

PERFORMANCE OF SOMACLONES OF SUGARCANE VAR. CoN 95132 FOR YIELD AND ITS COMPONENTS AS WELL AS QUALITY ATTRIBUTES

PATEL, S. R.* AND VASHI, P. S.

COLLEGE OF AGRICULTURE
NAVSARI AGRICULTURAL UNIVERSITY
BHARUCH-390 012, GUJARAT, INDIA

**Email: srpatelnau@yahoo.co.in*

ABSTRACT

The experiment was framed out to study the performance of somaclones of sugarcane var. CoN 95132 for yield and its components as well as quality attributes at Sugarcane Tissue Culture Laboratory, Regional Sugarcane Research Station, Navsari Agricultural University, Navsari during 2009-10. Leaf and stem explants were found suitable for callus induction in sugarcane. The treatment, MS medium supplemented with 3 mg/l 2, 4-D, 10 per cent CW and 20 g/l sucrose found most suitable for callus induction and multiplication. Shoot regeneration frequency from callus cells was high in MS medium supplemented with 1 mg/l 2, 4-D, but thick, vigorous and healthy shoots were obtained with 3 mg/l 2, 4-D. The developed Somaclones were hardened, planted and evaluated in field condition. Leaf callus somaclone LCS - 274 performed the best for most of yield and yield attributing characters. It recorded maximum number of tillers at 120 days and shoots at 240 days, plant height, millable cane height, length of internodes and single cane weight. In individual characters, somaclone LCS - 289 exhibited maximum number of millable canes per culm and LCS - 805 was ranked first in millable cane diameter with average quality features. In quality point of view, LCS - 1086, LCS - 1661 and LCS - 452 showed first, second and third rank, respectively. In case of stem callus somaclone, SCS - 276 was found superior in number of tillers at 120 days, total plant height, number of internodes per millable cane and length of internodes and somaclone SCS -1447 was nearer to SCS - 276 in number of tillers at 120 days, number of shoots at 240 days and number of millable cane per culm with top ranking in quality attributes.

KEY WORDS: *Callus, quality, somaclones, sugarcane, yield,*

INTRODUCTION

Sugarcane is an important cash crop of India. It is a tropical crop and is the major source of sugar. Sugarcane variety CoN 95132 is known as Gujarat Sugarcane 3, was developed from cross between Co 8213 x Co 62198. A basic requirement for the success of crop improvement through breeding is the availability of genetic variability. In the absence of variability, the kind of assemblies

that a breeder wants to create is not possible. An obvious and most practicable method has been to utilize the Mendelian concepts of segregation, independent assortment and recombination. The next phase of variability creation is to extend the phenomenon of spontaneous mutation to experimental development of genetic changes through mutagenesis. In spite of the large investment of effort, an ideal mutagen has not yet been

discovered and a search continues for procedures that can lead to directed mutagenesis.

Since last three decades, the technical advances in plant tissue culture have been tremendous and unique in their application as commercial tools to various agricultural sciences. The dramatic strides have been made over the years in step by step evolutionary progress in the manipulation of the plant cells. Chromosomal/genetic variations are normally quite common in callus cells. Creating variability is the first step in any crop improvement programme. Thus callus culture may help in development of desired variations necessary for crop improvement as well as may result into newer genotype(s).

MATERIALS AND METHODS

The investigation was carried out to study the performance of somaclones of sugarcane var. CoN 95132 for yield and its components [number of tillers at 120 days, number of shoots at 240 days, total plant height (cm), millable height (cm), number of millable canes/ culm, number of internodes / millable cane, length of internode (cm), millable cane diameter (cm), single cane weight (Kg)] as well as quality attributes (juice Brix per cent at harvest, sucrose per cent in juice or pol per cent in juice at harvest, juice purity % at harvest, pol % cane at harvest, commercial cane sugar per cent, and fibre per cent) at Regional Sugarcane Research Station, Navsari Agricultural University, Navsari during 2009-10. Total 3600 somaclones were raised from leaf and stem segments on MS medium supplemented with various concentrations of 2, 4-D (1.0 to 6.0 mg/l 2, 4-D) and they were planted at 1 x 1 m distant in three replications in Randomized Block Design at College Farm, N. M. College of Agriculture, Navsari for comparative studies. Each replication contained six plots of leaf and stem somaclones (total 1200 somaclones in each replication) and each plot contained 100 somaclones. The gross plot area

was 12 m x 10 m and net plot area was 10 x 10 m. Total 12 plants were arranged in a row. All the recommended cultural practices including plant protection measures were followed. At time of harvest, 9 best somaclones were selected from each treatment of each replication. Thus, total 108 somaclones were selected and observations were recorded of selected somaclones. In addition, the best three somaclones from each treatment (6 + 1) in each replication were also selected and the data on their yield components as well as quality traits were recorded.

