Evaluation of BSRI Released Sugarcane Varieties in Saline Belt of Bangladesh

H.M. Al- Amin[1*], M. A. Rahman[2], M.L. Kabir[2], M.I. Hossain[3] and M.H. Rahman[2]
[1] BSRI Sub-Station Rajshahi, [2] Onfarm Research Division and [3] Pathology Division
Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna, Bangladesh

ABSTRACT

Salinity is a major problem in all over the world especially in Bangladesh in recent time. Sugarcane is a relatively salt tolerant crop and suitable for saline zones. Therefore, it is important to test the potentiality of some sugarcane varieties in saline prone area of Bangladesh. The experiment was conducted at five villages (Gazipur, Harikhali, Kodla, Sofipur, Rampal) of Terokhada upazilla of Khulna district at Ganges Tidal Flood Plain Soil, AEZ-13 in cropping season 2011-2012 under irrigated condition to study the performance of sugarcane varieties in saline belt of Bangladesh. The commercial varieties of BSRI Isd 37, Isd 39. Isd 40 and one local variety were included as factor one and five plots of five villages of Terokhada upazilla were considered as factor two. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Considering the effect of location, among the five villages highest cane yield (105.15 t ha^{-1}) and brix (%) (21.81 %) were recorded at Harikhali and maximum salinity (18.50 ds/m) arises in the month of April at Harikhali also. So sugarcane production of those villages were not affected by these type of temporary arise of salinity. Evaluating the effect of variety, among the four variety significantly highest yield (107.43 t ha^{-1}) and maximum brix % (20.67 %) was recorded by variety Isd 40. The combined effect of varieties and different locations revealed that, significantly highest yield (114.35 t ha^{-1}) and maximum brix % (22.12 %) was recorded by variety Isd 40 also. So, considering salinity and performance of those four varieties it can be said that Isd 40 is the best among those four varieties under this condition.

Key words: Sugarcane, tiller, millable cane, yield, brix, salinity

INTRODUCTION

Salinity is a major problem in all over the world in the recent time. The Environment program of United Nations estimates that approximately 20% of the world's agricultural land and nearly 50% of all irrigated land is adversely affected by soil salinity (Flower and Yeo, 1995). It is a worldwide problem, but most acute in North and Central Asia, Australia and South America (Pessarakli, 1999). In Bangladesh, over 30% of the net cultivable area lies in the coastal zone of Bay of Bengal, of which approximately 53% is affected by varying degrees of salinity. The salt affected area in the coastal zone of the country was about 0.83 million ha in 1966-76, which expanded to 3.1 million ha over the last two decades in addition, more area in that zone is expected to become saline

*Corresponding author: H. M. Al Amin, Scientific Officer
e-mail: alamin.bsri@gmail.com

affected in future due to increase in sea water level as a consequence of the greenhouse effect. The other concern is that the area under irrigation is increasing worldwide day by day leaving more area to be affected by salinity stress. As estimated by FAO, about 20-30 million ha of irrigated lands worldwide were seriously damaged in 2002 due to the build-up of salts (Martinez-Beltran and Manzur, 2005).

Depending on the ability to grow in saline environment plants can be grouped as halophytes and glycophytes. Halophytes are native to saline soils (around 500 mM NaCl) and able to complete their life cycle in that environment. Glycophytes or non-halophytes, on the other hand, cannot survive at a high salt concentration. Most of the agricultural crops are glycophytes although some of them like sugar beet, barley, wheat etc. can tolerate salt to some extent. Rice is one of the most sensitive plants to salinity with a critical tolerance level 40 mM (Glenn, Brown and khan, 1997).In Bangladesh sugarcane is an important cash-cum industrial crop but its yield is low (about 50 t ha^{-1}). Sugarcane cultivation in saline areas received no attention in the past, but due to increase demand for sugar and goor, it has become imperative to explore the potentials of these lands where sugarcane is being cultivated years together without adopting modern technologies.

The area of sugarcane cultivation is decreasing day by day due to competition of short duration crops. About 1.056 million hectares of land of southern districts of Bangladesh are affected by varying degrees of soil salinity which are still uncultivated due to want of suitable salt tolerant crop varieties. Actually, Salinity level of different villages of these area were different in different months. So, five plots of five villages of Terokhada upazilla were taken for this experiment. The soil salinity levels of those villages were very low in winter months (December-January). With the rising of temperature, the soil salinity levels of those villages were increased. The highest level of salinity was recorded (18.50 dS/m) from the month of April. Then rainfall started from the month of May and rain water washes away those salts from the soil and soil salinity levels of those villages were decreased. Sugarcane is a relatively salt tolerant crop and suitable for saline zones. Therefore, it is important to test the potentiality of these varieties especially in saline prone area of southern region.

