Performance of chewing sugarcane varieties on growth parameters and yield in a saline prone area of Bangladesh

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Abstract

The experiment was conducted at Hazipur site of Kalapara Upazilla in Patuakhali district during 2014-2015 cropping season to select the suitable chewing sugarcane varieties for profitable cultivation. The experiment was laid out in Randomized Complete Block Design (RCBD) having three replications. Four (4) varieties were tested in farmers field i.e., BSRI Akh41 (Amrita), Madhumala, Misrimala, and Co208. Results revealed that in saline condition growth parameters and yield of different chewing sugarcane responded significantly due to different chewing variety at Hazipur site. The chewing sugarcane variety Madhumala performed better regarding number of tiller (137.67×10^3 ha^{-1}), chewable cane (96.37×10^3 ha^{-1}), yield of cane (98.40 t ha^{-1}) and Brix percent. The highest gross return and BCR was also obtained from chewing variety Madhumala (Tk. 13,76,700 ha^{-1} and 8.56, respectively). Initial and post harvest soil nutrients status at Hazipur site revealed that pH, organic carbon, nitrogen, phosphorus, potassium and sulpher content in soil slightly changed due to the cultivation of different chewing varieties of sugarcane.

Key words: Chewing Sugarcane Varieties, Yield and yield parameters, Soil properties, aline Prone Area

Introduction

Salinity is an ever increasing environmental problem in tropical irrigated areas including Bangladesh. There are some 2.5 Mha of low-lying coastal lands between 0.9 and 2.1 meter mean sea levels (MSL) in Bangladesh. Around 1.51 Mha (53%) of these areas are affected by salinity (Iftekhar and Islam 2004; Haque, 2008). The coastal and offshore area of Bangladesh includes tidal, estuaries and river floodplains in the south along the Bay of Bengal.

Agricultural land use in these areas is very poor, which is roughly 50% of the country's average (Petersen & Shireen, 2001). Major agricultural crops include rice, betel leaves, fruits and vegetables, mustard and oilseeds, coconut and sugarcane. Soil salinity is a serious constraint which adversely affects plant growth and development. Economic yield of plants is of great significance which is severely affected under salinity (Shannon, 1984; Francois, 1996). High salt concentrations decrease the osmotic potential of soil solution creating a water stress in plants and also cause severe ion toxicity, saline Na+ is not readily sequestered into vacuoles as in halophytes. Salt stress consists of two components, like, osmotic stress caused by the increase in external osmotic pressure due to high external concentration of salt and the physiological and biochemical effect of cations and anions on plant cell (Munns and Termaat 1986). The interactions of salt with mineral nutrition may result in nutrient imbalance and deficiencies. The consequence of all these can ultimately lead to plant death as a result of growth arrest and molecular damage (Mc Cue and Hanson 1990). Salinity in the root zone of sugarcane decreases sucrose yield, through its effect on both, biomass and juice quality (Lingle & Wiegand, 1996). Saline soil reduces millable stalks per hectare, stalk length, and stalk weight (Wiegand *et al.*, 1996). These reductions reduce the tonnage harvested from salt affected fields. Tolerant plants have adopted certain strategies of ion regulation at root (Wahid *et al.*, 1999), stem (Wolf *et al.*,1992) or leaf level (Kumar *et al.*, 1994). Changes in physiological processes triggered by ion excess appear as changed morphology of the plant (Meinzer *et al.*, 1994). Another aspect is the selection of salinity tolerant plants at different growth stages (Maas *et al.*, 1985). This carries significance because incidence of salinity spell at any of the growth stages may lead to drastic reduction in crop yield or even complete crop failure. Cultivation of chewing sugarcane is a

profitable practice in Bangladesh. Sugarcane juice contains only about fifteen percent total sugar content, all of which is in a raw unrefined form. The rest of the juice consists of water brimming with an abundance of vitamins and minerals. Sugarcane is rich in calcium, chromium, cobalt, copper, magnesium, manganese, phosphorous, potassium and zinc. It also contains iron and vitamins A, C, B1, B2, B3, B5, and B6, plus a high concentration of phytonutrients (including chlorophyll), antioxidants, proteins, soluble fibre and numerous other health supportive compounds. Working synergistically, these nutrients provide a supremely health-promoting food which has been studied for its role in fighting cancer, stabilizing blood sugar levels in diabetics, assisting in weight loss, reducing fevers, clearing the kidneys, preventing tooth decay, and a host of other health benefits. Proper evaluation of this crop germplasm against salinity may prove highly fruitful venture for its successful cultivation in problem soils. This study reports effect of salinity on some growth attributes of some chewing sugarcane cultivars in saline prone area of Bangladesh.

