Performance of Some Newly Released BSRI Bred Sugarcane Varieties in Farmers Field Condition under Old Himalayan Piedmont Plain Soil

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ABSTRACT

An experiment was conducted at farmers' field at Thakurgaon in Old Himalayan Piedmont Plain Soil (AEZ 1) of Bangladesh during the cropping season 2013-2014. For this study six selected varieties viz., Isd 20 (Standard), Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40 were planted following RCB design with three replications. Among the latest varieties over other Isd 39 showed superiority over other varieties in respect of the number of tillers (192.30 x 10^3 ha^{-1}) , number of millable cane (106.08 x 10^3 ha^{-1}), stalk height (3.39 m), length of internode (13.21 cm) and cane yield (99.71 tha^{-1}). The highest germination (55.78%), single stalk weight (1.02 kg), brix (21.0 %), stalk diameter (2.35 cm) and lowest tiller mortality (%) was recorded from the variety of Isd 37 while highest number of internode (27.0) found in the variety Isd 40. The lowest germination (%), number of tiller, number of millablecane, cane yield were obtained from Isd 38 while the lowest individual stalk weight, brix (%), height, number of internode, stalk diameter and brix % were found in Isd 20 which was used as standard variety. In terms of economic return, the variety Isd 39 showed higher benefit cost ratio (2.29) followed by Isd 37 (2.23). The overall result revealed that among commercial sugarcane varieties Isd 39 and Isd 37 may be recommended for cultivation in Old Himalayan Piedmont Plain Soil (AEZ 1) in Northern region of Bangladesh.

Key words: Sugarcane, mortality (%), brix (%), cane yield, benefit cost ratio.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a vegetative propagated perennial crop. It is a cash crop and main source of white sugar in Bangladesh. Sugarcane is grown in tropical and sub-tropical regions of the world in a range of climates from hot dry environment near sea level to cool and moist environment at higher elevations. It is the main sugar-producing crop (Junejo *et al.*, 2010). It is a commercially important crop that accounts for approximately 65% of the global sugar production (Deho *et al.*, 2002). Besides sugar production, sugarcane produces numerous valuable by products like, alcohol used by pharmaceutical industry, ethanol used as a fuel, bagasse used for paper, and chip board manufacturing and press mud used as a rich source of organic matter and nutrients for crop production. Sugarcane is cultivated in many of the world countries with Brazil as a major producer followed by India, China, Thailand, Pakistan and Mexico (FAOSTAT, 2013). In Bangladesh sugarcane cultivation is restricted to only 130 thousand hectares covering both mill and non-mill zones with an annual production of 4,603 thousand tons as against the current annual requirement of 19,500 thousand tons (BBS, 2013).

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It is mainly grown in high and medium high land under rain-fed condition mostly in the north-west and south-west regions of the country. The soil and climate of Bangladesh is very much congenial for sugarcane production but the average sugarcane yield is around 44 tha^{-1} (BBS, 2011). The average cane yield can be improved by adopting improved package of technology and developing high yielding varieties through different breeding techniques (Memon *et al.*, 2004).The performance of promising variety depends upon the agro-ecological conditions as a promising variety may not perform good in all agro-ecological zones due to variation of agro climatic factors (Bashar and Paul, 2005). Considering the fact a study evaluate the performance of some newly developed sugarcane varieties for replacing low yielding existing traditional sugarcane varieties in farmers' field in Old Himalayan Piedmont Plain Soils (AEZ 1).

MATERIALS AND METHODS

An experiment was conducted at farmer's field in Old Himalayan Piedmont Plain Soil (AEZ 1) during cropping season 2013-2014. The land was medium high land typical sandy loam soil with P^H 5.5. The seven sugarcane varieties viz., Isd 20 (Standard) (T_1), Isd 35 (T_2),Isd 36 (T_3), Isd 37 (T_4), Isd 38 (T_5), Isd 39 (T_6) and Isd 40 (T_7) were laid out RCB design and with three replications. Each variety was considered as treatment. The unit plot size was 6 m × 6 m. Two budded setts were planted end to end with conventional method to maintain row to row distance was 90 cm. Setts were planted on 12th December, 2013 and harvested one 15th January 2015. Fertilizers were applied following the recommended rate N, P, K, S and Zn for sugarcane @ 165, 55, 120, 30 and 2.5 kg ha^{-1}, respectively (BARC, 2012). 1/3 dose of N + 1/3 dose of K + full dose of P,S and Zn were applied at the time of planting, remaining 2nd and 3rd doses of N and K were applied at 1st and 2nd earthing up. Irrigation was applied 3 times at germination, tillering and stem elongation stage. The appropriate intercultural operations were done in proper time. In growth stage data were recorded on germination (%) at 30 DAP, tiller population at 150 DAP, millable cane, tiller mortality (%) but stalk height, number of internode $stalk^{-1}$, length of internode, stalk diameter, single stalk weight, yield, and brix (%) of cane were recorded at harvest. Data were analyzed statistically using analysis of variance (ANOVA) according to Gomez and Gomez (1984) procedure for a randomized complete block design with Statistix 10 software package and the mean differences were compared by least significant difference (LSD) at 5% level of probability.