MATERIALS AND METHODS

The experiment was conducted at five villages (Gazipur, Harikhali, Kodla, Sofipur, Rampal) of Terokhada upazilla of Khulna district at Ganges Tidal Flood Plain Soil, AEZ-13 in cropping season of 2011-2012 under irrigated condition to study the performance of sugarcane varieties in saline belt of Bangladesh. Actually, Salinity level of different villages of these area were different in different months. So, five plots of five villages of Terokhada upazilla were taken for this experiment. The soils of the experiment site were loamy with medium high land. It was a factorial experiment. The commercial varieties of BSRI lsd 37, lsd 39, lsd 40 and one local variety were included as factor one and five plots of five villages of Terokhada upazilla were consider as factor two. The experiment was laid out in a randomized complete block design (RCBD) with three replications. There were five locations in the experiment. Each location was divided into 12 unit plots where the treatment combinations were allocated at random. There were altogether 60 plots in the experiment. The area of each plot was 8 m x 8 m where row-to-row distance maintained 1 meter. Double budded sugarcane setts of all varieties were directly planted in mid November 2011 and harvested at its maturity after twelve months

of planting. NPKS fertilizers were applied @ 325 kg urea, 250 kg TSP, 190 kg MP, 180 kg Gypsum and 9 kg Zn SO4 per hectare. Urea was applied in 3 splits and MP in two splits because these two fertilizers are quick releasing fertilizer. Intercultural operations were done as and when required. Top shoot borer and Early shoot borer were controlled by using Furadan 5G at the rate of 40 kg ha^{-1}. Data on tillers, millable canes and yield production were recorded at harvest. Salinity level was determined in different months from planting to harvesting period by EC meter. Brix (%) was determined by Brix refractometer. Statistical analysis was performed and means values were compared using LSD at 5% level of probability (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Tiller

Significant difference in tiller population was observed among the tested varieties (Table 1). The highest tiller population was obtained from lsd 40 (176.31 x 10^3 ha^{-1}) which was statistically similar with lsd 39 (175.95 x 10^3 ha^{-1}) and variety lsd 37 (166.02 x 10^3 ha^{-1}) while the lowest tiller population was observed from Local variety (143. 07 x 10^3 ha^{-1}). Variation in tiller production among the different clones/varieties was reported by Miah *et al.* (1984) and Rashid *et al.* (2001).

Table 1. Effect of varieties on tiller, millable cane, yield and brix % of Sugarcane

Variety	Tiller (x10^3 ha^{-1})	Millable cane (x10^3 ha^{-1})	Yield (t ha^{-1})	Brix %
lsd 37	166.02 ab	118.44	103.77a	19.50b
lsd 39	175.95a	122.38	102.98a	19.34b
lsd 40	176.31a	117.91	107.43a	20.67a
Local	143.07b	116.75	87.79 b	18.05c
LSD (0.05)	29.86	NS	9.40	0.97
CV (%)	18.41	12.61	9.54	5.10

* Figures in a column having the same letter do not differed significantly as per DMRT

A significant difference in tiller population was found in different locations (Table 2). The highest tiller population was observed at village Sofipur (188.35 x 10^3 ha^{-1}) which was statistically similar with village Rampal (182.20 x 10^3 ha^{-1}) and village Kodla (173.98 x 10^3 ha^{-1}) while the lowest tiller population was observed at village Harikhali (135.88 x 10^3 ha^{-1}) which was statistically similar with village Gazipur (146.28 x 10^3 ha^{-1}).

Table 2. Effect of different locations on tiller, millable cane, yield and brix % of Sugarcane

Locations	Tiller ($x10^3$ ha^{-1})	Millable cane ($x10^3$ ha^{-1})	Yield (t ha^{-1})	Brix %
Gazipur	146.28 bc	124.85	103.67ab	19.55
Harikhali	135.88c	119.88	105.15a	19.72
Kodla	173.98 ab	113.63	103.68ab	19.38
Sofipur	188.35 a	123.50	96.51ab	19.25
Rampal	182.20a	112.48	93.44b	19.05
LSD (0.05)	35.58	NS	11.21	NS
CV (%)	18.41	12.61	9.54	5.10

* Figures in the column having the same letter do not differed significantly as per DMRT

Tiller population was significantly influenced by the interaction effect of varieties and different locations. The highest tiller population was obtained from lsd 39 (201.41 x 10^3ha^{-1}) at Sofipur. Statistically similar tiller population was observed from varieties at different locations except local variety (106.82 x 10^3 ha^{-1}) at Harikhali only (Table 3).

