Identify Sugarcane Clones for Maturity Status and Quality Jaggery Production

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ABSTRACT

Sugarcane (*Saccharum officinarum* L.) is the main source for production of sugar and jaggery in Bangladesh. It is essential to identify the maturity status and quality jaggery production of the clones before releasing a variety for cultivation in farmers' field. Sugarcane varietal identification programme through zonal yield trials was being carried out at BSRI farm to identify early maturing clones and suitable for jaggery manufacture. Four elite clones developed at BSRI clones with one standard Isd 39 were tested for consecutive three cropping seasons 2014-2015, 2015-2016 and 2016-2017. The experiments were laid out in randomized completely block design (RCBD) with three replications. The study revealed that the clones I 157-07, I 127-09 and I 130-09 were focused higher pol % cane and lower reducing sugars content than other clones in early part of crushing season from September to October. Jaggery prepared from the same clones was evaluated on the basis of physico-chemical properties and visual observations. The clones I 157-07 and I 290-08 have shown excellent quality with attractive golden yellow colour, highly crystalline and sweeter in taste. The rest of the clone was medium in quality.

Key words: Sugarcane, maturity, quality, jaggery, production

INTRODUCTION

Sugarcane is growing in different agro-climatic regions and encounters all the three seasons' i.e summer, monsoon and winter in its life cycles. Sugarcane maturity mainly regulated by factor such as varietal characters, environmental factors and management practices. Maturity status has direct impact on sugar production as well as quality jaggery production (Arefin *et al.*, 2010). Sugar recovery is dependent on different factors viz., variety, climate, physiological maturity, milling performance etc. Among three factors, variety occupies prime role in influencing sugar yield (Singh and Singh, 2000). High tonnage varieties possess lower sugar potential and vice versa (Jabber *et al.*, 2005). Generally high yielding varieties play an important role in increasing the productivity of sugarcane (Singh *et al.*, 2001). In Bangladesh, sugar production is much less than that in other sugar producing countries due to low cane yield and sugar recovery. Crushing of immature and over matured cane by sugar mills is one of the major factors responsible for low sugar recovery. Maturity determination and crushing of cane at its peak maturity phase is very important to obtain higher recovery of cane sugar.

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Jaggery is manufactured almost in all parts of Bangladesh where sugarcane is grown in abundance. Selection of sugarcane variety/clones suitable for quality jaggery production is important. The varieties suitable for jaggery making are found to be equally good for sugar production. However, a variety suitable for sugar production may not be equally suitable for jaggery making. Jaggery quality is judged by its sucrose content, reducing sugars, texture, attractive colour, crystalline nature etc. (Arefin *et al.*, 2014). Though, quality may be further improved by method of boiling and clarificant used for preparation of jaggery. Chemical composition of jaggery and its quality normally dependent on composition of juice from which jaggery is made. The quality of jaggery may be influenced by climate, soil type, crop management, clarificants used, stage of maturity at harvest and method of juice boiling adopted but mainly depends upon the variety from which it is made (Kapur *et al.*, 1988). Jaggery is high calorie sweetener and it contains sucrose, minerals, protein, glucose and fructose. It is known to be healthier in composition to white sugar. Good quality jaggery contains more than 70% sucrose, less than 10% of glucose and fructose, less than 5% minerals and less than 3% moisture (Nath *et al.*, 2015). Jaggery is highly hygroscopic in nature and as a result it becomes soft and sticky and often liquefies completely at high humidity period. Some micro-organisms are responsible for fermentation which brings about various changes resulting in heavy losses both in weight and quality of jaggery (Sarker *et al.*, 1985). There are wide variations in quality of jaggery prepared from different varieties like chemical composition of jaggery, colour and deterioration during storage (Patil *et al.*, 1994). The present study was undertaken with objectives to screen some new promising early maturing clones with high sucrose and noticeable cane yield for quality jaggery production at early part of the crushing period.

MATERIALS AND METHODS

Four promising sugarcane clones viz., I 157-07, I 290-09, I 127-09 and I 130-09 were evaluated for their performance compared with one variety Isd 39 (standard) in three consecutive cropping seasons of 2013-2014, 2014-2015 and 2015-2016 under Zonal Yield Trial (ZYT) test stages. Two budded setts of each clone/variety were planted in 10 m × 10 m plots with three replications. Intercultural operations including control of pests and diseases were done as and when necessary. Cane samples were collected from each plot and crushed for analysis. Data on brix, pol in cane, reducing sugars content and fibre content from individual clones were recorded. Brix was determined by brix hydrometric method. Pol in cane was measured in Horne's dry basic lead acetate method by Polarimeter (Anon, 1970), while reducing sugars were measured by Lane and Eynon method (Chen, 1985). Fibre content of cane was determined by direct method. Jaggery was prepared from each clone/variety by simple open pan boiling method without adding/using any hazardous chemical clarificants. Physical and chemical properties of prepared jaggery from the sugarcane clones were analysed for sucrose, colour transmittance (0.25N solution), pH, and reducing sugars jaggery from same clones were recorded and presented in graphical forms and in bar diagrams.

