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# Potentiality of plant and ratoon crops of sugarcane under Old Himalayan Piedmont Plain Soils of Bangladesh

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## ABSTRACT

The experiment was carried out in farmers' field of Thakurgaon sugar mills area under Old Himalayan Piedmont Plain Soils (AEZ-1) of Bangladesh during the cropping year of 2012-13 and 2013-14 to evaluate ratooning potentiality of some sugarcane varieties. Seven selected varieties viz: Isd 20, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40 were planted following RCB design with three replications. Significant differences were observed for tiller population, stalk height, stalk diameter, single stalk weight, yield and brix (%) of plant and ratoon crops as well. The tiller population was increased upto 150 days after planting (DAP), after that it was decreased. The highest number of tillers of $278.32\times10^3$ $ha^{-1}$ and the lowest number of tillers of $208.72\times10^3 ha^{-1}$ were observed in Isd 39 and Isd 37, respectively at 150 DAP in plant cane but the highest ($253.30\times10^3$ $ha^{-1}$) and the lowest ($175.23\times10^3 ha^{-1}$) number of tillers in ratoon cane were observed in Isd 37 and Isd 38, respectively at 150 days after shaving (DAS). However, the highest number of millable cane was recorded from the variety Isd 39 in both plant and ratoon cane. The highest cane yield of 103.85 $tha^{-1}$ was harvested in Isd 39 followed by 98.78 $tha^{-1}$ in Isd 37 in case of plant crop, while the highest ratoon cane yield of 89.07 $tha^{-1}$ was recorded from Isd 37 followed by 86.17 $tha^{-1}$ from Isd 39. The plant crop ensured the higher yield than ratoon crop, but the higher brix (%) was achieved in ratoon crop. In plant cane the highest BCR of 2.60 was recorded with the variety of Isd 39 followed by Isd 37 (2.47) while the highest BCR of 2.75 in ratoon cane was calculated with Isd 37 followed by 2.65 from Isd 39 that is higher profit comes from ratoon cane. However, considering yield, brix (%) and economic return, Isd 39 and Isd 37 may be recommended for cultivation as plant and ratoon crop in Old Himalayan Piedmont Plain Soils of Bangladesh.

**Keywords:** Sugarcane, plant cane, ratoon cane, yield

## INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a perennial crop grows in tropical and sub-tropical countries for sugar production (Mehareb 2015). Like other perennial grasses, it can regenerate shoots from the left over stalks of preceding crops known as ratoon crop. Ratooning of sugarcane is a common practice throughout the world and ratoon occupies almost 50 percent of the total area under sugarcane production (Sundara 2008). It is an age old practice in almost all the major sugarcane growing countries, following at least two even more ratoon from the same plantation (Bashir et al. 2013). In Hawaii, Mauritius, Philippines and Cuba four to six ratoons are quite common (Misra and Mathur 1983). In India, research strategies for sugarcane production through ratooning has been undertaken as an aid to save about 30-35% money spent on the cost of cultivation (Singh et al. 2003). In Bangladesh, only 20% of the cane area is ratooned every year producing in an average 40 $tha^{-1}$

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while the potential yield has been found to be around 80 t $ha^{-1}$ (Anon 2019). Growing ratoon is 30-40% cheaper due to saving the cost of seedbed preparation, seed material and planting operations (Shukla et al. 2013).

Under similar conditions sugarcane ratoon have a supplementary advantages of better juice quality and sugar recovery more than plant cane of same variety (Tahir et al. 2014). Ratoon crop of sugarcane matures prior to plant cane ensuring early supply of cane to mills.

The genetic potential of a variety to give better yields in plant and ratoon cane is the focal point for sustaining high productivity and its acceptance by the farmers for good ratooning potential (Arain et al. 2011). Different varieties do differ in their ratooning potential (Yadav 1992) and any variety may be considered to have good ratooning ability if it can maintain yield and/or it has a high yield potential over the normal crop cycle. Good ratooning ability of cane cultivars is an essential pre-requisite determined by a number of factors. Various plant characters were associated with ratooning ability of sugarcane varieties and success of the variety depends on its ability to provide more profitable ratoon (Tahir et al. 2014). Thus, sugarcane variety which shows good performance in plant and ratoon crop should be promoted for commercial cultivation.

Therefore, the objectives of the present study was to evaluate the ratooning ability as well as the performance of some promising sugarcane varieties grown in Old Himalayan Piedmont Plain Soils (AEZ-1) of Bangladesh.