RESULTS AND DISCUSSION

Out of 3600 somaclones planted in field, 108 somaclones (54 best leaf callus somaclones + 54 best stem callus somaclones) were selected from various treatments on the basis of their superior phenotypic performance in the field and the results of the observations recorded on various traits are presented and discussed below:

Performance of best selected somaclones for yield and its components in field

Performance of best selected somaclones for yield and its components in field was presented in Table 1. The results showed that among different treatments, the maximum number of tillers (31.55) at 120 days was recorded in treatment T₃ somaclones and it was statistically at par with T₄ (29.89) leaf segment callus somaclones. Similar trend was observed in case of stem callus somaclones. Significantly maximum number of shoots (23.22) at 240 days was recorded in treatment T₃ somaclones and it was statistically at par with T₄ (22.78) somaclones developed from leaf segment callus. The same pattern was observed in case of stem callus somaclones, but recorded slightly lower number of shoots than leaf callus somaclones. Among different treatments, maximum plant height (335 cm) was recorded in treatment T₃ somaclones and it was statistically at par with T₄ (317 cm) and T₅ (308cm) somaclones developed from leaf segment callus. Similarly,

among stem callus somaclones also, treatment T₃ somaclones were found superior for plant height (316 cm) and it was statistically at par with T₄ (295 cm) somaclones. Significantly the highest millable cane height (289 cm) was recorded in treatment T₃ somaclones and it was statistically at par with T₄ (317 cm) somaclones developed from leaf segment callus. Somaclones produced from stem segment callus also recorded highest millable cane height in treatment T₃ (282 cm) somaclones, which was statistically at par with T₄ (261 cm) somaclones. In relation to number of millable cane per culm, it was found maximum (16.7) in treatment T₃ somaclones and it was statistically at par with T₄ (15.1) and T₅ (14.9) somaclones developed from leaf segment callus. The same results were noticed in somaclones raised from stem segment callus. Treatment T₃ somaclones recorded highest number of internodes (21.33) per millable cane followed by T₂ (21.00) somaclones created from leaf segment callus. On the other hand, somaclones raised from stem segment callus, T₄ somaclones showed the highest number of internodes per millable cane (21.00). Millable cane diameter was observed maximum (2.78 cm) in treatment T₃ somaclones and it was statistically at par with treatment T₄ (2.72 cm) somaclones raised from leaf segment callus. In case of somaclones developed from stem segment callus also, the somaclones of treatment T₃ recorded highest diameter of millable cane followed by T₄ somaclones. In the context to single cane weight (kg), the highest stalk weight (1.360) was obtained in treatment T₃ somaclones and it was statistically at par with T₄ (1.340) somaclones created from leaf segment callus. Similar results were recorded in somaclones obtained from stem segment callus.

Performance of inimitable somaclones for specific trait(s)

Performance of the best somaclones raised from leaf callus for yield components and quality attributes was presented in Table 2

and Table 4, respectively. The best three leaf callus somaclones were selected from each treatment (six). The somaclone LCS - 274 developed in MS medium containing 3 mg/l 2, 4-D ranked first in number of tillers at 120 days, number of shoots at 240 days, total plant height (cm), millable cane height (cm), length of internodes (cm) and single cane weight (kg) among all the selected somaclones. This clone may be further evaluated as new variety and may also be utilized for further breeding programme to improve yield. In individual character, somaclone LCS - 289 exhibited maximum number of millable canes per culm and LCS - 805 ranked first in millable cane diameter (cm) in all the selected somaclones. The somaclone LCS - 452 developed in MS medium fortified with 5 mg/l 2, 4-D stood second in length of internodes (cm) and millable cane diameter (cm) among all selected somaclones. From quality point of view, LCS - 1086, LCS - 1661 and LCS - 452 exhibited first, second and third rank, respectively, for all quality characters in all the selected somaclones. These somaclones can play a crucial role in improvement of quality traits in sugarcane in future.

