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International Journal of Plant Biology & Research

Research Article

Performance of Sugarcane Somaclones under Field Condition

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Submitted: 07 July 2016

Accepted: 29 November 2016

Published: 30 November 2016

ISSN: 2333-6668

Keywords
- Sugarcane
- Somaclonal variation
- Field performance
- Isd (Ishurdi)

Abstract

An experiment conducted at Bangladesh Sugarcane Research Institute (BSRI) farm, Ishurdi, Pabna during the cropping season of 2011-2012 and 2012-2013 to evaluation of somaclonal variation under field condition. Induction of somaclonal variation and genetic transformation were used to create new genetic variability for improvement of sugarcane. One hundred twenty somaclones from each of the varieties were established and maintained in the field. Among them four somaclones from each of five varieties were selected from Ro plants. After full growth, individual somaclones were selected for agro-morphological variability, yield and yield contributing and biochemical characters. Field evaluation of somaclones and their respective parents was performed based on analysis of qualitative, quantitative and biochemical parameters. Among the five mother parents and their 20 somaclones, the best performance for number of tiller in Isd 37SC2 (137.80×103 ha-1), number of millable cane in Isd 40SC2 (96.46×103 ha-1), yield of cane was observed in Isd 40SC4 (105.40 t ha-1), the highest single stalk weight in Isd 2-54SC2 (1.20kg), plant height in Isd 37SC2 (4.71m), stalk height in Isd 37SC2 (3.04m), stalk girth in Isd 2-54SC2 (2.57cm), number of internode in Isd 37SC2 (30.23), internode length in Isd 40SC4 (12.28cm), leaf length in Isd 2-54 SC3 (1.60m), leaf breadth in Isd 2-54SC2 (5.35cm) and number of green leaf in Isd 17SC3 (15.57). In respect of biochemical analysis the highest purity percent was recorded in Isd 17SC1 (90.20). The highest brix (22%), the highest pol % cane (15.73) and the highest recovery (12.93%) were found in Isd 17SC4. These somaclones could be forwarded for the development of commercial variety.

INTRODUCTION

Sugarcane propagates clonally due to lack of true seed and its highly heterozygous and polyploid nature [1]. Conventional method of breeding usually takes 10-15 years to complete a selection cycle. Besides, a released variety takes again several years for commercial cultivation since it requires long time to produce enough seed canes as set. The technique of plant tissue culture is being routinely used for producing large number of clonal plants by *in vitro* culture of explants from wide range of species throughout the world. It has become now a viable and effective alternative to conventional breeding and clonal propagation methods. Somaclonal variation can produce desirable agronomic changes in the progeny and increase sugar yield in sugarcane [2].

In vitro regeneration of sugarcane has also been reported by Heinz [3]. To meet the future requirements of sugar it is essential to develop some improved varieties, suitable for the agronomic conditions of Bangladesh within shorter period of time. Plant tissue culture is considered as a powerful tool for crop improvement within limited time period. Somaclonal variation has emerged as an important para sexual tool for crop improvement. This technique has been developed as a breeding tool for improving the quality and production of vegetatively propagated crops such as sugarcane [4]. Somaclones show variation for different parameters such as yield, sugar recovery, diseases resistance, drought tolerance and maturity. Somaclonal

variation reduces the time for releasing new variety by at least two years as compared to mutation breeding and by three years as compared to back cross method of gene transfer. Somaclonal variation is an important aspect of tissue culture technology and widely recommended for crop improvement. Development of somaclones of sugarcane with increasing sugar contents reported by [5,6]. The plant regeneration from callus are capable of producing somaclonal variants for different traits like high yield, more sugar recovery, disease resistance, drought tolerance and early maturity etc. Somaclonal variation has provided important genetic material for selection of useful variants in well adopted high sugar and high yielding genotype which might help to facilitate development of varieties.