## MATERIALS AND METHODS

The experiment was carried out in farmers' field of Thakurgaon sugar mills area under Old Himalayan Piedmont Plain Soils (AEZ-1) of Bangladesh during the season of 2012-2013 and 2013-2014. Seven selected sugarcane varieties *viz:* Isd 20, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40 were planted to evaluate the performances as plant and ratoon crop following Randomize Complete Block Design (RCBD) with three replications and the unit plot size was 8m × 6m. Two budded setts were used as planting material and planted on 15$^{th}$ November, 2012 in 100 cm apart rows with end to end placement. Fertilizers viz. Urea, TSP, MOP, Gypsum and $ZnSO_4$ were applied @ 358, 275, 240, 188 and 7kg $ha^{-1}$, respectively for plant cane while full amount of TSP, Gypsum, $ZnSO_4$ and 1/3$^{rd}$ of Urea and MOP were applied in trenches and mixed with soil prior to planting of setts. The second dose of Urea (1/3$^{rd}$) and MOP (1/3$^{rd}$) were applied as first top dressing (at 90 DAP) and final top dressing was done with the rest amount of Urea and MOP at 150 DAP. After harvesting of plant cane on 20$^{th}$ December, 2013 and ratoon cane was raised from the left over stubbles of plant cane. Therefore, soon after harvesting of plant crop, stubble shaving was done with a sharp edged spade. Irrigation was applied without delay after stubble shaving. Fertilizers for ratoon crop, Urea, TSP, MOP, Gypsum and $ZnSO_4$ were applied at the rate of 458, 375, 300, 235 and 9 kg $ha^{1}$, respectively. After stubble shaving and as soon as the soil attained tilth, one third of Urea and MOP, full amount of TSP, gypsum, zinc sulphate were applied in between rows and thoroughly mixed with soil. These operations were necessary to initiate a good growth of ratoon crop. The remaining dose of Urea and MOP were applied as top dressing with two splits, one was after tillering completion stage i.e. 90 days after stubble shaving (DAS) and the other at grand growth phase (180 DAS). Pesticides Regent 3GR (Chlorpyrifos) was applied at the rate of 33 kg $ha^{-1}$ during planting for the control of termite and Furadan 5G (Carbofuran) was applied (40 kg $ha^{-1}$) two times in the month of March and May of both the cropping seasons for controlling stem borer. Intercultural operations like irrigation, weeding, mulching, earthing-up, tying and cross tying etc were done accordingly. Tiller population was counted at 90, 120, 150, 180 and 210 DAP and DAS, respectively. Millable cane, stalk height, stalk diameter, single stalk weight, cane yield, and brix (%) of cane were recorded at harvesting time. The brix reading of sugarcane juice was calculated by using a hand-held Refractometer (ATAGO) when, measured water at environment temperature, and adjusted the scale to brix at 0.0% (Zero Set). Benefit cost ratio indicated whether the cultivation was profitable or not, which was calculated as follows (CIMMYT 1988)

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

Gross return = Value of cane
Cost of production = Sum of the cost of the resources.

**Statistical analysis:** Fisher's analysis of variance (ANOVA) was used for statistical analysis of collected data and for comparison of differences among treatment means. Least significant difference (LSD) test was done at 5% level of probability (Steel et al. 1996). Statistix 10 (Tallahassee FL 32317) was used for the determination of statistical differences.

## RESULTS AND DISCUSSION

**Tiller population:** Number of tiller production was found different among the treatments at 90, 120, 150, 180 and 210 DAP and DAS, respectively in both conditions (Figure 1 and 2). The highest number of tiller population was recorded as $165.54\times10^3$, $211.26\times10^3$, $278.32\times10^3$, $190.32\times10^3$ and $145.32\times10^3$ $ha^{-1}$ in plant

cane at 90, 120,150, 180 and 210 DAP, respectively (Figure1) but the highest number of tillers of $132.20\times10^3$, $181.14\times10^3$, $253.30\times10^3$, $181.65\times10^3$ and $139.32\times10^3$ $ha^{-1}$ were found in ratoon cane at 90, 120,150, 180 and 210 DAS, respectively (Figure 2).

Both plant and ratoon cane, the number of tiller population was increased up to 150 DAP and DAS while tiller population gradually decreased up to actual millable cane formation stage. It was also found that the highest number of tiller population was recorded from

Isd 39 in both conditions at 150 DAP while the lowest number of tiller was found from Isd 37 and Isd 38 at 150 DAP and DAS respectively. Similar findings was reported by Arefin et al. (2017) where they mentioned that the highest tiller population ($159\times10^3$ $ha^{-1}$) was at 150 DAT and the lowest tiller population ($64.60\times10^3$ $ha^{-1}$) at 210 DAT.