Performance of selected somaclones raised from stem callus for yield components and quality attributes was presented in Table 3 and Table 5, respectively. The best three stem callus somaclones were selected from each treatment (six). Somaclone SCS - 276 raised in MS medium containing 3 mg/l 2, 4-D was superior in number of tillers at 120 days, total plant height (cm), number of millable canes per culm, number of internodes per millable cane and length of internode (cm) and ranked third in quality features among all the selected somaclones. On the other hand, somaclone SCS - 1447 ranked first in number of tillers at 120 days, number of shoots at 240 days and number of millable canes per culm and was at top ranked in all the quality attributes among all the selected somaclones. While the somaclone SCS - 848 showed maximum

millable height (cm) at harvest and ranked second in quality features. The quality point of view, somaclones developed from leaf callus in treatment 5 mg/l 2, 4-D had taken 1st rank in most of the quality parameters followed by somaclones raised in treatment 3 mg/l 2,4-D and treatment 6 mg/l 2,4-D, while somaclones raised from stem callus, the treatment 3 mg/l 2,4-D achieved 1st rank in most of the quality parameters followed by the treatment 5 mg/l 2,4-D and treatment 6 mg/l 2,4-D. The somaclones morphologically resembled their donor parent to a large extent. However, some somaclones retained earliness and high sucrose content of the donor parent (Jalaja *et al.*, 1987). Somaclones of sugarcane cv. CoN 95132 exhibited potential variations in field. Overall, somaclone LCS - 274 was found to be the best considering yield and quality parameters and its field performance. This clone may be further evaluated as new variety and may also be utilized for further breeding programme to improve yield. In individual character, somaclone LCS - 289 exhibited maximum number of millable canes per culm and LCS- 805 ranked first in millable cane diameter (cm) in all the selected somaclones which may also be included in further improvement programme on sugarcane for higher yielding potential. From the quality point of view (sucrose content in juice, purity of juice, commercial production of sugar as well as fibre percent in sugarcane), leaf somaclone LCS - 1086 and stem somaclone SCS - 1447 exhibited top rank in all the quality attributes. These somaclones can play an essential role in improvement of qualitative traits in sugarcane in future. Investigations on quality aspects in sugarcane somaclones were carried out by Sreenivasan and Jalaja (1982a); Dhumale *et al.* (1994) and Kaur *et al.* (2001). Variation observed among somaclones is largely due to change in genetic composition as influenced by hormones stated by many researchers namely, Khan *et al.* (2002); Hoy *et al.* (2003) and Patel *et al.* (2004) studied

different phenotypic variations in the somaclones of different sugarcane genotypes.

CONCLUSION

For improvement of millable cane diameter (cm), the somaclones SCS - 356, SCS - 848 and SCS - 1680 and for stalk weight, the clones SCS - 848, SCS - 276 and SCS - 1447 would be best sources. From quality point of view, LCS - 1086, LCS - 1661 and LCS - 452 showed first, second and third rank, respectively. These somaclones can be included in future for improving specific traits under breeding programmes.

REFERENCES

- Dhumale, D. B., Ingole, G. L. and Durge, D. V. (1994). Variation for morphological and quality attributes in clones of callus regenerants in sugarcane cv. CoC 671. *Indian J. Genet.*, **54**(3): 317-320.
- Hoy, J. W., Bischoff, K. P., Milligan, S. B. and Gravois, K. (2003). Effect of tissue culture explant source on sugarcane yield components. *Euphytica*, **129**(2): 237-240.
- Jalaja, S., Sreenivasan, T. V. and Alexander, K. C. (1987). Somaclonal variation for rust resistance in sugarcane. *Indian J. Genet.*, **47**(2): 109-114.
- Kaur, A., Gosal, S. S., Gill, R. and Thind, K. S. (2001). Induction of plant regeneration and somaclonal variation for some agronomic traits in sugarcane (*Saccharum officinarum* L.) *Crop Improv.*, **28**(2): 167-172.
- Khan, I. A., Khatri, A., Javed, M. A., Siddiqui, M. A., Khanzada, M. H., Dahar, N. A. and Khan, R. (2002). Performance of sugarcane somaclones under field conditions. *Pakistan J. Bot.*, **34**(1): 65-71.
- Patel, S. R., Patel, A. I., Tailor, S. I., Patel, C. L., Vashi, R. D. and Patel, D. U. (2004). Improvement of CoC 671 for disease resistance with physical

-
- mutagenesis. *Indian J. Sugar Tech.*,
19 (1&2): 58-63.
- Sreenivasan, T. V. and Jalaja, N. C. (1982a).
Sugarcane Varietal Improvement
Through Tissue Culture. In: Cell
and Tissue in Culture Crop
Improvement (eds. S.K. Sen and K.
Giles). Plenum, New York: 371-
376.