MATERIALS AND METHODS

In vitro regenerated hardened plants (R_0) are transplanted in the field during the period of 2011-2012 to 2012-2013 at the field of the Breeding Division, Bangladesh Sugarcane Research Institute (BSRI), Ishurdi, Pabna. The plants (R_0) were transplanted in the field with row to row spacing of 1.0 m and plant to plant spacing of 0.30 m. To avoid *in vitro* effect and insufficient plant materials agro-morphological, yield and yield contributing characters were not studied in the first year transplanted plants R_0. After full growth individual somaclones (individual clumps) were visually selected for transplantation on following year to study agro-morphological variability on yield and yield contributing characters. In the first year, 20 somaclones were selected according to morphological characters, yield, brix percent, diseased and pest infestation. The selected somaclones were planted in the second year as R_1 plants in replicated trial. It was laid out in randomized complete block design (RCBD) with three replications. The plot size was 4m × 4m. Line to line distance was 1 meter and plant to plant distance 0.3 meter. Data were collected considering each 4m × 4m of following RCB design.

Normal dose of fertilizers were applied at the following rates as recommended by the Soil Science Division of the Bangladesh Sugarcane Research Institute. After 70 days of planting, one third of Urea and MP were applied. The remaining amounts of fertilizer (Urea and MP) were applied in other two splits as top dressing at 120 and 180 days of planting. Intercultural operations were done as and when required. Earthing up and tying of cane was done in the month of July to August in each year. Data were recorded on Germination (%), Number of tillers per plot, Number of millable cane (NMC), Cane yield (TCH), Stalk characters of cane such as Plant height (m), Stalk height (m), Stalk girth (cm), Single stalk weight, Number of internode per plant, Inernode length (cm), Number of green leaf per plant, Leaf length (cm), Leaf breadth (cm), Biochemical parameterssuch as Brix (%), Pol% cane, Purity (%) and Recovery (%).

RESULTS AND DISCUSSION

Mean field performance of 20 somaclones derived from five sugarcane mother parents for stalk and leaf characters are shown in Table 1. Considerable plant height significant variation was observed among the somacloes and mother parent which ranged from 2.17 cm to 4.71 cm. The highest plant height (4.17m) was recorded in the somaclones Isd 37SC2 followed by 4.48m in Isd 40SC3, 4.44 in Isd 2-54, 4.03 in Isd 40, 4.36 Isd 37SC3, 4.22 in Isd 37, 4.18 in Isd 40SC4 and 4.03 in Isd 403.97. The somaclones Isd 2-54, LJ-C SC1, LJ-C SC2 and LJ-C (mother parent) produced statistically identical. The lowest plant height was found as 2.71 in LJ-C SC3. Among the somaclones, Isd 37SC3 exhibited superior performance all the stalk and leaf characters. The results of the present investigation agree with the findings of Balasundaram and Bhagyalakshmi [7] and Caldo [8]. Significant variations among callus derived plants in sugarcane observed by Balakrishnan [9].

The highest stalk height was found as 3.13m in Isd 40SC2 which was followed by 3.12m in Isd 40SC3, 3.04 in Isd 37SC2, 2.79 in Isd 37 and 2.59 in Isd 37SC3. The lowest plant height was found as 1.55 in LJ-C SC3. The present investigation was reveals that stalk height of somaclones (Isd 40) better than the mother parent. This might be due to the genotypic variation of the explants. Lal and Lantin [10] reported that some of the somaclones of sugarcane cultivars CAC 57-13 showed significant differences from the parental variety in cane diameter, stalk length and weight.

Sood [11] demonstrated that tissue culture derived sugarcane var. CoJ 64 plants attained better height, stalk length, increased cane yield and sugar recovery percent as compared to conventionally propagated sugarcane plants under parallel agronomic practices in the field.

Liu and Chen [5,6] found significant variation amongst sugarcane somaclones from eight varieties in characters such as cane yield, sugar yield, stalk number, stalk length, diameter, volume, density and weight, percent fibre, auricle length, dewlap shape, hair group and attitude of top leaf. Some of their somaclones showed significant improvement over the parental performance.

The highest stalk girth was found as 2.57cm in Isd 2-54SC2 which was followed by 2.46 m in Isd 37SC2, 2.41 in Isd 37, 2.34 in Isd 40SC1, 2.34 in Isd 17SC2 and 2.32 in LJ-C SC4. The lowest stalk girth was found as 1.88cm in Isd 2-54SC3 followed by 1.91m in LJ-C. The present investigation was observed that the somaclones (Isd 2-54SC2) showed significant improvement over the parental performance. Lal and Lantin [10] reported that some of the somaclones of sugarcane cultivars CAC 57-13 showed significant differences from the parental variety in cane diameter (stalk girth), stalk length and weight. Liu and Chen [5,6] found significant variation amongst sugarcane somaclones from eight varieties in characters such as cane yield, sugar yield, stalk number, stalk length, stalk girth (diameter), volume, density and weight, percent fibre, auricle length, dewlap shape, hair group and attitude of top leaf. Some of their somaclones showed significant improvement over the parental performance.