**Number of millable cane, stalk diameter and number of internode per stalk:** The number of millable cane, stalk diameter (cm) and number of internodes per stalk are shown in table1. The number of millable cane influences cane yield directly. Millable cane was not significantly different in plant cane but it was differed significantly in ratoon cane. The number of millable cane was ranged from $89.21\times10^3$ to $108.17\times10^3$ $ha^{-1}$ and $77.79\times10^3$ to $110.40\times10^3$ $ha^{-1}$ in plant and ratoon cane, respectively while the highest millable cane of $110.40\times10^3$ $ha^{-1}$ was found from the variety Isd 39 in ratoon cane and the lowest of $77.79\times10^3$ $ha^{-1}$ was found from the variety Isd 36 (Table 1). The present result was in agreement with Karim et al. (2015) where they found that Isd 39 gave the highest millable cane of $95.39\times10^3$ $ha^{-1}$ and Isd 36 gave the lowest millable cane $81.73\times10^3$ $ha^{-1}$ in ratoon cane.

The stalk diameter (cm) for plant and ratoon crops were statistically different among the tested varieties. The highest cane diameters of 2.37cm and 2.25cm were recorded from the variety Isd 37 in plant and ratoon cane, respectively (Table 1). On the other hand, the lowest stalk diameter of 2.08 and 1.95cm was recorded from the variety of Isd 20 from plant and ratoon cane, respectively. From the results it was clear that different stalk diameter was found in different variety and also from plant to ratoon cane but variety Isd 20 showed the lowest stalk diameter. The finding was in conformity with the reports of Arain et al. (2011) who found that the lowest stalk diameter of 1.93cm and 1.87cm were in plant and ratoon cane, respectively. The highest number of internodes per stalk (27.12) was recorded with Isd 36 which was statically identical with all the tested varieties except Isd 39 and Isd 35 in plant cane while the lowest number of internodes per stalk (24.95) was recorded with the variety of Isd 39 which was at par with the varieties of Isd 35, Isd 37, Isd 20 and Isd 38 (Table 1). In case of ratoon cane the highest number of internodes per stalk (28.04) was recorded with Isd 40 which was statically identical with all the tested varieties except Isd 39 while the lowest number of internodes per stalk (25.16) was recorded with the variety of Isd 39 which was as good as with all the tested varieties except Isd 40 (Table 1).

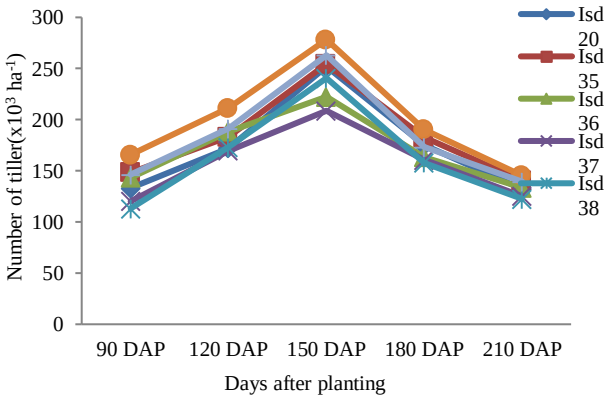


**Figure 1.** Number of tiller at different days after planting (DAP) of the plant cane

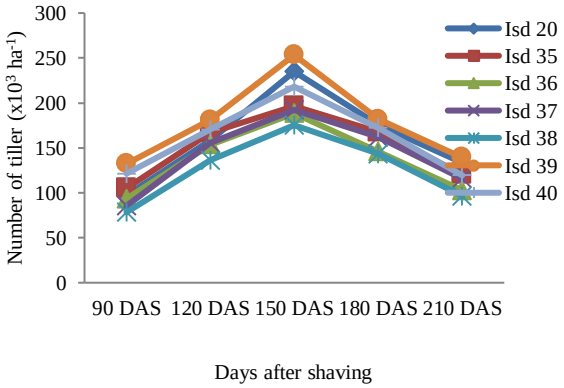


**Figure 2.** Number of tiller at different days after shaving (DAS) of the ratoon cane

**Stalk height:** The study demonstrated that stalk height was higher in plant cane than ratoon cane. The highest stalk heights of 3.41m and 3.28 m were found from the variety Isd 37 which were statically similar with Isd 39 in plant and ratoon cane. The lowest stalk heights of 3.07m and 2.85m were found from the variety Isd 20 in plant and ratoon cane, respectively (Fig. 3). The result was agreement with that of Arain et al. (2011) and Gomathi et al. (2013).