Table 1: Performance of best selected somaclones for yield and its components in field (Somaclones derived from leaf and stem segment callus)

Tr . No .	Treat-ment	No. of Tillers at 120 days	No. of Shoots at 240 days	Total Plant Height (cm)	Millable Height (cm))	No. of Millable Canes/ Culm	No. of Internodes/ Millable Cane	Length of Internodes (cm)	Millable Cane Diameter (cm)	Single Cane Weight (Kg)
Somaclones derived from leaf segment										
T ₁	1 mg	22.67	16.89	275	241	12.8	19.55	12.76	2.43	1.04
T ₂	2 mg	23.00	19.67	296	263	13.9	21.00	12.98	2.57	1.14
T ₃	3 mg	31.55	23.22	335	289	16.7	21.33	14.57	2.78	1.36
T ₄	4 mg	29.89	22.78	317	280	15.1	20.89	13.88	2.72	1.34
T ₅	5 mg	28.22	19.11	308	264	14.9	20.44	13.24	2.65	1.24
T ₆	6 mg	25.55	18.22	291	256	13.8	20.11	13.05	2.62	1.20
T ₇	Control	20.88	15.55	263	231	11.4	13.99	15.49	2.54	1.11
S. Em ±		0.81	0.735	9.95	7.78	0.64	0.64	0.43	0.03	0.012
C.D. at 5%		2.49	2.27	30.7	23.9	1.97	1.98	1.32	0.09	0.04
C.V. %		5.40	6.59	5.79	5.17	7.88	5.67	5.42	1.96	1.86
Somaclones derived from stem segment										
T ₁	1 mg	21.22	15.89	258	229	13.0	19.11	11.73	2.32	1.03
T ₂	2 mg	23.11	18.33	277	245	13.4	19.89	11.33	2.44	1.12
T ₃	3 mg	27.89	22.33	316	282	15.9	20.89	13.73	2.69	1.33
T ₄	4 mg	27.11	20.67	295	261	14.4	21.00	12.87	2.66	1.32
T ₅	5 mg	26.22	17.66	285	252	13.9	19.55	12.70	2.55	1.22
T ₆	6 mg	25.11	16.55	280	245	13.4	18.89	12.53	2.54	1.17
T ₇	Control	20.99	16.00	254	222	10.9	14.22	15.33	2.55	1.10
S. Em ±		0.778	0.79	8.33	7.84	0.50	0.67	0.40	0.03	0.01
C.D. at 5%		2.40	2.43	25.7	24.2	1.55	2.05	1.23	0.08	0.04
C.V. %		5.49	7.51	5.14	5.48	6.43	6.05	5.33	1.71	2.00

No. of selected clones: Three clones were selected from each treatment (6+1) in each replication (3).

**Table 2: Performance of best three somaclones for various quantitative traits under different treatments
(Somaclones derived from leaf segment callus)**