The highest single stalk weight was found as 1.20kg in Isd 2-54SC2 which was followed by 1.06 in Isd 40SC3, 1.10in Isd 40SC4, 1.00kg Isd 17SC4, 1.00kg in LJ-C SC4 and 0.98kg in Isd 37SC2. The lowest single stalk weight was found as 0.65kg in Isd 2-54. Mannan and Karim [12] reported that the single-stalk weight was found significant variation over the parental performance. For selection of high yielding genotypes, attention to be paid to single stalk weight and number of millable canes per stool.

The highest number of internode was found as 30.23 in Isd 37SC2 and the lowest number of internode was found as 20.47 in mother parent. Our findings agree with the results of

Table 1: Field performance of stalk and leaf characters of 20 somaclones along with their respective five sugarcane parents.

Varieties/ Somaclones	Plant height (m)	Stalk height(m)	Stalk girth (cm)	Single stalk weight (kg)	No. of internode	Internode length (cm)	Leaf length (m)	Leaf breadth (cm)	No. of green leaf
Isd 2-54SC1	3.02 jk	1.87 h-k	1.88 l	0.70 ghi	23.00 b-e	7.01 f	1.00 k	3.00 l	9.40 ij
Isd 2-54SC2	4.44 ab	2.15 d-i	2.57 a	1.20 a	20.47 e	9.17 cde	1.33 bc	5.35 a	12.00 cde
Isd 2-54SC3	3.24 ij	2.00 f-j	1.98 ij	0.70 ghi	22.30 b-e	8.20 ef	1.60 a	3.00 l	9.70 g-j
Isd 2-54SC4	3.71 e-h	2.04 e-j	1.98 ij	0.70 ghi	25.33 b	8.20 ef	1.33 e-j	3.83 e-h	10.17 f-j
Isd 2-54	3.02 jk	1.64 jk	1.94 jk	0.72 gh	22.47 b-e	8.40 def	1.14 e-i	3.15 i-l	9.60 ij
LJ-C SC1	3.05 jk	2.26 d-h	2.04 gh	0.65 i	23.57 b-e	9.23 cde	1.06 h-k	3.12 jkl	9.70 hij
LJ -C SC2	3.32 ik	2.01 f-j	2.30 cde	0.88 de	24.50 b	7.35 f	1.06 h-k	3.85 e-h	9.10 j
LJ-C SC3	2.71 k	1.55 k	2.18 f	0.68 hi	21.06 de	8.18 ef	1.37 e-j	3.30 i-l	11.33 e-h
LJ-C SC4	3.57 f-i	2.06 e-j	2.32 cd	1.00 c	23.50b-e	8.44 def	1.20 d-g	4.80 b	9.50 ij
LJ-C	3.00 jk	1.62 jk	1.91 kl	0.60 j	21.17 cde	8.63 def	1.01 jk	3.20 i-l	9.50 ij
Isd 17SC1	3.42 hi	1.90 g-k	2.00 hi	0.75 g	25.10 b	9.16 cde	1.35 b	3.50 g-l	13.27 b
Isd 17SC2	3.55 ghi	2.35 c-g	2.34 c	0.88 de	24.52 b	8.71 def	1.10 f-k	3.02 kl	13.33 b
Isd 17SC3	3.86 d-g	2.37 c-f	2.15 f	0.89 d	24.63 b	9.21 cde	1.21 def	3.00 l	15.57 a
Isd 17SC4	4.04 cde	2.43 b-f	2.16 f	1.00 c	22.33 b-e	9.19 cde	1.21 def	3.3 6h-l	13.37 b
Isd 17	3.44 hi	1.74 ijk	2.01 hi	0.69 hi	25.20 b	8.66 def	1.30 bcd	3.00 l	11.60 c-f
Isd 37SC1	3.92 def	2.44 b-f	2.17 f	0.89 d	23.40 b-e	9.48 cde	1.04 ijk	3.61 f-j	13.30 b
Isd 37SC2	4.71 a	3.04 a	2.46 b	0.98 c	30.23 a	8.19 ef	1.17 e-h	4.21 cde	13.10 c
Isd 37SC3	4.36 bc	2.59 bcd	2.07 g	0.73 gh	29.53 a	8.55 def	1.08 g-k	3.64 f-i	11.00 e-i
Isd 37SC4	3.48 hi	2.18 d-i	2.29 cde	0.88 de	23.03 b-e	9.46 cde	1.22 c-f	3.52 g-k	12.27 cde
Isd 37	4.22 bcd	2.79 acb	2.41 b	0.97 c	24.47 b	10.07 cd	1.12 e-j	4.04 def	11.80 c-f
Isd 40SC1	3.97 de	2.49 bcde	2.34 c	0.82 f	24.33 bc	10.81 abc	1.22 c-f	4.13 de	11.40 d-g
Isd 40SC2	3.92 def	3.13 a	2.04 gh	0.83 ef	24.10 bcd	8.42 def	1.15 e-i	3.92 efg	9.76 g-j
Isd 40SC3	4.48 ab	3.12 a	2.25 e	1.06 b	22.27 b-e	12.18 ab	1.15 e-i	4.60 bc	11.63 c-f
Isd 40SC4	4.18 bcd	2.82 ab	2.26 e	1.10 b	23.16 b-e	12.28 a	1.07 h-k	3.59 f-j	11.77 c-f
Isd 40	4.03 cde	2.48 bcde	2.28 cde	0.91 d	21.23 cde	10.63 bc	1.24 b-e	4.50 bcd	12.33 cde
LSD Value	0.3200	0.388	0.05191	0.0519	2.654	1.490	0.1038	0.4312	1.498
CV%	1.87	5.25	10.33	7.63	1.04	6.79	9.96	5.63	7.13