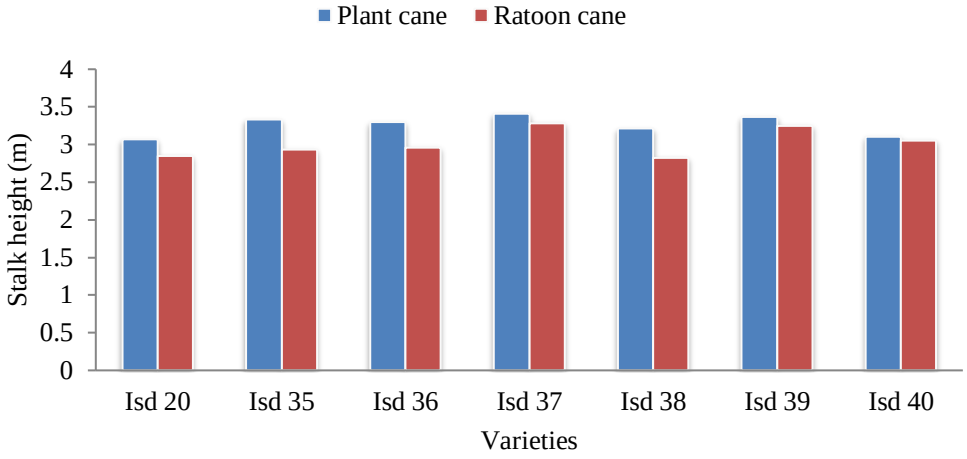


**Figure 3.** Stalk height (m) of different sugarcane varieties of the plant and ratoon cane

**Table 1.** Performance of plant and ratooncrop of sugarcane for number of millable cane, stalk diameter and number of internodes per stalk

| Treatments | Number of millable cane ($\times 10^3$ ha$^{-1}$) | | Stalk diameter (cm) | | Internodes per stalk | |
|---|---|---|---|---|---|---|
| | Plant cane | Ratoon cane | Plant cane | Ratoon cane | Plant cane | Ratoon cane |
| Isd 20 | 98.17 | 101.08 ab | 2.08 d | 1.95 c | 26.02 a-c | 26.70 ab |
| Isd 35 | 99.98 | 95.61 abc | 2.17 bcd | 2.05 bc | 25.10 bc | 25.67 ab |
| Isd 36 | 89.21 | 85.47 bc | 2.14 cd | 2.15 ab | 27.12 a | 26.41 ab |
| Isd 37 | 96.34 | 97.54 ab | 2.37 a | 2.25 a | 25.85 a-c | 25.30 ab |
| Isd 38 | 89.72 | 77.79 c | 2.13 cd | 2.02 bc | 26.11 a-c | 26.63 ab |
| Isd 39 | 108.17 | 110.40 a | 2.24 b | 2.17 ab | 24.95 c | 25.16 b |
| Isd 40 | 92.68 | 92.94 bc | 2.18 bc | 2.15 ab | 27.02 ab | 28.04 a |
| Lsd (0.05) | NS | 17.95 | 0.10 | 0.17 | 1.20 | 2.80 |

In a column, figures with similar letters do not differ significantly at 5% level

**Single stalk weight, cane yield and brix:** Single stalk weight was differed significantly among the varieties of both the plant and ratoon cane. The highest single stalk weight of 1.02 kg and 0.91 kg were obtained from the variety Isd 37 in both the plant and ratoon cane but the lowest single stalk weight 0.80 kg and 0.67 kg was obtained from the variety Isd 20 in both the plant and ratoon cane, respectively (Table 2).

In plant cane, the highest cane yield of 103.85 tha$^{-1}$ was found from the variety Isd 39 which was statistically similar with the variety of Isd 37 (98.78 tha$^{-1}$) but statistically differed from all other variety. In case of ratoon cane, the highest cane yield of 89.07 tha$^{-1}$ was found in Isd 37 which was at par with Isd 39 (86.17 tha$^{-1}$) and Isd 40 (81.29 tha$^{-1}$) while the lowest one was recorded in Isd 38 (60.28 tha$^{-1}$). The lowest cane yield of 73.54 tha$^{-1}$ and 60.28 tha$^{-1}$ were found from the variety Isd 38 in plant and ratoon cane, respectively which was statically identical with the variety Isd 39, Isd 35 and Isd 20. It is clear from the present study that the lower yield was recorded in ratoon cane than that of plant cane from all the varieties (Table 2). The findings of the present study were in close agreement with the observations of Karim et al. (2015) and Shukla et al. (2013) who found lower yield in ratoon cane compared to plant cane. Brix (%) was higher in ratoon cane than plant cane. In plant cane the highest brix reading of 20.48% was obtained from the variety Isd 37 which was statistically similar with all the varieties except Isd 36 and in ratoon cane the highest brix reading of 22.03% was obtained from the variety Isd 38 which was statistically similar with Isd 39, Isd 20 and Isd 37 (Table 2). Similar findings were observed by Karim et al. (2015) where they mentioned that brix (%) higher in ratoon cane than plant cane. Arian et al. (2011) who found that juice quality traits and sugar yield were increased with older crops than at early selection stage of sugarcane.

