Max	
1	SL 126	**HSF 240 x Open polycross**	430	3	16	18	SLF17. 1…3
2	SL 62	SL 09 01 x SL 92 4918	560	1	17	17	SLF 17. 4
3	SL 63	M 351 57 x SL 8754	340	2	16	17	SLF 17. 5…6
4	SL 64	Co 775 x SLC 0829 (Offi)	260	4	17	18	SLF 17.7…10
5	SL 70	SLC 1249 (Offi) x SL 8101	20	1	18		SLF 17. 11
6	SL 99	SL 8520 x SLC 10-12 (Offi)	680	16	17	18	SLF 17. 12…27
7	SL 100	H 82 1600 x SL 8212	60	2	16	17	SLF 17. 28…29
8	SL 102	SLC 1026 (Offi) x SL 92 5588	600	1	16		SLF 17. 30
9	SL 103	SLC 08 126 (Offi) x NS 12	380	1	18		SLF 17. 31…
	SL 126	**HSF 240 x Open polycross**	410	41	16	22	SLF 17. 32…72
10	SL 127	**HSF 240 x SL 90 5695**	250	24	18	23	SLF 17. 73…96
11	SL 134	**BL 04 x open polycross**	280	16	16	23	SLF 17. 97…112
12	SL 135	**SPF 245 x open polycross**	400	36	18	21	SLF 17. 113…148
13	M1	CoL 50	180	3	16		FD 17. 149…151
14	M4	CoL 36	34	1	17		FD 17. 152
15	M16	CoL 8		10	16	19	FD 17. 153…162
16	M 17	BL 21	3	2	19		FD 17. 163…164
17	SL 1	SL 92 4997 (Open poly cross)		15	17	19	SLF 17. 165…179
18	SL 13	SL 91 41 90 x Co 775		1	18		SLF 17. 180
19	SL 14	SLC 08 46 (Offi) x SL 94 2914		2	17	18	SLF 17. 181…182
20	SL 16	Co 775x M 115-66-6 Polycross)		1	20		SLF 17. 183
21	SL 20	SL 96 276 x SLC 1212 (Offi) (Open poly cross)	50	2	17	18	SLF 17. 184…185

22	SL 27	Co 8232 x BE 166	15	2	17	17	SLF 17. 186…187
23	SL 31	Kodayana x M 1176 77	90	7	16	18	SLF 17. 188…194
24	SL 32	M 442 51 x SL 8418	817	29	16	22	SLF 17. 195…223
25	SL 37	PR 980 x SL 84 0 6	30	1	17		SLF 17. 224
26	SL 41	SL 89 111 x H 44 2772	20	2	16	17	SLF 17. 225…226
27	SL 43	H 82 1600 x SL 8702	30	1	18		SLF 17. 227
28	SL 68	Q.83 x SL 89 1675	200	5	17	18	SLF 17. 228…232
29	SL 86	SL 91 4190 x SLC 1029 (Offi)	20	1	20		SLF 17. 233
30	SL 91	Mohana x H 55 4848	80	2	18	19	SLF 17. 234…235
31	SL 48	M 115-66-6 x SL 89 2249	100	2	17	18	SLF 17. 236…237
32	SL 84	SLC 1023 (Offi) x Helamula	60	1	17		SLF 17. 238
33	SL 87	SL 96 128 x SLC 08 109 (Offi)	160	2	18	18	SLF 17. 239…240
34	SL 88	Co 775 x PH71-15	160	1	16		SLF 17. 241
35	**SL 105**	CSSG 676 x SL 982118	32	6	17	19	SLF 17. 242…247
36	SL 10	**SLC 0901 (Offi) x Co J 84**	420	2	18	20	SLF 17. 248…249
37	SL 110	**SPF 213 x open polycross**	98	14	18	21	SLF 17. 250…263
38	SL 111	**SPF 238 x SL 80 04**	100	5	17	21	SLF 17. 264…268
39	SL 113	**SPF 238 x SL 8303**	40	4	18	22	SLF 17. 269…272
40	SL 114	**SPF 238 x SL 95 4444**	40	2	18		SLF 17. 273…274
41	SL 117	**SPF 245 x SL 95 4432**	20	2	18	20	SLF 17. 275…276
42	SL 119	**SPF 238 x SLT 8407**	160	3	17	19	SLF 17. 277…279
43	SL 125	**HSF 240 x SL 88 116**	100	5	16	21	SLF 17. 280…284
44	SL 129	**SL 8511 x HSF 240**	20	2	17	20	SLF 17. 285…286
45	SL 136	**SPF 245 x SL 95 4444**	5	14	19	23	SLF 17. 287…300
46	SL 138	**SPF 238 x SL 89 1673**	220	9	18	21	SLF 17. 301…309
47	**SL139**	NSG 555 x open polycoss	193	1	18		SLF 17. 310
48	SL 140	**SL 91 4190 x CP 4333**	180	1	17		SLF 17. 311
Total		**48 crosses**	**Selected and promoted entries to the Nursery –I**				**311**

Table 4: Summary of crosses of the parental varieties of different institutes promoted to

Nursery-I during Oct./Nov., 2017

S.No.	Institute	Cross/parent	No. of entries
1	SRI, Srilanka	26	105
2	SRI, Faisalabad	16	183
3	SSRI, Jhang	2	7
4	SBSS, Murree	4	16
	Total	**48**	**311**

Varieties at final stage

Ten to twelve years time span is consumed for releasing sugarcane varieties to the farmers.