* In a column, figure having same letter(s) do not differ significantly at 5% level

Table 2: Performance on yield and yield contributing characters of 20 somaclones along with their five parents.

Varieties/ Somaclones	Germination (%)	No. of tiller ($\times 10^3$ ha^{-1})	No. of millable cane ($\times 10^3$ ha^{-1})	Single stalk weight (kg)	Yield (TCH)
Isd 2-54SC1	36.00 bc	126.90 efg	90.62 b-f	0.70 ghi	63.43 jk
Isd 2-54SC2	33.00 cd	115.4 i	70.20 j	1.20 a	84.3 de
Isd 2-54SC3	34.00 c	128.80def	88.54 d-h	0.70 ghi	61.97 j-l
Isd 2-54SC4	33.00 cd	121.90 gh	86.46 f-i	0.70 ghi	60.52 klm
Isd 2-54	34.00 c	128.10 ef	88.54 c-h	0.72 gh	63.74 jk
LJ-C SC1	35.00 bc	118.80 hi	84.37 ghi	0.65 i	54.84 n
LJ -C SC2	35.00 bc	117.50 hi	84.37 ghi	0.88 de	74.24 h
LJ-C SC3	33.00 cd	115.60 i	83.33 hi	0.68 hi	57.67l mn
LJ-C SC4	34.00 c	121.90 gh	86.46 f-i	1.00 c	86.46 d
LJ-C	34.00 c	121.90 gh	86.46 f-i	0.60 j	60.52 klm
Isd 17SC1	33.00 cd	130.0 c-f	88.54 d-h	0.75 g	66.40 ij
Isd 17SC2	35.00 bc	131.30b-f	89.58 b-g	0.88 de	78.76 fg