Sr. No.	Clone No.	No. of Tillers at 120 days	No. of Shoots at 240 days	Total Plant Height (cm)	Millable Height (cm)	No. of Millable Canes/ Culm	No. of Internodes/ Millable Cane	Length of Internodes (cm)	Millable Cane Diameter (cm)	Single Cane Weight (Kg)
Somaclones derived from 1 mg 2,4-D treatment										
1	LCS - 92	24	17	288	250	15	16	15.4	2.42	1.06
2	LCS - 641	24	18	289	251	16	19	14.0	2.36	1.03
3	LCS - 648	22	17	286	247	13	21	12.0	2.68	1.06
Somaclones derived from 2 mg 2,4-D treatment										
1	LCS - 197	25	20	305	265	17	16	16.0	2.74	1.13
2	LCS - 737	19	17	291	255	14	22	11.8	2.65	1.17
3	LCS - 1391	25	22	297	259	15	19	13.6	2.50	1.16
Somaclones derived from 3 mg 2,4-D treatment										
1	LCS - 274	35	24	338	299	18	18	24.9	2.74	1.39
2	LCS - 289	32	24	337	298	20	20	16.0	2.72	1.36
3	LCS - 805	32	23	337	297	17	18	16.4	2.82	1.36
Somaclones derived from 4 mg 2,4-D treatment										
1	LCS - 326	31	24	326	286	17	19	14.8	2.79	1.36
2	LCS - 923	31	24	325	285	16	17	16.6	2.78	1.35
3	LCS - 1585	31	23	310	275	16	16	17.8	2.79	1.35
Somaclones derived from 5 mg 2,4-D treatment										
1	LCS - 452	30	21	322	282	16	16	22.6	2.81	1.25
2	LCS - 1086	30	20	308	268	16	17	15.8	2.76	1.28
3	LCS - 1661	30	21	306	264	16	17	15.6	2.75	1.26
Somaclones derived from 6 mg 2,4-D treatment										
1	LCS - 529	26	20	258	245	15	20	13.1	2.78	1.23
2	LCS - 1124	25	18	302	262	15	18	14.6	2.73	1.22
3	LCS - 1755	29	18	319	265	16	16	14.6	2.60	1.25
1	Clone - 4	20	16	255	217	12	13	16.7	2.65	1.11
2	Clone - 6	22	18	261	218	14	13	16.8	2.49	1.09
3	Clone - 8	23	18	278	235	13	14	15.4	2.58	1.13

LCS= Leaf Callus Somaclones

**Table 3 : Performance of best three somaclones for various quantitative traits under different treatments
(Somaclones derived from stem segment callus)**

Sr	Clone No.	No. of Tillers at 120 days	No. of Shoots at 240 days	Total Plant Height (cm)	Millable Height (cm))	No. of Millable Canes/ Culm	No. of Internodes/ Millable Cane	Length of Internodes (cm)	Millable Cane Diameter (cm)	Single Cane Weight (Kg)
Somaclones derived from 1 mg 2,4-D treatment										
1	SCS - 35	22	16	234	225	14	20	11.7	2.32	1.08
2	SCS - 611	22	17	264	245	14	18	12.4	2.31	1.05
3	SCS - 1294	23	17	285	227	14	21	10.8	2.32	1.04
Somaclones derived from 2 mg 2,4-D treatment										
1	SCS - 191	22	19	274	236	15	21	11.7	2.30	1.12
2	SCS - 771	22	18	270	235	14	16	14.7	2.78	1.15
3	SCS - 1388	27	21	294	275	15	22	10.6	2.70	1.12
Somaclones derived from 3 mg 2,4-D treatment										
1	SCS - 276	29	23	334	290	17	24	16.6	2.69	1.36
2	SCS - 848	27	21	310	284	16	22	12.9	2.79	1.37
3	SCS - 1447	28	26	313	276	17	22	14.0	2.68	1.36
Somaclones derived from 4 mg 2,4-D treatment										
1	SCS - 356	28	23	301	262	16	23	12.1	2.80	1.34
2	SCS - 979	29	23	310	260	17	24	14.6	2.70	1.33
3	SCS - 1541	26	18	282	265	14	22	15.1	2.69	1.33
Somaclones derived from 5 mg 2,4-D treatment										
1	SCS - 1085	27	18	280	257	16	18	14.3	2.52	1.22
2	SCS - 1680	28	19	298	258	15	23	13.7	2.79	1.28
3	SCS - 1694	29	20	301	259	16	20	14.7	2.54	1.29
Somaclones derived from 6 mg 2,4-D treatment										
1	SCS - 536	24	16	289	251	15	16	13.0	2.75	1.21
2	SCS - 1722	26	17	279	249	15	16	15.4	2.45	1.17
3	SCS - 1768	27	18	280	253	15	20	13.0	2.72	1.20
1	Clone - 2	22	17	247	230	12	15	16.5	2.53	1.11
2	Clone - 5	21	16	245	244	12	13	16.1	2.70	1.13
3	Clone - 8	21	15	273	236	13	15	15.5	2.53	1.13

SCS= Stem Callus Somaclones

Table 4: Quality parameters of selected somaclones (Individual base) developed through leaf callus culture in sugarcane cv. CoN 95132 at 12 months