Tiller mortality was calculated with the following formula:

$$\text{Tiller motality (\%)} = \frac{\text{Number of tiller} - \text{Number of millable cane}}{\text{Number of tiller}} \times 100$$

Benefit cost ratio indicated whether the cultivation was profitable or not, which was calculated as follows (CIMMYT, 1988):

$$\text{BCR} = \frac{\text{Gross return (Tk. ha}^{-1}\text{)}}{\text{Cost of production (Tk. ha}^{-1}\text{)}}$$

Gross return = Value of chewing cane

Net Return = Gross return (Tk. ha^{-1}) – Total cost of production (Tk. ha^{-1}).

RESULTS AND DISTCUSSION

The performances of the tested different sugarcane varieties after set placement of germination (%), stalk height (m), internode stalk^{-1} (no.), length of internode and stalk diameter (cm) were represented in Table 1.

Germination (%)

Germination percent is the most critical factor which determines the varietal potential to exploit the available resources and ultimately effects on cane stand. In the study highest germination (55.78%) was observed in Isd 37 which was at par with the varieties Isd 40, Isd 39 and Isd 35. The lowest germination (35.24 %) was observed in Isd 38. These findings are analogous with Razzak *et al.* (2015) who found variable germination for different cane cultivars.

Stalk height (m)

Stalk height of a cane contributes materially towards final cane yield (Panhwar, *et al.*, 2006). Among different varieties the highest stalk height of 3.39 m was found from Isd 39 which was statistically similar with Isd 37 (3.27 m) while the lowest stalk height of 2.75 m was found from the variety of Isd 20 that was significantly similar with the varieties of Isd 35, Isd 36 and Isd 38. Similar finding was observed by by Khan *et al.* (2007) who reported that stalk height varied among different sugarcane varieties.

Number of internode stalk^{-1}

The highest number of internode stalk^{-1} (27) was recorded in Isd 40 which was statically similar with Isd 37 (26.10) and Isd 39 (25.67) while the lowest number of internode stalk^{-1} (23.85) was recorded in the variety of Isd 20 which was statically similar with the varieties of Isd 35, Isd 36 and Isd 38.

Length of internode (cm)

The highest length of internode (13.21 cm) was recorded in the variety of Isd 39 that was statistically similar with Isd 37 (12.54 cm). The lowest length of internode (11.36 cm) was recorded in Isd 40 which was identical with other varieties except Isd 37 and Isd 39.

Stalk diameter (cm)

Stalk diameter is an important yield contributing trait and use of large stalk diameter would enhance the acceptability of varieties from commercial point of view (Ramdoyal, 1999). The highest stalk diameter (2.35 cm) was found in the variety Isd 37 that was at par with Isd 39 (2.27 cm) and Isd 40 (2.22 cm) while the lowest cane diameter (1.90 cm) was found in Isd 20 which was identical with the varieties Isd 38 (1.97) and Isd 35 (2.05).

Table 1. Growth parameters of different sugarcane varieties at farmer fields, 2013-2014

Treatments	Germination (%)	Height (m)	Number of internode stalk^{-1}	Length of internode (cm)	Diameter (cm)
T_1: Isd 20 (Std)	39.72 cd	2.75 d	23.85 d	11.68 bc	1.90 e
T_2: Isd 35	45.78 a-d	2.93 cd	24.22 cd	12.10 bc	2.05 cde
T_3: Isd 36	43.48 b-d	2.97 cd	24.79 bcd	11.98 bc	2.15 bcd
T_4: Isd 37	55.78 a	3.27 ab	26.10 ab	12.54 ab	2.35 a
T_5: Isd 38	35.24 d	2.88 cd	24.00 cd	12.06 bc	1.97 de
T_6: Isd 39	49.88 a-c	3.39 a	25.67 abc	13.21 a	2.22 abc
T_7: Isd 40	52.77 ab	3.08 bc	27.00 a	11.36 c	2.27 ab
LSD (0.05)	5.24	0.12	0.83	0.34	0.09

Results from our study further indicated that varieties exerted significant influence on the yield and its component, viz., tiller, millable cane, single stalk weight, yield and cane Brix (%) presented in Table 2.