Isd 17SC3	34.00 c	121.90 gh	86.46 f-i	0.89 d	76.94 gh
Isd 17SC4	33.00 cd	127.50 efg	87.50 e-i	1.00 c	87.50 cd
Isd 17	30.00 d	113.60 i	82.30 i	0.69 hi	56.78 mn
Isd 37SC1	38.00 ab	136.3 ab	93.33 a-d	0.89 d	83.06 def
Isd 37SC2	40.00 a	137.8 a	92.91 a-e	0.98 c	91.05 c
Isd 37SC3	35.00 bc	135.6 abc	93.62 a-d	0.73 gh	68.34 ijk
Isd 37SC4	40.00 a	134.40 a-d	90.62 b-f	0.88 de	79.74 fg
Isd 37	40.00 a	137.5 a	92.71 a-e	0.97 c	90.85 c
Isd 40SC1	34.00 c	126.30 fg	87.71 e-i	0.82 f	77.72 gh
Isd 40SC2	36.00 bc	132.50 a-e	96.46 a	0.83 ef	80.12 efg
Isd 40SC3	38.00 ab	131.30 b-f	94.66 ab	1.06 b	100.30 b
Isd 40SC4	38.00 ab	130.00 c-f	95.00 ab	1.10 b	105.40 a
Isd 40	38.00 ab	134.40 a-d	94.16 abc	0.91 d	85.68 d
LSD Value	2.724	5.194	4.746	0.0519	4.088
CV%	2.49	3.26	3.28	7.63	3.97

*In a column, figure having same letter(s) do not differ significantly at 5% level

Table 3: Mean performance of somaclones and five mother parents for bio-chemicals characters.

Varieties/ Somaclones	Brix (%)	Purity (%)	Pol % of cane	Recovery (%)
Isd 2-54SC1	20.00 de	89.08 ab	14.07 bc	11.57 de
Isd 2-54SC2	21.00 bc	89.97 fghi	14.93 a	12.43 b
Isd 2-54SC3	19.00 fg	86.52 fghi	12.99 ef	10.49 hi
Isd 2-54SC4	19.77 def	88.84 def	13.90 bc	11.40 def
Isd 2-54	19.50 ef	87.96 abcd	13.48 cde	10.98 fg
LJ-C SC1	19.10 fg	87.30 efgh	13.17 def	10.67 gh
LJ -C SC2	19.63 ef	88.33 cde	13.54 cde	11.04 fg
LJ-C SC3	20.00 de	88.84 bcd	14.04 bc	11.54 de
LJ-C SC4	20.60 cd	87.44 efg	14.23 b	11.73 cd
LJ-C	19.00 fg	87.79 defg	13.18 def	10.60 gh
Isd 17SC1	21.00 bc	90.20 a	14.96 a	12.46 b
Isd 17SC2	21.70 ab	89.02 abcd	15.26 a	12.76 ab
Isd 17SC3	21.50 ab	89.59 abc	15.22 a	12.72 ab
Isd 17SC4	22.00 a	88.78 bcd	15.43 a	12.93 a
Isd 17	20.60 cd	87.44 efg	14.20 b	12.00 c
Isd 37SC1	19.43 ef	89.33 abc	13.69 bcd	11.19 ef
Isd 37SC2	18.60 g	85.92 ij	12.63 f	10.13 i
Isd 37SC3	17.60 h	85.65 hij	11.91 g	9.41 j
Isd 37SC4	19.60 ef	88.59 cde	13.72 bcd	11.22 ef
Isd 37	20.50 cd	85.46 j	13.91 bc	11.41 def
Isd 40SC1	20.50 cd	86.50 ghij	14.10 bc	11.41 def
Isd 40SC2	20.00 de	87.88 def	13.88 bc	11.38 def
Isd 40SC3	20.50 cd	86.73 fghij	14.05 bc	11.55 de
Isd 40SC4	19.80 def	88.84 bcd	13.90 bc	11.40 def
Isd 40	20.00 de	87.88 def	13.88 bc	11.38 def
LSD Value	0.704	0.665	0.524	0.408
CV%	2.14	0.93	2.30	2.17

*In a column, figure having same letter(s) do not differ significantly at 5% level

Hogarth [13] suggested that yield could be improved by giving due weightage to cane length, length of internode and number of internode. Khan [14] reported that the somaclones were found better in the characters of tillers/plant, stalk height, number of nodes/stem and root band width but they found no differences in the length of internodes of somaclones and source plants.