**Table 2.** Performance of plant and ratooncrop of sugarcane for stalk weight, cane yield and brix (%)

| Treatments | Single cane weight (kg) | | Cane yield ($tha^{-1}$) | | Brix (%) | |
|---|---|---|---|---|---|---|
| | Plant cane | Ratoon cane | Plant cane | Ratoon cane | Plant cane | Ratoon cane |
| Isd 20 | 0.80 d | 0.67 c | 79.29 cd | 69.59 cd | 21.48 a | 21.20 a |
| Isd 35 | 0.82 cd | 0.77 bc | 81.98 cd | 73.17 bcd | 20.36 ab | 19.50 bc |
| Isd 36 | 0.84 cd | 0.79 b | 74.96 d | 67.40 cd | 19.04 b | 19.06 c |
| Isd 37 | 1.02 a | 0.91 a | 98.78 ab | 89.07 a | 21.55 a | 21.06 ab |
| Isd 38 | 0.82 cd | 0.76 bc | 73.54 d | 60.28 d | 21.20 a | 22.03 a |
| Isd 39 | 0.96 ab | 0.79 b | 103.85 a | 86.17 ab | 21.34 a | 21.40 a |
| Isd 40 | 0.91 bc | 0.83 ab | 88.15 bc | 78.29 abc | 20.66 ab | 19.46 c |
| Lsd (0.05) | 0.10 | 0.11 | 12.95 | 14.14 | 2.02 | 1.58 |

In a column, figures with similar letters do not differ significantly at 5% level.

**Economic analysis:** The benefit cost ratio for growing of the cane varieties were calculated and presented in Table 3. In plant cane, out of the seven varieties Isd 39 gave the highest profit of 159625 $Tk.ha^{-1}$ with the highest BCR of 2.60 that was followed by with the variety Isd 37. In case of ratoon cane the highest profit of 141675 $Tk.ha^{-1}$ with the highest BCR of 2.75 was achieved from the variety Isd 37 which was followed by Isd 39. This analysis shows that in the conditions higher profit was found from ratoon cane than plant cane as reported by Khan et al**.** (2007).

**Table 3.** Economic return of plant and ratoon crop of seven sugarcane varieties

| Treatments | Total cost of production ($Tk.ha^{-1}$) | | Gross return ($Tk.ha^{-1}$) | | Net return ($Tk.ha^{-1}$) | | Benefit cost ratio (BCR) | |
|---|---|---|---|---|---|---|---|---|
| | Plant cane | Ratoon cane | Plant cane | Ratoon cane | Plant cane | Ratoon cane | Plant cane | Ratoon cane |
| Isd 20 | 1,00,000 | 81,000 | 198225 | 173975 | 98225 | 92975 | 1.98 | 2.15 |
| Isd 35 | 1,00,000 | 81,000 | 204950 | 182925 | 104950 | 101925 | 2.05 | 2.26 |
| Isd 36 | 1,00,000 | 81,000 | 187400 | 168500 | 87400 | 87500 | 1.87 | 2.08 |
| Isd 37 | 1,00,000 | 81,000 | 246950 | 222675 | 146950 | 141675 | 2.47 | 2.75 |
| Isd 38 | 1,00,000 | 81,000 | 183850 | 150700 | 83850 | 69700 | 1.84 | 1.86 |
| Isd 39 | 1,00,000 | 81,000 | 259625 | 215300 | 159625 | 134300 | 2.60 | 2.65 |
| Isd 40 | 1,00,000 | 81,000 | 220375 | 195725 | 120375 | 114725 | 2.20 | 2.42 |

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

## CONCLUSION

The results of this experiment indicated that among the tested sugarcane varieties Isd 39 and Isd 37 perform better regarding yield, brix (%) and economic return in both plant and ratoon cane. Thus it can be suggested that these cultivated varieties are suitable for the Old Himalayan Piedmont Plain Soils (AEZ I) of Bangladesh.

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