Leaf Callus Somaclones							
Treatment	Clone No.	Brix Per Cent	Sucrose Per Cent Juice	Purity Per Cent	Pol Per Cent cane	CCS Per Cent	Fibre Per Cent
1 mg	LCS - 92	19.68	18.34	93.19	13.53	12.91	16.24
	LCS - 641	20.18	18.78	93.06	13.79	13.21	16.56
	LCS - 648	19.68	18.34	93.19	13.56	12.91	16.08
2 mg	LCS - 197	20.18	18.78	93.06	14.14	13.21	14.72
	LCS - 737	19.68	18.34	93.19	13.95	12.91	13.96
	LCS - 1391	20.50	18.78	93.06	14.22	13.21	14.28
3 mg	LCS - 274	21.00	19.46	94.10	14.65	13.76	14.72
	LCS - 289	20.50	18.78	93.06	14.26	13.21	14.08
	LCS - 805	21.00	19.22	92.94	14.48	13.51	14.68
4 mg	LCS -326	20.00	18.34	93.19	13.63	12.91	15.68
	LCS -923	21.00	19.46	94.10	14.50	13.76	15.48
	LCS -1585	20.00	18.34	93.19	13.69	12.91	15.36
5 mg	LCS - 452	22.00	20.34	93.82	15.13	14.37	15.60
	LCS - 1086	22.50	20.78	93.69	15.53	14.67	15.28
	LCS - 1661	22.00	20.58	94.93	15.40	14.61	15.16
6 mg	LCS - 529	20.50	19.02	94.25	14.42	13.46	14.16
	LCS - 1124	21.00	19.46	94.10	14.70	13.76	14.48
	LCS - 1755	20.50	18.78	93.06	14.34	13.21	13.64
Control	Clone - 4	20.34	19.42	93.06	13.69	13.26	15.16
	Clone - 6	20.36	19.46	93.12	13.74	13.29	15.36
	Clone - 8	20.44	19.78	93.18	13.79	13.32	15.48

LCS= Leaf Callus Somaclones

Table 5: Quality parameters of selected somaclones (Individual base) developed through stem callus culture in sugarcane cv. CoN 95132 at 12 months

Stem Callus Somaclones							
Treatment	Clone No.	Brix Per Cent	Sucrose Per Cent Juice	Purity Per Cent	Pol Per Cent cane	CCS Per Cent	Fibre Per Cent
1 mg	SCS - 35	19.68	18.34	93.19	13.81	12.91	14.72
	SCS - 611	19.68	18.10	91.97	13.71	12.66	14.28
	SCS - 1294	19.68	18.34	93.19	13.84	12.91	14.56
2 mg	SCS - 191	20.18	19.02	94.25	14.38	13.46	14.40
	SCS - 771	19.68	18.34	93.19	13.73	12.91	15.16
	SCS - 1388	20.18	18.78	93.06	14.14	13.21	14.72
3 mg	SCS - 276	21.68	20.58	94.93	15.46	14.61	14.88
	SCS - 848	22.18	20.78	93.69	15.49	14.67	15.44
	SCS - 1447	22.18	21.02	94.77	15.77	14.92	14.96
4 mg	SCS - 356	20.18	18.78	93.06	14.11	13.21	14.88
	SCS - 979	20.68	19.46	94.10	14.68	13.76	14.56
	SCS - 1541	19.68	18.34	93.19	13.78	13.91	14.84
5 mg	SCS - 1085	21.68	20.34	93.82	15.21	14.37	15.20
	SCS - 1680	20.68	19.22	92.94	14.35	13.51	15.36
	SCS - 1694	21.18	19.90	93.96	14.89	14.06	15.16
6 mg	SCS - 536	20.68	19.22	92.94	14.35	13.51	15.36
	SCS - 1722	21.18	19.66	92.82	14.61	13.82	15.68
	SCS - 1768	20.18	18.78	93.06	13.89	13.21	16.04
Control	Clone - 2	19.68	18.34	94.03	13.84	12.91	14.72
	Clone - 5	20.22	19.66	93.19	13.95	13.46	15.48
	Clone - 8	19.77	18.78	92.94	13.78	13.21	15.16
	Control	20.18	19.46	93.02	13.87	13.29	15.36

SCS= Stem Callus Somaclones

[MS received: April 07, 2013]

[MS accepted: May 19,2013]