The highest internode length was found in 12.28 cm in Isd 40SC4 and the lowest internode length was found in 7.01 in Isd 2-54SC1. Our research findings were supported by Hogarth [13] suggested that yield could be improved by giving due weightage to cane length, length of internode and number of internode. Khan [14] also reported that the somaclones were found better in the characters of tillers/plant, stalk height, number of nodes/stem and root band width but they found no differences in the length of internodes of somaclones and source plants.

The highest leaf length was found as 1.60m in Isd 2-54SC3 and the lowest leaf length was found as 1.00m in Isd 2-54SC1. The somaclones Isd 17SC3, Isd 17SC4 and Isd 37SC4, Isd 37, Isd 40SC1 and Isd 40SC2 produced identical for leaf length per stalk. The present investigation was reveals that leaf length of somaclones better than the mother parent. This might be due to the genotypic variation of the explants. These results supported by Islam [15] who reported that field evaluation of somaclones and their parents were performed based on analysis of quantitative agro-morphological traits. Some variability was found from leaf length and leaf breadth.

The highest leaf breadth was found as 5.35cm in Isd 2-54SC2 which was followed by 4.80cm in LJ-C SC3, 4.60 in Isd 40SC3, 4.50 in Isd 40 and 4.21 in Isd 37SC2. The lowest leaf breadth was found as 3.59cm in Isd 40SC4. The investigation was reveals that leaf breadth is better than mother parent. This might be due to the genotypic variation of the explants.

The highest number of green leaf was found as 15.57 in Isd 17SC3 which was followed by 13.37 in Isd 17SC4, 13.33 in Isd 17SC2, 13.27 in Isd 17SC1 and 13.30 Isd 37SC1. The lowest number of green leaf was found as 9.10 in LJ-C SC2. The result of the present study was supported the findings of Islam [15]. Rao [16] examined number of leaves, stalk height and diameter, clump weight and brix at the 9th and 12th months of growth. By now it is established that there is a lot of variation among the somaclones derived from cell and tissue cultures due to numerical variations in chromosome.

Yield and yield contributing characters

Results on mean performance 20 somaclones along with five parents for yield and yield contributing characters are presented in Table (2). Significant variation among the somaclones and mother parent for germination percentage was observed which ranged from 30.00 to 40.00 (Table 2). The highest germination percentage was found as 40.00 in Isd 37SC2 which was followed by 40.00 in Isd 37SC4, 40.00 in Isd 37 and 38.00 in Isd 37SC1. The lowest germination percentage was found as 30.00 in Isd [17].

The highest number of tiller was found as 137.80 in Isd 37SC2 which was followed by 137.5 in Isd 37, 136.3 in Isd 37SC1 and 135.60 in Isd 37SC3. The result of the present study was comparable to those by Khan [14] reported that the somaclones were found better in the characters of tillers/plant and number of nodes/stem but they found no differences in the length of internodes of somaclones and source plants. But our research finding do not agree with them, because number of tiller of mother parent and somaclones are statistically differences, but only mother parent Isd 37 was similar only. The highest number of millable cane was found as 96.46 in Isd 40SC2 which was followed by 95.00 in Isd 40SC4, 94.66 in Isd 40SC3 and 94.16 in Isd 40 (mother parent). The lowest number of millable cane was found as 70.20 in Isd 2-54SC2. The result of the present study was supported the findings of Punia [17] studied six yield component characters in 41 genotypes of sugarcane and reported that millable cane and cane weight was the most important components of cane yield.

The highest single stalk weight was found as 0.89kg in Isd 2-54SC2 which were followed by 1.06 in Isd 40SC1, 1.10 in Isd 40SC4, 1.00 in LJ-C SC4 and 1.00 in Isd 17SC4. The lowest single stalk weight was found as 0.89kg in Isd 37SC1. Single stalk weight was most important character of cane yield. In our investigation, some of their somaclones showed significant improvement over the parental performance. Mannan and Karim [12] reported that the single-stalk weight was found significant variation over the parental performance. For selection of high yielding genotypes, attention to be paid to single stalk weight and number of millable canes per stool.