RESULTS AND DISCUSSION

Results of the clones tested were found different in pol per cent cane, reducing sugars and fibre content have been presented in Figures 1-9. Four promising sugarcane clones including one standard variety (Isd 39) have been chemically analyzed at monthly interval beginning from mid September to mid February. The early maturing potential clones were grouped on the basis of higher pol per cent cane and lower reducing sugars content in the month of October and mid maturing potential clones were grouped on the basis of the same in the month of November. Results have been shown in Figures 1 & 2. Data on pol in cane, figure 1 showed that pol per cent cane of the clones and variety Isd 39 were quadratic in nature creating peaks in January. It is also seen that the clone I 157-07 had higher rate of increase trend in pol in cane up to December compared to the rest clones and lower trend of pol per cent cane was observed after January except the clone I 290-08. Pol per cent cane of the clone was increased up to February. Similar results were reported by Jabber *et al.* (2005). However, in case of reducing sugars content opposite trend was observed in all the clones tested in the present investigation. From figure 2, it is seen that reducing sugars of the clones I 157-07, I 127-09 and I 130-09 decreased gradually up to January. Since pol per cent cane in clones I 157-07, I 127-09 and I 130-09 were above 10% in October and shown peak in January. The reducing sugars content was observed below 1% in October, the clones I 157-07, I 127-09 and I 130-09 were considered as early maturing potential. The rest of the clones tested were considered as mid maturing potential. The softness and juiciness of a sugarcane variety mainly depends on its fibre content. Higher is the fibre content lower is the juice extraction and results in poor cane quality. Higher fibre content leads to higher bagasse production and lower juice extraction resulting higher loss of pol in bagasse. Results of fibre per cent cane have been shown in the figure 3. The lowest fibre per cent cane was observed in clone I 130-09 (15.40%) followed by Isd 39 (15.61%), I 157-07 (15.79%), I 12-09 (15.88%) and I 290-08 (16.39%). These results were agreed with Jabber *et al.* (2005). Overall it can be concluded that the clone I 157-07 showed early maturing and the clone I 290-08 were mid maturing potential along with other qualities.

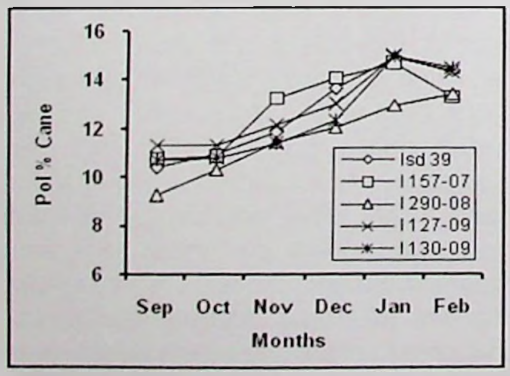

Figure 1. Pol content of sugarcane clones (Mean of 3 seasons)

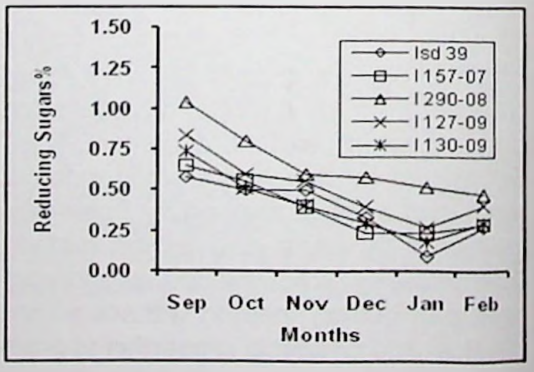

Figure 2. Reducing sugars content of sugarcane clones (Mean of 3 seasons)

