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EVALUATION OF CHEWING TYPE SUGARCANE GERMPLASM IN RELATION TO MORPHOLOGY, FIBRE CONTENT AND JUICE QUALITY

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ABSTRACT

An experiment was carried out at Regional Sugarcrop Research Station, Gazipur, Bangladesh to identify best quality chewing type sugarcane considering the morphological attributes, fibre content and juice quality using fifteen genotypes, like Piyashi, VMC 86-550, Kazla, Fulpur gandary, Misrimala, Q 69, Co 527, Co 208, Madhumala, Misridana, Senegal, Bonpara gandary, Bombay along with BSRI Akh 41 and BSRI Akh 42 as check. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Results revealed a great variation in morphology, fibre content and juice quality of different chewing cane genotypes. The tallest cane (2.90 m) was observed in Bombay which is identical to Fulpur gandery (2.68 m), Senegal (2.60 m), Misrimala (2.57 m) and check variety BSRI Akh 41 (2.53 m). The genotype Senegal exhibited maximum girth (3.50 cm) with highest single cane weight (1.98 kg), while, the genotype Co 527 showed minimum number of internode (15.33) but highest number (161×10^3 ha^{-1}) of chewable cane. Contrary, the longest internode (16.93 cm) was found in Misridana genotype. Fibre content however, lower in Senegal (8.90%) and Bonpara gandary (9.24%) genotypes. Considering juice quality, the genotype Modhumala was outstanding as it contained the highest proportion of purity (86.87%), Brix (19.51%) and sucrose (12.67%) although reducing sugar was the highest (1.40%) in Kazla and check variety BSRI Akh 41. As the best quantitative and qualitative parameters are found in different genotypes, future research is suggested for breeding program to develop new varieties of chewing cane with desired chewing characteristics.

Keywords: Chewing cane, morphology, juice quality

Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the important cash crops in Bangladesh. Two types of sugarcane are grown in Bangladesh; one is industrial and another is chewing type. The industrial cane is the hard or tough type generally processed into sugar and the soft cane is chewing cane which is mainly chewed raw for its sweet juice. Although sugarcane is grown in all over the country but its commercial cultivation for industrial supply is mostly concentrated in the northern districts and for chewing purpose, it is concentrated in southern and southern-west districts of Bangladesh (Rahman *et al.* 2013). Currently, sugarcane is grown in 92.02 thousand hectares of land out of which half of this area is located in the sugar mill zone and rest is in the non-mills zone where gur and juice are produced (BBS 2017).

Chewing cane is immensely popular in Bangladesh because of its sweetness. It is also one of the cheapest and available sources of instant energy including vitamins, minerals, carbohydrate and fibres. Sugarcane juice contains water (75-85%), nonreducing sugars (sucrose: 10-21%), reducing sugars (glucose and fructose: 0.3-3%), organic substances (0.5-1%), inorganic substances (0.2-0.6%) and nitrogenous bodies (0.5-1%) which are useful for human body (Swaminathan 1995).

Currently research however, mostly focuses on industrial variety development ignoring the importance of chewing cane. Sohel *et al.* (2009) reported that chewing sugarcane is more economical than industrial cane especially for small farming community. Economic profitability of chewing sugarcane may be increased either by increasing the cane yield per unit area or by increasing juice quality or by both parameters (Rakkiyappan *et al.* 2003). In present context, Bangladesh Sugarcrop Research Institute released only two (BSRI Akh 41 and BSRI Akh 42) chewing sugarcane varieties although local chewing varieties are very few

in number (Rashid *et al*. 2009). Further, softness and juice quality of these chewing canes were not sufficiently evaluated. This study therefore, was undertaken to identify some promising chewing type sugarcane lines in relation to morphological traits, fibre content and juice quality which can be used for future breeding program.