Number of tillers

Tillering potential of a variety ultimately effects cane yield positively. In the present study, number of tiller per hectare ranged from 118.84 x 10^3 ha^{-1} to 192.30 x 10^3 ha^{-1}. The highest number of tiller (192.30 x 10^3 ha^{-1}) was obtained in Isd 39 which was at par with Isd 20 (174.80 x 10^3 ha^{-1}) but significantly different from other varieties. The lowest tiller was obtained in the variety of Isd 38 (118.84 x 10^3 ha^{-1}) which was statistically similar with Isd 36 and Isd 37. Similar fininding was observed by Razzak *et al.* (2015). They concluded that all tested varieties were significantly influence on tiller production.

Number of millable cane

The number of millable cane directly influences cane yield as it is the combined interaction of germination, tillering and tiller mortality (Aslam, *et al.*, 2010). The highest number of millable cane (106.08 x 10^3 ha^{-1}) was observed in Isd 39 that was significantly similar with other varieties except Isd 36 and Isd 38. The lowest number of millable cane (70.22 x 10^3 ha^{-1}) was observed in the variety of Isd 38 which was significantly differ from other variety except Isd 36 (83.47 x 10^3 ha^{-1}). The similar result was found by Razzak *et al.* (2015). The variation in millable cane among the varieties was probably due to heredity or varietal characteristics.

Tiller mortality (%)

Different factors like varietal characteristics, light, nutrient level, time of planting, soil moisture etc. usually influence tiller mortality (%) of sugarcane (Rao and Prasad, 1962). Among the test varieties tiller mortality ranges from 33.92%-46.11%. The highest tiller mortality (46.11%) was obtained from the variety of Isd 39 while the lowest mortality (33.92%) was obtained from the variety Isd 37 (Figure 1). The similar result was closely agreement with Kabiraj *et al.* (2011). They reported that tiller mortality varied from 23.93-50% among different varieties.

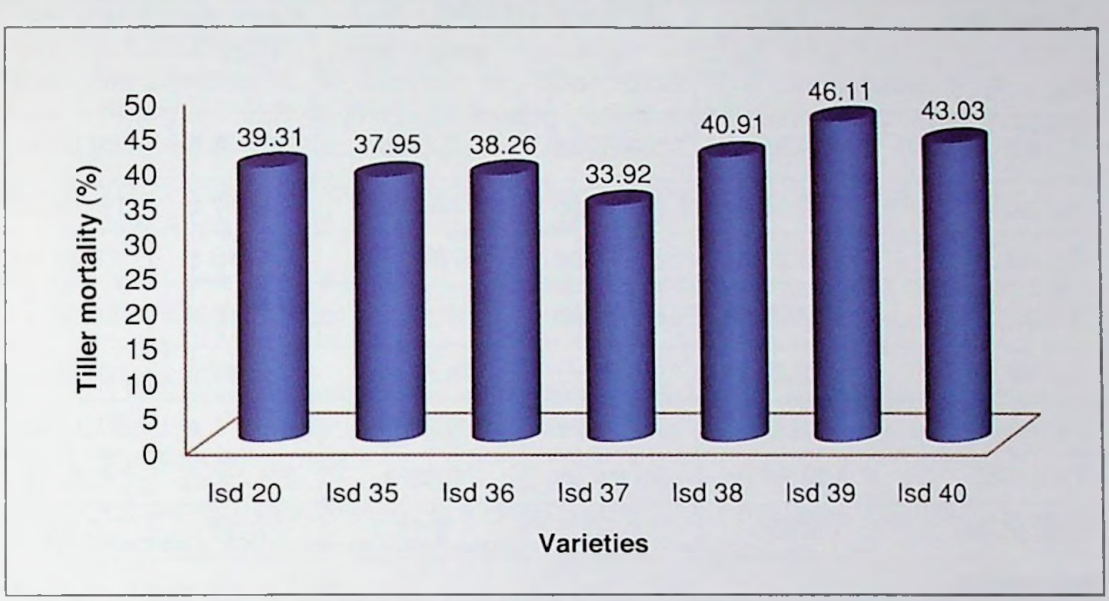

Figure 1. Tiller mortality of different sugarcane varieties in farmer's field, 2013-2014