Table 3. Combined effect of varieties and locations on Tiller, millable cane, yield and brix % of Sugarcane

Location	Variety	Tiller ($x10^3$ ha^{-1})	Millable cane ($x10^3$ ha^{-1})	Yield (t ha^{-1})	Brix %
Gazipur	lsd 37	128.96ab	118.40	106.40ab	19.27a-c
	lsd 39	168.12ab	135.04	106.99ab	19.86a-c
	lsd 40	151.18ab	128.43	111.04ab	20.65a-c
	Local	136.86ab	117.55	90.24ab	18.40c
Harikhali	lsd 37	153.35ab	123.09	107.95ab	19.85a-c
	lsd 39	146.81ab	125.51	106.56ab	19.33a-c
	lsd 40	136.55ab	117.55	113.60a	21.81ab
	Local	106.82b	113.39	92.48ab	17.88c
Kodla	lsd 37	180.96ab	119.36	107.52ab	19.56a-c
	lsd 39	177.16ab	114.67	105.60ab	18.07c
	lsd 40	195.94ab	97.87	114.35a	22.12a
	Local	141.85ab	122.64	87.25ab	17.77c
Sofipur	lsd 37	184.24ab	119.81	100.26ab	19.80a-c
	lsd 39	201.41a	123.76	97.76ab	19.80a-c
	lsd 40	196.98ab	129.79	102.55ab	19.00bc
	Local	170.77ab	120.64	85.49ab	18.40c
Rampal	lsd 37	182.57ab	111.54	96.72ab	19.00bc
	lsd 39	186.26ab	112.94	97.97ab	19.63a-c
	lsd 40	200.93ab	115.91	95.63ab	19.77a-c
	Local	159.02ab	109.51	83.46b	17.80c
LSD (0.05)	-	94.37	NS	29.72	3.07
CV (%)	-	18.41	12.61	9.54	5.10

* Figures in the column having the same letter do not differed significantly as per DMRT

Millable cane

No significant difference in millable cane population was recorded among the varieties (Table 1). No significant difference in millable cane population was recorded in different locations also (Table 2). No Significant variation was observed in millable cane population with the interaction effect of varieties and different locations also (Table 3).

Yield

Varieties had significant influence on yield (Table 1). The highest cane yield was obtained from Isd 40 (107.43 t ha^{-1}) which was statistically similar with Isd 37 (103.77 t ha^{-1}) and Isd 39 (102.98 t ha^{-1}) while the lowest tiller population was observed from Local variety (87.79 t ha^{-1}). The cane yield variation among varieties due to yield producing attributes. The findings of the present experiment is in agreement with Singh *et al.* (1999) and Arvind *et al.* (1997) where they found variation in cane yield among different varieties.

A significant difference in yield was found in different locations (Table 2). Highest cane yield was recorded at Harikhali (105.15 t ha^{-1}) which was statistically similar with Kodla (103.63 t ha^{-1}), Gazipur (103.67 t ha^{-1}) and Sofipur (96.51 t ha^{-1}) while the lowest cane yield was observed at Rampal (93.44 t ha^{-1}).

Significant variation was observed in yield of cane with the interaction effect of Varieties and different locations. The highest cane yield was obtained from variety Isd 40 (114.35 t ha^{-1}) at Kodla. Statistically similar cane yield was observed from varieties at different locations except local variety (83.46 t ha^{-1}) at Rampal (Table 3).

Brix(%)

Higher brix % of any variety is an indication to produce higher sugar. Significant difference in brix % was observed among the varieties (Table1). Highest brix % was recorded from Isd 40 (20.67%) while the lowest brix % was observed from Local variety (18.05%). No significant difference in brix % was recorded in different locations (Table 2). Significant variation was observed in brix % with the interaction effect of varieties and different locations. The highest brix % was obtained from Isd 40 (22.12%) at Kodla. Statistically similar brix % was recorded from Isd 40 (21.81%), Isd 37(19. 85%), Isd 39(19. 33%) at Harikhali and Isd 40 (20.65%), Isd 39 (19. 86%), Isd 37 (19. 27%) at Gazipur. The lowest brix% was observed from Local variety (17.77%) at Kodla, (17.80%) at Rampal, (17. 88%) at Harikhali, (18. 40%) at Sofipur and Gazipur (Table 3).

Table 4. Salinity ranges of five Villages at Terokhada Upazilla, Khulna

No. of Plots	Name of Villages	Level of Salinity EC (dS/m)
1	Gazipur	1.77-8.50
2	Harikhali	1.04-18.50
3	Kodla	1.05-7.06
4	Sofipur	1.57-9.20
5	Rampal	1.17-11.44

Salinity of five villages of Terokhada Upazilla, Khulna was not same round the year. With the rising of temperature, the salinity level of soil of those plots was increased. The highest level of salinity was recorded from Village Harikhali (18.50 dS/m) in the month of

April followed by plot Rampal (11.44 dS/m). Then rainfall started from the month of May and rain water washes away those salts from the soil and salinity level of soil of those plots was decreased (Figure 1).