Significant variation among the somaclones and mother parent for yield of ton cane per hectare were observed which ranged from 54.87 to 105.40 (Table 2). The highest yield of ton cane per hectare was found as 105.40 in Isd 37SC4 which was followed by 100.30 in Isd 40SC3, 91.05 in Isd 37SC2, 90.85 in Isd 40SC1 87.50 in Isd 17, 86.46 in LJ-C SC4, 84.30 in Isd 2-54SC2 and 80.12 in Isd 40SC2. The lowest yield of ton cane per hectare was found as 54.84 in LJ-C SC1. Cane yield is the most important character of the ton per hectare. Liu and Chen [5,6,18] found significant variation amongst sugarcane somaclones from eight varieties in characters such as cane yield, sugar yield, stalk number, stalk length, diameter, volume, density and weight, percent fibre, auricle length, dewlap shape, hair group and attitude of top leaf. In our investigation, some of their somaclones showed significant improvement over the parental performance. Mannan and Karim [12] reported that the cane yield was found significant variation over the parental performance. Liu and Chen [5,6,18] also have reported significant variation in somaclones in characters such as cane yield and its components, sugar contents and some morphological traits.

Biochemical characters

Mean performance on bio-chemicals characters of somaclones along with their five parents are shown in Table (3).

Significant variation of 20 somaclones and five mother parent for brix percentage were observed which ranged from 17.60 to 22.00 (Table 3). The highest brix percent of cane was recorded as 22.00 in Isd 17SC4 which were followed by 21.70 in Isd 17SC2, 21.50 in Isd 17 SC3, 21.00 in Isd 17SC1 and 21.00 in Isd 2-54SC2. The lowest brix percent of cane (17.60%) was recorded in Isd 37SC3. Brix percent is the important character of the sugar recovery. In this study the highest brix percent of cane was observed in somaclone Isd 17SC4 which was over the parental performance. Siddiqui [4] compared the brix percent of cane of somaclones with those of their parents and found the

somaclones better than their parents in this character. On the other hand, Khan [14] reported that brix % of canes of somaclones was less than those of their parents. The highest purity of cane was found as 90.20 in Isd 17SC1 which were followed by 89.97 in Isd 2-54SC2, 89.02 in Isd 17SC2, 89.59 in Isd 17SC3, 89.33 in Isd 17SC1 and 89.08 in Isd 2-54SC1. The lowest purity of cane (85.46) was found in the mother parent (Isd 37). Pol%, brix, purity and commercial cane sugar (CCS) found negatively correlated with yield [19].

The highest pol % of cane was recorded as 15.43 in Isd 17SC4 which was followed by 15.26 in Isd 37SC2, 15.22 in Isd 17SC3,14.96 in Isd 17SC1 and 14.93 in Isd 2-54SC2. The lowest pol percent of cane (11.91) was recorded in Isd 37SC3. In this experiment, we obtained the highest pole % of cane in somaclone Isd 17SC4 which was better than the mother parent. It was clearly reveals that the variation occurred somaclons. Sugar yield per hectare is mainly dependent on tiller per plant, cane yield, pol% and CCS%. Sangwan and Singh [20] reported positive and significant association of sugar yield with brix. The negative correlation of Pol% and CCS% with cane yield and positive correlation with sugar yield is one of the major constraints in the improvement of sugarcane.

Significant variation among the somaclones and mother parent for recovery percent were observed which ranged from 9.41 to 12.93 (Table 3). The highest recovery percent was recorded as 12.93 in Isd 17SC4 which were followed by 12.76 in Isd 17SC2, 12.72 in Isd 17SC3, 12.46 in Isd 17SC1, 12.43 in Isd 2-54SC2 and 12.00 in Isd [17]. The somaclones produced the lowest recovery percent (9.41) was recorded in Isd 37SC3. In this study supported by Sood [11] demonstrated that tissue culture derived sugarcane var. CoJ 64 plants attained better height, millable stalk length, increased cane yield and sugar recovery percentage as compared to conventionally propagated sugarcane plants under parallel agronomic practices in the field.

Variation was observed among somaclones for many characteristic such as tillering, thickness, leaf breadth and brix percentage. Some of these somaclones have produced higher brix than mother parents. The causes of variations were unknown, although they may be associated with variation in chromosome balance [21].