At institute level, preliminary yield trials, semi-final and final varietal trials comprising high yielding with maximum sugar potential clones are conducted. Eleven (11) clones having one (1)

selected from 2002's year group (S2002-US-133), three (3) from 2003,s group (S2003-US-127, S2003-US-410, S2003-US-633), two (2) from 2005's (S2005-US-54, S2005-Aus-740) and five (5) from 2006 year's group (S2006-US-272,S2006-US-300, S2006-US-641,S2006-US-832, S2006-US-904) were tested against standard check HSF 240 for continuous three year from 2008-09 to 20010-11.

During 2008-09, Table 5 showed that clone S2002-US-133 excelled 21% more yield (157.72 t/h) than standard check HSF 240 (129.95 t/h) followed by S2003-US-127 (149.66 t/h) and S2003-US-633 (140.64 t/h). Clone S2003-US-633 kept maximum sugar recovery of 13.10% which possessed 5.47 % more sugar recovery than standard HSF 240 (12.42%).

During the year 2009-10, Clone S2003-US-410 obtained maximum yield of 98.77 t/h in Final Varietal Trial followed by S2003-US-127 (98.06 t/h). Theses clones were proved to be higher cane yielder than standard check HSF 240 (90.74 t/h). In case of sugar recovery of the clones during the same year, maximum reading was observed by S2003-US-633 of 14.12%, ever highest sugar recovery observed during the course of study. Another maximum sugar recovery observed were 13.77% and 13.60% of S2003-US-127 and S2005-Aus-740, respectively as compared to the 12.85% sugar recovery of standard HSF 240.

Similarly, during the year 2010-11, top yielder clones were S2006-US-272, S2005-US-54 and S2006-US-832 with the yield of 105.6, 104.4 and 104.1 t/h, respectively. Maximum sugar recovery of 13.68% was recorded by S2003-US-633 followed by 13.39% sugar recovery by S2003-US-127.

On overall basis for three average, clone S2003-US-127, produced maximum yield of 116.5 t/h followed by S2002-US-133 (114.4 t/h) and S2003-US-633 (108.8 t/h). Maximum sugar recovery during the average of these three years was recorded by S2003-US-633 of 13.6% and S2003-US-127 of 13.4%.

Data in Table 6 of National Uniform Varietal Yield Trial (NUVYT) during 2008-09 revealed that on an average of three locations of Faisalabad, Larkana and Nawabsha, clone S2003-US-633 yielded 26% more yield (114.1 t/h) than standard HSF 240 (90.8 t/h) followed by S2002-US-133 (113.5 t/h) and S2003-US-127 (108.3 t/h).

In the Table 7 of NUVYT2009-10, also showed the top yielder clones of S2003-US-127 (128.90 t/h),S2002-US-133 (124.9 t/h) and S2003-US-633 (120.70 t/h). Sugar recovery of theses clones were also found as 12.99, 12.66 and 12.00%, respectively.

Last but no means the least, In the latest trial at SRI, Faisalabad, Final Varietal Trial comprising, eight high yielder clones were evaluated against check CPF 247 for continuous two years. New clone S2008-M-42 produced 140.0 t/h than CPF 247 (114.2 t/h) and possessed on an average of two years with maximum sugar recovery of 12.6% than any other tested clone during 2013-14 and 2014-15. So, these clones like S2002-US-133, S2003-US-127, S2003-US-633 and M 42 are in the pipe line of SRI, Faisalabad for their approval.

Table: 5 FINAL VARIETAL TRIAL AT SRI, FAISALABAD

S.No.	Variety	2008-09		2009-10		2010-11		average	
		Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)
1	**S2002-US-133**	**157.72**	**12.22**	**70.99**	**12.83**	**-**	**-**	**114.4**	**12.5**
2	**S2003-US-127**	**149.66**	**12.89**	**98.06**	**13.77**	**101.90**	**13.39**	**116.5**	**13.4**
3	S2003-US-410	129.67	12.23	98.77	12.91	67.50	12.60	98.6	12.4
4	**S2003-US-633**	**140.64**	**13.10**	**88.89**	**14.12**	**96.95**	**13.68**	**108.8**	**13.6**
5	S2005-US-54	-	-	-	-	104.44	12.09	104.4	12.1
6	S2005-Aus-740	-	-	75.92	13.60	73.84	11.93	74.9	12.8
7	S2006-US-272	-	-	-	-	105.64	11.34	105.6	11.3
8	S2006-US-300	-	-	-	-	75.55	11.96	75.6	11.9
9	S2006-US-641	-	-	-	-	85.21	11.32	85.2	11.3
10	S2006-US-832	-	-	-	-	104.10	11.49	104.1	11.5