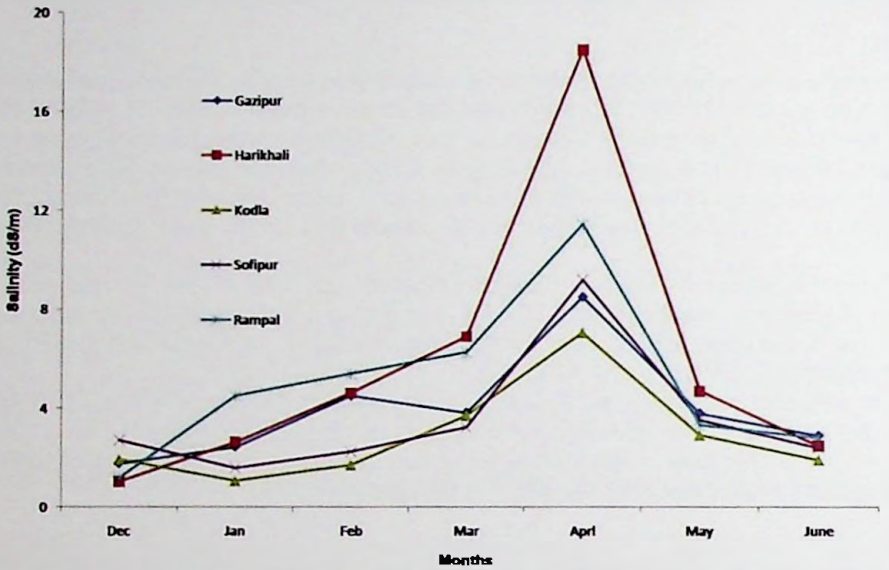

Figure 1. Salinity Pattern of Southern Delta in Different Months at Terokhada Upazilla, Khulna

Considering the effect of location, among the five villages highest cane yield (105.15 t ha^{-1}) and brix % (21.81%) were recorded at Harikhali (Table 2) and maximum salinity (18.50 ds/m) arises in the month of April at Harikhali also (Figure 1).So sugarcane production of those villages were not affected by these type of temporary arise of salinity.

Considering the effect of variety, among the four variety significantly highest yield (107.43 t ha^{-1}) and maximum brix % (20.67 %) was recorded from the variety Isd 40 (Table 1). The combined effect of varieties and different locations revealed that, significantly highest yield (114.35 t ha^{-1}) and maximum brix % (22.12%) was also recorded from Isd 40 (Table 3).

Based on performance of the tested four varieties under salinity stress condition it can be concluded that the variety Isd 40 showed better performance in context of yield and sugar content among the varieties.

REFERENCES

Arvind, M.; Naidu, K.M. and Misra A. 1997. Performance of promising mid late and late maturing sugarcane varieties under sub tropical conditions. Agricultural Science – Digest- Karnal, **17**(2): 79-82.

Glenn, E.; Brown, J. and Khan, J. 1997. Mechanisms of salt tolerance in higher plants. In: A. Basra (ed.), Mechanisms of environmental stress resistance in plants.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research (2nd Ed.) A Wiley Interscience Publication, NY, USA. pp. 680.

Flower, T.J. and Yeo. 1995. Use of wild relatives to improve salt tolerance in wheat. *J. Exp. Bot.*, **57**: 1059-1078.

Martinez-Beltran, J. and Manzur, C.L. 2005. Overview of salinity problems in the world and FAO strategies to address the problem. Proceedings of the international salinity forum, Riverside, California, April. 311-313.

Miah, M.A.; Awal, A.; Nahar, S.M.N.; Mannan, Sk. A. and Ali, M.Y. 1994. Performance of some promising clones and varieties of sugarcane in Himalayan piedmont plain soils. *Bangladesh J. Sugarcane*, **16**: 116-119.

Pessarakli, M.1999. Handbook of Plant and Crop Stress, 2nd Edition, Revised and Expanded, Marcel Dekker, Inc., York, 1254 p.

Rashid, M.H.; Quddus, M.A.; Rashid, M.A. and Elahi NE. 2001. Performance of modern sugarcane varieties for gur production in Modhupur Tract soils. *Bangladesh J. Sugarcane*, **23**: 57-60.

Singh, J.P.R.; Singh, U.P. and Kumar, S. 1999. Performance of mid late sugarcane varieties of north central zone in calciorthents soils of Bihar, *Indian Sugar*, **49**(6): 411-413.