Materials and Methods

The experiment was conducted at Hazipur site of Kalapara Upazilla in Patuakhali district during 2014-2015 cropping season to select the suitable sugarcane varieties for chewing purpose in Patuakhali region. The experiment was laid out in Randomized Complete Block Design (RCBD) having three replications. Four (4) varieties were tested in farmers field i.e., BSRI Akh41 (Amrita), Madhumala, Misrimala, and Co208. The experimental plot size was 8m×6m. The sugarcane variety Isd 40 was used in the experiment as a test crop. Two eyed soil bed seedling was used for plantation. Line to line and plant to plant spacing was maintained 1 M and 50 cm, respectively in the plots. Gypsum and manure in the required quantities for different treatments was applied and thoroughly mixed with the soil before plantation of cane. Uniform application of recommended rates of N, P, K, S, Mg, B and Zn @ 165, 55, 120, 30, 10, 2 and 2.5 kg ha^{-1} was applied each plot in the field. Cowdung was applied@ 12.5 t ha^{-1} in the plot prior seven days of planting and mix well with the soil. Transplanting of seedlings was done in 14 December, 2014. Necessary intercultural operations were done throughout the cropping season for proper growth and development of the crop. Crop was harvested on 12 December, 2015. The soil salinity level was measured and found that it was 4.1-8.1 ds/m during the study period. The highest salinity was found in the month of April (8.1 ds/m) and lowest in December (4.1 ds/m). .Collected data were compiled and tabulated in proper form and were subjected to statistical analysis by using the computer package Statistix 10 program for Windows Version. Computation was done by the use of Microsoft Excel 2003 program.

Results and Discussion

Effect of different chewing cane variety on growth parameters and Yield in saline soil

Results presented in Table 1 showed that in saline condition growth parameters and yield of sugarcane responded significantly due to different chewing variety at Hazipur site. The highest number of tiller was found in variety Madhumala (137.67×10^3 ha^{-1}) and the second highest was obtained in Misrimala (129.37×10^3 ha^{-1}). Though chewing cane varieties BSRI Akh 41 and Co 208 showed statistically similar number of tiller but Co 208 recorded the lowest (114.00×10^3 ha^{-1}) regarding tiller production. The highest number of chewable cane was also found in variety Madhumala (96.37×10^3 ha^{-1}) and the second highest was obtained in Misrimala (90.56×10^3 ha^{-1}). Though chewing cane varieties BSRI Akh 41 and Co 208 showed statistically similar number of chewable cane but Co 208 recorded the lowest (79.80×10^3 ha^{-1}) regarding chewable cane production. The highest yield of cane was also found in variety Madhumala (98.40 t ha^{-1}) which was followed by variety Misrimala (94.64 t ha^{-1}). The lowest cane yield was recorded in variety Co 208 (85.47 t ha^{-1}). This might be due to existence of salinity tolerance potential of the variety which may lead to exerts better performance in saline soil condition. This result corroborates with the findings of Begum *et al*. (2015) who reported in salinity stress some somaclones of sugarcane performed better in morpho-physiological performance at field condition in two sequential years.

Effect of different chewing cane variety on Brix percent in saline soil

Brix percent is an important quality parameter for quality chewing sugarcane. Results presented in Fig. 1 showed that Brix percent cane responded significantly due to different chewing cane variety in saline condition. The highest Brix percent cane was recorded in chewing variety Madhumala (20.07 %) which was followed by variety BSRI Akh 41(19.50 %) and Mishrimala (19.33 %), respectively. This might be due to existence of salinity tolerance potential of the variety which may lead to produce higher Brix percent in saline soil condition. The lowest Brix percent cane was recorded in chewing sugarcane variety Co 208 (17.60 %).

Economics of chewing cane production in saline prone area

The economic performance of different chewing cane varieties at Hazipur site was presented in Table 2. The highest gross return was obtained from chewing variety Madhumala (Tk. 13,76,700 ha^{-1}) and the second highest from chewing variety Mishrimala (Tk. 12,93,700 ha^{-1}). The lowest gross return was obtained from chewing variety Co 208 (Tk. 11,40,000 ha^{-1}). The highest BCR was also found in Madhumala (8.56) and the second highest from chewing variety Mishrimala (8.04). The lowest BCR was obtained from chewing variety Co 208 (7.09). Hence, cultivation of chewing sugarcane variety Madhumala was found to be the most profitable economically in saline prone areas of Patuakhali.

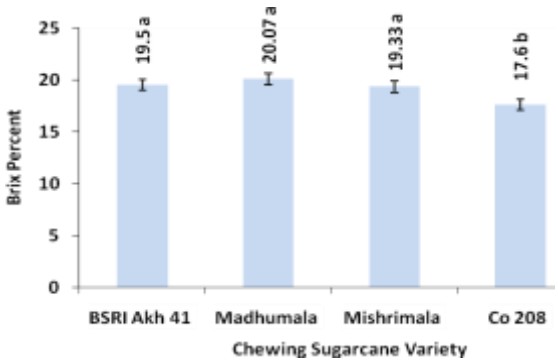

Figure 1. Effect of different chewing cane variety on Brix percent cane in saline soil.