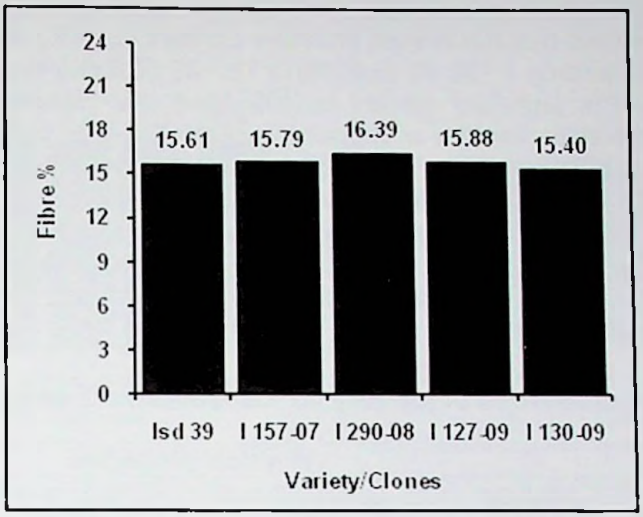

Figure 3. Fibre content of sugarcane clones at harvest time (Mean of 3 seasons)

In case of physical properties of jaggery, the clones I 157-07 and I 290-08 showed superior quality jaggery due to golden yellow colour and good crystalline nature compared to rest of the clones tested (Table 1). Results from the Figure 4 observed that the highest sucrose content were recorded in clone I 157-07 (78.90%) followed by I 290-08 (77.88%), I 130-09 (76.75%), I 127-09 (76.65%) and Isd 39 (76.68%), respectively. It may be mentioned that sucrose is the main sweetening factor of jaggery. Considering reducing sugars content of jaggery, the clones I 157-07 showed the lowest reducing sugars content (4.18%) and the result was followed by I 130-09 (4.44%), I 127-09 (4.89%) and I 290-08 (4.91%), respectively (Figure 5). The highest reducing sugars 4.92% was produced in variety Isd 39. These results were supported by Arefin *et al.* (2010) who reported that a good quality jaggery should have higher sucrose and lower reducing sugars content. Jaggery containing higher per cent of reducing sugars generally discouraged; because it is hygroscopic in nature, resulting poor quality and low shelf-life.

The colour transmittance of jaggery is presented in Figure 7. From this figure, it is seen that the entire clone noticed higher colour transmittance of jaggery in compared to standard variety. It is evident from the data that colour transmittance of jaggery prepared from the clone I 157-07 produced the highest value of colour transmittance (74.80%) and the lowest colour transmittance of jaggery (72.30%) was recorded in standard variety Isd 39. Similar findings were reported by Sarker, *et al.* (1985). The light coloured jaggery is always preferred by consumers for eating purpose, and good quality jaggery is generally characterized by light colour.

The pH of jaggery was recorded similar trend in all the clones/variety (Figure 6). Lower pH indicates acidic in nature. Figure 7 showed that the pH value of jaggery prepared from the tested clones/variety were nearly equivalent to neutral pH, and prepared jaggery from these clones were suitable for consumption.

Figure 8 shows that the lowest moisture content (6.14%) was observed in the clone I 157-07 followed by I 130-09 (6.80%), I 127-09 (7.02%) and I 290-08 (7.27%) respectively while the standard variety Isd 39 have the highest moisture content (7.34%). Higher moisture content of jaggery is generally less suitable for long term preservation (Gaur *et al.*, 1979). The highest jaggery recovery was recorded from the clone I 157-07 (10.20%) followed by the clones I 127-09 (10.00%), I 130-09 (9.90%) and I 290-08 (9.60%), respectively. The lowest jaggery recovery (9.50%) was observed in standard variety Isd 39 (Figure 9). On the basis of visual observations and chemical analyses the jaggery prepared from the clone I 157-07 and I 290-08 were excellent in quality.

Table 1. Physical properties of jaggery for consecutive 3 seasons

Variety / Clones	Physical properties			
	Texture	Crystalline in nature	Colour in solid state	Taste
Isd 39	Hard	Good	Golden	Sweety
I 157-07	Hard	Good	Golden Yellow	Sweety
I 290-08	Hard	Good	Golden Yellow	Sweety
I 127-09	Hard	Good	Golden	Sweety
I 130-09	Hard	Good	Golden	Sweety

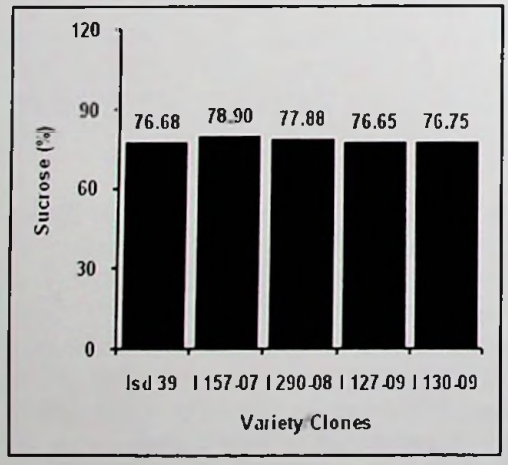

Figure 4. Sucrose content of jaggery (Mean of 3 seasons)