Single stalk weight (kg)

The stalk weight is the product of its length, girth and contributes substantially towards final cane yield (Panhwar *et al.*, 2006). The highest single stalk weight of 1.02 kg was found in Isd 37 which was statistically similar with other varieties except Isd 20 (0.68 kg).The lowest single stalk weight was found in Isd 20 which was significantly different with the varieties of Isd 37, Isd 39, and Isd 40. The finding was in conformity with the reports of Ganapathy and Purushothaman (2017).

Cane yield (t ha^{-1})

Statistically highest cane yield of 99.71 t ha^{-1} was obtained in Isd 39 which was similar with the variety Isd 37 (97.18 t ha^{-1}) and Isd 40 (85.29 t ha^{-1}). The lowest cane yield (55.47 t ha^{-1}) was obtained from Isd 38 which was statistically similar with Isd 20 (70.4 6 t ha^{-1}). Similar results were reported by Razzak *et al.* (2015) who reported that Isd 39 given highest yield (105 t ha^{-1}) among other tested varieties.

Brix (%)

The highest brix (%) was obtained from lsd 37 (21.00), which was statistically similar with other varieties except the variety lsd 20 and lsd 36. The lowest brix (%) was obtained from the variety lsd 20 (19.00) which was statistically similar with other varieties except lsd 37. The results are almost same as demonstrated by Sohel *et al.* (2011).

Table 2. Yield and yield components of different sugarcane varieties at farmer fields, 2013-2014

Treatments	Tiller ($x10^3$ ha^{-1})	Millable cane ($x10^3$ ha^{-1})	Single Stalk weight (kg)	Cane yield (t ha^{-1})	Brix (%)
T_1: lsd 20 (Std)	174.80 ab	103.62 ab	0.68 b	70.4 6 bc	19.00 b
T_2: lsd 35	154.10 bc	95.61 ab	0.80 ab	77.17 b	19.33 ab
T_3: lsd 36	135.20 cd	83.47 bc	0.89 ab	74.40 b	18.67 b
T_4: lsd 37	143.07 cd	94.54 ab	1.02 a	97.18 a	21.00 a
T_5: lsd 38	118.84 d	70.22 c	0.79 ab	55.47 c	20.00 ab
T_6: lsd 39	192.30 a	106.08 a	0.94 a	99.71 a	20.33 ab
T_7: lsd 40	159.63 bc	90.94 ab	0.93 a	85.29 ab	19.33 ab
LSD (0.05)	12.55	9.50	0.11	8.51	0.88

Economics

The benefit cost ratio of the varieties was calculated and presented in Table 3. Among the seven varieties lsd 39 gave the highest profit (140.28 x 10^3 Tk. ha^{-1}) with BCR (2.29) that was followed by lsd 37 with profit (133.95 x 10^3 Tk. ha^{-1}) and BCR (2.23). The lowest profit (29.68 x 10^3 Tk. ha^{-1}) and BCR (1.27) was obtained from the variety of lsd 38. The similar result was observed by Razzak *et al.* (2015).

Table 3. Economic return of different sugarcane varieties

Treatments	Total cost of production cost. (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Net return (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_1: lsd 20 (Std)	1,09,000.00	1,761,50.00	67,150.00	1.62
T_2: lsd 35	1,09,000.00	1,92,925.00	83,925.00	1.77
T_3: lsd 36	1,09,000.00	1,86,000.00	77,000.00	1.71
T_4: lsd 37	1,09,000.00	2,42,950.00	1,33,950.00	2.23
T_5: lsd 38	1,09,000.00	1,38,675.00	29,675.00	1.27
T_6: lsd 39	1,09,000.00	2,49,275.00	1,40,275.00	2.29
T_7: lsd 40	1,09,000.00	2,13,225.00	1,04,225.00	1.96

Price of sugarcane : 2,500.00 Tk. ton^{-1},

The overall result revealed that newly released sugarcane varieties lsd 39 and lsd 37 performed better than other varieties regarding yield and economic return. So, it can be suggested for growing these two varieties with optimum management packages for getting higher yield as well as economic benefits from sugarcane cultivation at farmer's field in Old Himalayan Piedmont Plain Soil (AEZ 1) in Northern region of Bangladesh.

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