Materials and Methods

The field experiment was conducted at Regional Sugarcrop Research Station, Gazipur, Bangladesh during 2018-2019 cropping season following Randomized Complete Block Design having three replications. Thirteen chewing cane genotypes viz. Piyashi, VMC 86-550, Kazla, Fulpur gandary, Misrimala, Q 69, Co 527, Co 208, Madhumala, Misridana, Senegal, Bonpara gandary, Bombay along with two check varieties BSRI Akh 41 and BSRI Akh 42 were used as planting materials in the experiment. The experimental plot size was 2 m x 1 m. 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. Fertilizers were applied as per BARC (2018) @ of N_{182}, P_{60}, K_{130}, S_{35}, Mg_{22}, Zn_3 and B_2 kg ha^{-1} in each plot. Cow dung was applied @ 12.5 t ha^{-1} in the plot prior to seven days of planting and mix well within the soil. The sugarcane settlings were transplanted in the plots on 20 February, 2018. All the intercultural operations and insect control measures were taken as and whenever necessary. Data on different plant morphological characters viz. single cane weight (kg), cane length (m), girth (cm), number of internodes per cane, internode length (cm) and chewable cane number were recorded**.** The cane juice quality parameters (Brix%, sucrose%, Purity% and reducing sugar%) and fibre proportion were determined by the method described in Queensland Laboratory Manual (Anon 1970). All data were statistically analyzed by analysis of variance and mean values were compared using Duncan's Multiple Range Test (DMRT) at 5% level of significance (Gomez and Gomez 1984).

Results and Discussion

Morphological parameters of chewing cane such as cane length, girth, internode number, internode lengths, single cane weight and chewable cane number are presented in Table 1. The results showed significant differences in all the parameters of sugarcane genotypes. Among the genotypes the tallest cane (2.90 m) was observed in Bombay which is identical in length of Fulpur gandary (2.68 m), Senegal (2.60 m), Misrimala (2.57 m) and BSRI Akh 41 (2.53 m);

Table 1. Morphological characteristics and chewable cane number of different chewing sugarcane genotypes

Genotypes	Cane length (m)	Girth (cm)	Internode number	Internode length (cm)	Single cane weight (kg)	Chewable cane ($\times 10^3$ ha^{-1})
Piyashi	1.87 c	3.27 ab	27.33 a-c	13.08 c-f	0.97 g-i	96 ef
VMC 86-550	2.44 b	2.64 cd	19.33 de	13.00 c-f	0.83 ij	107 bc
Kazla	2.50 b	2.98 bc	30.33 ab	9.65 g	1.48 bc	99 c-f
Fulpur	2.68 ab	3.02 bc	30.33 ab	13.83 b-e	1.27 c-f	62 i
Misrimala	2.57 ab	2.97 bc	33.67 a	12.47 d-f	1.25 d-f	101 b-e
Q-69	2.47 b	3.18 ab	19.33 de	13.00 d-f	1.38 b-d	100 b-e
Co 527	1.90 c	1.74 e	15.33 e	12.67 d-f	0.68 j	161 a
Co 208	1.45 d	3.33 ab	18.33 de	11.20 e-g	0.85 h-j	91 fg
Modhumala	2.38 b	3.08 b	30.17 ab	15.54 a-c	1.30 b-e	109 b
Misridana	2.47 b	2.38 d	19.00 de	16.93 a	1.28 c-f	101 b-e
Senegal	2.60 ab	3.50 a	20.33 c-e	11.76 e-g	1.98 a	82 gh
Bonpara gandary	2.35 b	3.06 b	18.67 de	11.00 fg	1.14 e-g	96 ef
Bombay	2.90 a	2.24 d	25.00 b-d	15.83 ab	1.07 f-h	106 b-d
BSRI Akh 41	2.53 ab	3.00 bc	24.00 b-d	12.50 d-f	1.52 b	97 d-f
BSRI Akh 42	2.33 b	3.08 b	20.00 c-e	14.70 a-d	1.33 b-e	81 h
CV (%)	9.46	8.43	19.15	12.42	11.05	5.44

Means followed by same letter(s) in a column are not significantly different by DMRT at 5% level of significance.