11	S2006-US-904	-	-	-	-	90.84	12.13	90.8	12.1
12	HSF 240	129.95	12.42	90.74	12.85	88.10	12.80	102.9	12.6
	LSD 0.05%			9.714		4.62			

Table: 6 NUVYT 2008-9

S.No.	Variety	Fsd		Larkana		HS		Av	
		Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)
1	CSSG 2476	101.6	10.1	100.6	10.13	-	-	101.1	10.1
2	CPSG 1663	89.7	9.5	-	-	-	-	89.7	9.5
3	QSG 1471	86.19	10.1	-	-	75.54	10.6	80.9	10.4
4	QS 3	83.6	9.4	-	-	-	-	83.6	9.4
5	SPHS 2	83.4	9.9	-	-	-	-	83.4	9.9
6	SPHS 17	68.2	9.5	130.2	10.2	92.5	8.9	97.0	9.5
7	HoTh 344	103.3	9.0	-	-	-	-	103.3	9.0
8	HoTh 409	105.3	10.0	-	-	-	-	105.3	10.0
9	HS 4	77.0	10.5	-	-	-	-	77.0	10.5
10	HS 12	56.7	9.9	-	-	-	-	56.7	9.9
11	GUNJBUKSH	64.2	7.9	-	-	-	-	64.2	7.9
12	GT 7	72.5	8.9	99.9	9.7	-	-	86.2	9.3
13	**S2002-US-133**	**123.2**	**12.09**	**111.4**	**10.0**	**106.0**	**11.1**	**113.5**	**11.1**
14	S2002-US-160	98.4	10.0	116.3	10.6	-	-	107.4	10.3
15	**S2003-US-127**	**127.7**	**12.0**	**110.3**	**9.9**	**86.8**	**11.1**	**108.3**	**11.0**
16	**S2003-US-633**	**119.5**	**12.0**	**108.5**	**-**	**-**	**-**	**114.1**	**10.6**
17	HSF 240	111.2	12.1	-	-	-	-	90.8	11.2

Table: 7 NUVYT 2009-10

S.No.	Variety	Fsd		Average	
		Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)
1	CSSG 2476	102.70	11.08	102.70	11.08
2	CSSG 2402	83.76	10.76	83.76	10.76
3	CSSG 2453	96.42	12.34	96.42	12.34
4	CPSG 1663	90.84	11.93	90.84	11.93
5	QSG 1471	87.28	12.18	87.28	12.18
6	QS 3	81.44	12.11	81.44	12.11
7	SPHS 2	84.53	12.22	84.53	12.22
8	SPHS 17	69.37	12.36	69.37	12.36
9	HoTh 318	109.50	12.34	109.50	12.34
10	HoTh 344	104.40	10.22	104.40	10.22
12	HS 4	78.06	11.83	78.06	11.83
13	HS 12	57.85	11.72	57.85	11.72
14	GUNJBUKSH	65.26	10.63	65.26	10.63
15	GT 7	73.68	11.78	73.68	11.78
16	**S2002-US-133**	**124.9**	**12.66**	**124.9**	**12.66**
17	S2002-US-160	99.54	12.66	99.54	12.66
19	**S2003-US-127**	**128.90**	**12.99**	**128.90**	**12.99**
20	**S2003-US-633**	**120.70**	**12.00**	**120.70**	**12.00**
22	HSF 240	112.40	12.41	112.40	12.41

TABLE: 8 FINAL VARIETAL TRIAL (M 42)

S.No.	Variety	2013-14 (II)		2014-15 (I)		Average	
		Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)	Cane yield (t/h)	Sugar recovery (%)
1	S2006-SP-93	132.67	12.20	123.33	12.44	128.0	12.3
2	S2006-US-272	108.67	11.50	128.00	11.57	118.3	11.5
3	S2007-Aus-384	124.33	11.01	-	-	124.3	11.0
4	S2008-Fd-19	111.33	11.90	143.00	11.40	127.2	11.7
5	S2008-M-38	104.00	12.61	94.00	12.12	99.0	12.4
6	**S2008-M-42**	**138.33**	**12.86**	**141.67**	**12.21**	**140.0**	**12.6**

7	S2008-M-56	106.67	10.33	-	-	106.7	10.3
8	S2008-Aus-107	102.67	12.23	129.00	12.89	115.8	12.5
9	HSF 240	121.67	12.31	129.67	12.46	125.7	12.4
10	CPF 247	105.00	12.17	123.33	12.49	114.2	12.3

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