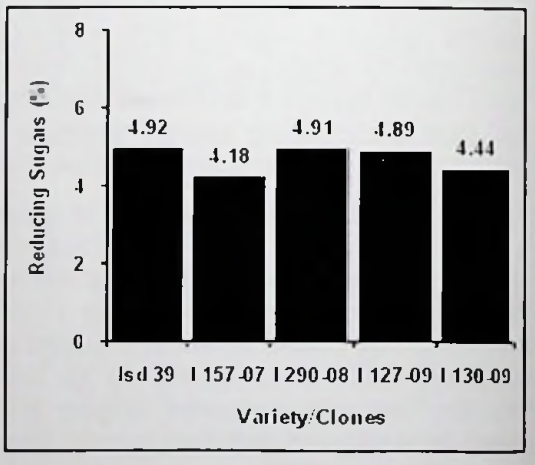

Figure 5. Reducing sugars content of jaggery (Mean of 3 seasons)

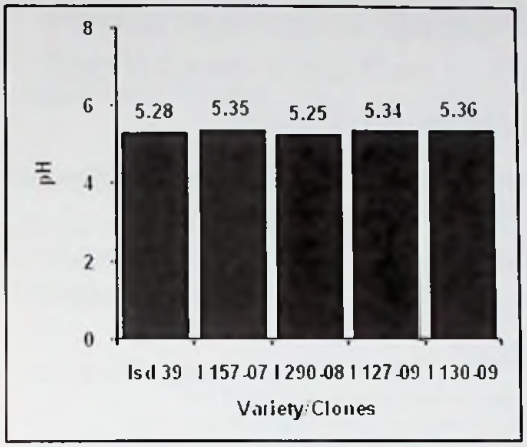

Figure 6. pH of jaggery (Mean of 3 seasons)

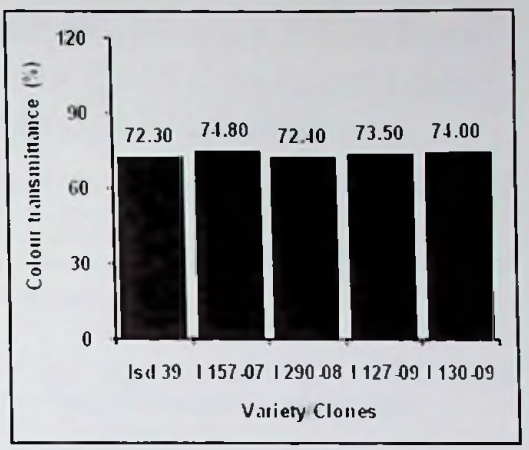

Figure 7. Colour transmittance of jaggery (Mean of 3 seasons)

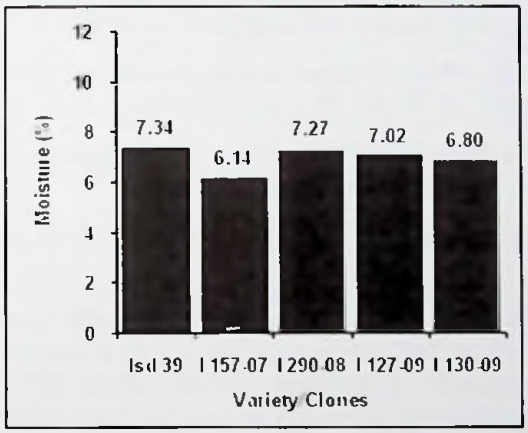

Figure 8. Moisture content jaggery (Mean of 3 seasons)

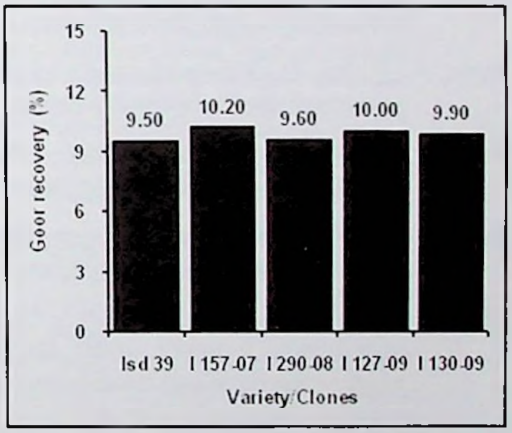

Figure 9. Recovery of jaggery (Mean of 3 seasons)

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