While the shortest length (1.45 m) of cane was recorded in Co 208 genotype. Gomathi *et al.* (2013) also identified significant variation in plant height of different varieties of sugarcane. Considering girth of the cane, maximum girth (3.50 cm) was found in Senegal which is similar to Co208 (3.33 cm), Piyashi (3.27 cm) and Q-69 (3.18 cm) chewing cane genotypes. In this regard, Javed *et al.* (2001) reported that weight per stalk largely depends upon stalk length and stalk girth. The sugarcane genotype Misrimala contained the highest number (33.67) of internode while it was the lowest (15.33) in Co527 genotype. Contrary, the longest internode was observed in Misridana (16.93 cm) and Bombay (15.83 cm) chewing type sugarcane. Ekpelikpeze *et al.* (2016) opined that fewer number of internode and longer internode are important parameters of chewing sugarcane as it provides easily chewing and it's have high economic value. In case of single cane weight, the genotype Senegal was outstanding as it produced significantly the highest single cane weight (1.98 kg) which is unparalleled to other genotypes. Chewable cane number is governed by germination capacity and tillering pattern and these are hereditary characters of sugarcane genotypes. Accordingly, the genotype Co 527 exhibited the highest (161×10^3 ha^{-1}) number of chewable cane which is significantly different than the other sugarcane genotypes. Second highest chewable cane number (109×10^3 ha^{-1}) was recorded from Madhumala which was followed by VMC 86-550 genotype (107×10^3 ha^{-1}). On the other hand, the lowest number of chewable cane (81×10^3 ha^{-1}) was found in check variety BSRI Akh 42 which was identical to cane number (82×10^3 ha^{-1}) of Senegal genotype. Other sugarcane genotypes produced intermediate number of chewable cane per hectare. Such genotypic variability in number of chewable cane was reported by other authors (Alam *et al.* 2011; Anbanandan and Saravanan 2010) where multiple genes are involved in controlling this character of sugarcane.

Fibre content is another important consideration for chewing type cane as it determines the softness during chewing (Malik 2010). According to Verheye (2010), thick noble canes which are relatively soft with a higher sugar and juice content and low fiber are the best for chewing. Hogarth and Cross (1987) found that extraction of the juice from cane stalk reduces with high fiber and hardness. Generally, low fibre makes the cane soft and extracts high juice and vice versa. In present study, the lowest fibre content (8.90%) was observed in Senegal which was similar with Bonpara gandary (9.24%) genotypes (Figure 1). Contrary, the highest fibre content (14.83%) was recorded in Piyashi which is as per fibre content (14.18%) of Misridana genotype. Low fibre content of Senegal and Bonpara gandary genotypes signify the better quality of chewing cane and important genetic materials for breeding program.

Different parameters of juice quality of chewing type sugarcane genotype are shown in Table 2 which indicated great variability in qualitative attributes of chewing cane. Juice purity of chewing cane genotypes ranged from 87.73 to 77.10% where the highest purity was observed