Note: Vertical bars represent standard error of treatment means. Means followed by uncommon letters are statistically different from each other at 5% level of provability by DMRT (LSD 0.05=1.65).

Soil chemical properties

Initial and post-harvest soil nutrients status at Hazipur site were presented in Table 3. It revealed that pH, organic carbon, nitrogen, phosphorus, potassium and sulpher content in soil slightly changed due to the cultivation of different chewing varieties of sugarcane.

Table 1. Effect of different chewing cane variety on growth parameters and Yield in saline soil

Varieties	Number of Tiller ($\times 10^3 ha^{-1}$)	Number of Chewable cane ($\times 10^3 ha^{-1}$)	Cane Yield (t ha^{-1})
BSRI Akh 41	118.90 c	83.23 c	89.83 b
Madhumala	137.67 a	96.37 a	98.40 a
Mishrimala	129.37 b	90.56 b	94.64 a
Co 208	114.00 c	79.80 c	85.47 c
LSD (0.05)	3.50	3.50	3.84

Table 2. Cost and return analysis of different chewing cane varieties per hectare

Varieties	Total Cost (Tk ha^{-1})	Number Chewable Cane ($\times 10^3 ha^{-1}$)	Gross Return (Tk ha^{-1})	Gross margin (Tk ha^{-1})	Benefit Cost Ratio (BCR)
BSRI Akh 41	1,60,808	118.90	11,89,000	10,99,000	7.39
Madhumala	1,60,808	137.67	13,76,700	12,86,700	8.56
Mishrimala	1,60,808	129.37	12,93,700	12,03,700	8.04
Co 208	1,60,808	114.00	11,40,000	10,50,000	7.09

Note: Input price: Urea= Tk. 16.00 kg^{-1}, TSP = Tk. 22 kg^{-1}, MoP= Tk. 15.00 kg^{-1}, Gypsum= Tk. 12.00 kg^{-1}, Zinc Sulphate (Mono)= Tk. 120 kg^{-1}, Boric Acid = Tk. 240 kg^{-1}, Cowdung = Tk. 1.00 kg^{-1}, Chewing cane Seedling = Tk. 1.00 $piece^{-1}$, Labour = 400.00 $person^{-1}$, Insecticide and Fungicide: Regent 3GR= Tk. 150.00 kg^{-1}, Furadan 5 G= 140.00 kg^{-1}, Bavistin= Tk. 2.50 g^{-1}, Land rent cost= Tk. 22500.00 $ha^{-1}year^{-1}$. Output price: Chewing cane =Tk. 10.00 $cane^{-1}$.

Table 3. Initial and post harvest soil nutrient status at Hazipur site, Kalapara, Patuakhali

Variety	pH	OC (%)	N (%)	P (ppm)	K (meq%)	S (ppm)
Initial soil	7.75	0.60	0.06	7.00	0.10	14
Post harvest Soil						
BSRI Akh 41	7.70	0.65	0.06	6.50	0.11	13
Madhumala	7.70	0.69	0.07	6.50	0.10	14
Mishrimala	7.72	0.68	0.07	7.00	0.10	14
Co 208	7.74	0.64	0.06	6.00	0.10	13

Conclusion

From the above discussion it may be concluded that in saline condition growth parameters and yield of sugarcane responded significantly due to different chewing variety at Hazipur site. The highest number of tiller was found in variety Madhumala (137.67×10^3 ha^{-1}) and the second highest was obtained in Misrimala (129.37×10^3 ha^{-1}). The highest number of chewable cane was also found in variety Madhumala (96.37×10^3 ha^{-1}) and the second highest was obtained in Misrimala (90.56×10^3 ha^{-1}). The highest yield of cane was also found in variety Madhumala (98.40 t ha^{-1}) which was followed by variety Misrimala (94.64 t ha^{-1}). Brix percent cane responded significantly due to different chewing cane variety in saline condition. The highest Brix percent cane was recorded in chewing variety Madhumala (20.07 %) which was followed by variety BSRI Akh 41(19.50 %) and Mishrimala (19.33 %), respectively. The highest gross return was obtained from chewing variety Madhumala (Tk. 13,76,700 ha-1) and the second highest from chewing variety Mishrimala (Tk. 12,93,700 ha-1). The highest BCR was also found in Madhumala (8.56) and the second highest from chewing variety Mishrimala (8.04). Hence, cultivation of chewing sugarcane variety Madhumala was found to be the most profitable economically in saline prone areas of Patuakhali. Initial and post harvest soil nutrients status at Hazipur site revealed that pH, organic carbon, nitrogen, phosphorus, potassium and sulpher content in soil slightly changed due to the cultivation of different chewing varieties of sugarcane.

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