REFERENCES

1. Narayanaswamy, S. Cereal and Grass Tissue Culture in Plants Cell and Tissue Culture, Maheshwari, P. Rengaawamy, MN.S. (eds.). Academic Press. 1999; 173-322.
2. Evans DA, Sharp WR, Medmi-Filho HP. Somaclonal and gametoclonal variation. Amer J. Bot. 1984; 71: 759-774.
3. HeinzD JM, Krisnamutri LG. Nickell A, Maretzi. Cell tissue and organ culture in sugarcane improvement. In: Applied and Fundamentaltal Aspects of Plant Cell, Tissue and Organ Culture. (Eds. Reinert J.and Bajaj Y.P.S.). Springer, Berlin, Heidelburg, New York, 1977; 3-17.
4. Siddiqui S H, Khatri A, Khan AL, Javed MA. In vitro cultures: a source of genetic variability and an aid to sugarcane improvement. Pak. J. Agric. Res. 1994; 15: 127-133.
5. Liu MC, Chen WH. Tissue and cell culture as aids to sugarcane breeding. I. Creation of genetic variation through callus culture. Euphytica. 1976; 25: 393-403.
6. Liu M, Chen W. The improvement in sugarcane by using tissue culture methods. In: T. A. Thorpe (ed) Fourth Intl. Congr. Plant Tiss. Cell Cult. Canada. 1978; 163.
7. Balasundaram N, Bhagalakshmi KV. Variability, heritability and association among yield and yield components in sugarcane. Indian J. Agric. Sci. 1978; 48: 261-263.
8. Caldo RA. Diversity analyses of improved rice (O. sativa) varieties and their progenitors using morphological characters and molecular markers. MS thesis. University of the Philippines,Los Banos, Philippines. 1996.
9. Balakrishnan R, Nair NV, Sreenivasan TV. A method for establishing a core collection of Saccharum officinarum L. germplasm based on quantitative-morphological data. Genetic Res Crop Evol. 2000; 47: 1-9.
10. Lal JB, Lantin M M. Agronomic performance of sugarcane clones derived from callus tissue. Philippine J. Crop Sci. 1976; 1: 117-123.
11. Sood N, Gupta PK, Srivastava RK, Gosal SS. Comparative studies on field performance of micropropagated and conventionally sugarcane plants. Plant Tiss Cult Biotech. 2006; 16: 25-29.
12. Mannan SA, Karim MA. Quantative estimate of some morphological characters in Sugarcane. Bangladesh J. Sugarcane, 1987; 9: 69-72.
13. Hogarth DM. A review of quantative genetics in plant breeding with particular reference to sugarcane. J. Aust. Inst. Agric. Sci. 1968; 34: 108-120.
14. Khan S J, Khan MA, Ahmad HK, Khan RD, Zafar Y. Somaclonal variation in sugarcane through tissue culture and subsequent screening for salt tolerance. Asian J. Plant Sci. 2004; 3: 330-334.
15. Islam MS, Masuduzzaman ASM, Islam AKMR, Hasan MA, Akhter S. Field performance of several morphological characters of six sugarcane genotype and their somaclones. Bangladesh J. Sugarcane. 2013; 33: 80-94.
16. Rao PN. Pattern of variability in the sexual and clonal generation of sugarcane. 1985; 1: 29.
17. Punia MS, Paroda RS, Hooda RS, Correlation and path coefficient analysis of cane yield in sugarcane. Plant Breed. Abst. 1983; 53: 613.
18. Liu MC, Chen W. The tissue and cell culture as aids to sugarcane breeding-II. Performance and field potential of Callus derived lines. Euphytica. 1978; 27: 273-282.
19. Sreekumar K, Kuriakose J, Mathew M, Thomas D. Alexander and S. Santhakumari. Variability, heritability and correlation studies on the yield and quality characters of sugarcane. Indian sugar. 1994; 44: 243-249.
20. Sangwan RS, Singh R. Correlation and path coefficient analysis of commercial character in sugarcane *(Saccharum species complex*). Indian sugar crops. J. 1983; 9: 7-9.
21. Krishnamurthi M, Tlaskal J, Fiji disease resistant. *Saccharum officinarum* L. var. pindar subclone from tissue culture. Proc. ISSCT. 1974; 15: 130-137.

Cite this article

Rahman MM, Ivy NA, Mian MAK, Rasul MG, Hossain MM (2016) Performance of Sugarcane Somaclones under Field Condition. Int J Plant Biol Res 4(2): 1056.