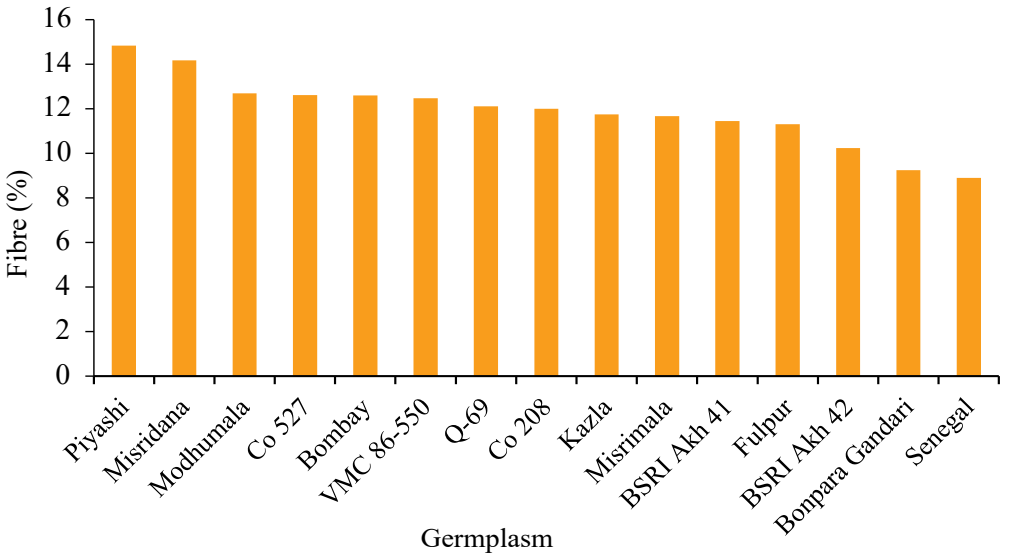


Fig. 1. Genotypic differences in fibre content of chewing cane

Table 2. Juice quality of different genotypes of chewing canes

Genotypes	Purity (%)	Brix (%)	Sucrose (%)	Reducing sugar (%)
Piyashi	80.45 c-e	15.32 e-g	9.60 d-f	1.22 b
VMC 86-550	87.73 a	17.80 bc	12.85 a	0.80 de
Kazla	77.10 e	13.65 i	8.50 f	1.40 a
Fulpur	79.32 de	16.00 d-f	9.80 c-e	1.33ab
Misrimala	81.91 b-d	16.73 c-e	9.67 d-f	1.02 c
Q-69	86.46 a	17.17 b-d	11.59 ab	0.55 f
Co 527	85.97 ab	18.45 ab	12.46 a	0.65 ef
Co 208	78.87 de	13.80 hi	8.67 f	0.93 c
Modhumala	86.87 a	19.51 a	12.67 a	0.39 g
Misridana	80.35 c-e	14.41 g-i	8.67 ef	0.95 c
Senegal	84.83 ab	15.20 f-h	10.85 b-d	0.80 d
Bonpara Gandari	85.03 ab	17.01 b-d	11.52 ab	1.04 c
Bombay	84.77 ab	17.87 bc	11.11 bc	1.00 c
BSRI Akh 41	83.67 a-c	15.80 d-g	10.35 b-d	1.40 a
BSRI Akh 42	86.85 a	17.25 b-d	11.10 bc	0.72 de
CV (%)	2.93	5.53	7.53	8.34

Means followed by same letter(s) in a column are not significantly different by DMRT at 5% level of significance.

in VMC 86-550 and the lowest in Kazla genotype. Here it may be noted that maximum genotype of chewing cane showed better quality in terms of purity. The result further revealed that Brix content was the highest (19.51%) in juice of Madhumala which was similar to Brix content (18.45%) of Co 527 genotype. This result confirms the finding of Alam *et al*. (2018) who found the highest Brix in Madhumala in comparison with other chewing type sugarcane. Sucrose content was the highest in VMC 86-550, Madhumala, Co 527and Q-69which varied from 12.85% to 11.52% over the genotypes. The genotype Kazla and Co 208 contained lower sucrose content which were 8.50 and 8.67%, respectively.

Reducing sugar was the highest (1.40%) both in Kazla and the check variety BSRI Akh 41 which was identical to reducing sugar content (1.33%) of Fulpur gandary. The lower content (0.55%) of reducing sugar was determined from the juice of Q-69 sugarcane genotype. Such variability in juice quality of chewing cane is very impressive in the process of variety development of sugarcane.

Conclusion

Evaluation of chewing type sugarcane revealed that there is great variability in morphological, fibre content and juice quality of fifteen genotypes. Considering the morphological attributes, the tallest cane was observed in Bombay, the highest girth and highest single cane weight was in Senegal, minimum internode and highest chewable was in Co 527 and the longest internode was found in Misridana genotypes. However, low fibre content was recorded in Senegal and Bonpara gandary only. For juice quality in terms of purity, Brix and sucrose, the genotype Madhumala was outstanding as it contained the highest proportion of these qualitative attributes. Contrary, reducing sugar was the highest in Kazla and check variety BSRI Akh 41. As different quantitative and qualitative parameters are exhibited in different genotypes, further breeding program is suggested to develop new chewing cane variety with best morphological, fibre content and juice quality.

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