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RATOONING POTENTIAL OF DIFFERENT PROMISING SUGARCANE GENOTYPES AT VARYING HARVESTING DATES

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ABSTRACT

In a field trial during 2010-2012, ratooning ability of four promising sugarcane genotypes *viz.* S2003-US-778, S2003-US-127, S2006-US-641, S2006-US-832 and check clone (HSF-240) was evaluated at the Sugarcane Research Institute, AARI, Faisalabad, Pakistan. Plant crop was harvested on 1st November, 1st December, 1st January, 1st February and 1st March in 2010-2011 and subsequent ratoon crop was harvested in January, 2012. It was observed that number of millable canes, cane yield and commercial cane sugar (CCS) varied significantly among all the harvesting dates and highest cane yield (56.25 t ha^{-1}) was recorded in case of February ratooned crop along with overall sugar yield of 7.35 t ha^{-1}. Whereas, similar cane yield was observed in case of genotypes S2003-US-778, S2003-US-127 and check (HSF-240) cultivar which was significantly higher than others. February ratooned crop produced highest cane and sugar yield among all harvesting dates for all the genotypes.

Keywords: sugarcane, genotypes, ratooning ability, harvesting dates.

INTRODUCTION

Sugarcane is the second major cash crop of Pakistan and share in value added in agriculture and GDP is 3.7 and 0.8 percent, respectively (GOP, 2012). It provides main stay to sugar industry and also raw material to many allied industries for chip board manufacturing, ethanol and a source of employment directly or indirectly to more than four million peoples of Pakistan (Naqvi, 2005). Globally Pakistan ranked 5th largest in sugarcane acreage and is 9th biggest producer of sugar (ISO, 2010). During 2011-12, it was cultivated on an area of 1, 046 (000 ha) with total production of 58.0 (000 tons) with average stripped cane yield of 55.49 t ha^{-1} which is lower than the world production of 65.20 t ha^{-1} (FAO Stat., 2005).

In the Punjab province, more than 50 percent of total sugarcane cropped area is kept as ratoon crop (Malik, 1997) and its contribution to the total cane production is about 25-30% (Rehman and Ullah, 2008). However, more than 35% of its productivity is lost due to improper attention of the farmers towards ratoons (Malik, 1997). Naturally the productivity of ratoon is 10-30% less than the plant crop of sugarcane. Low yield of ratoon crop is mainly due to low and differential ratooning potential of cultivars and suboptimal crop management. Ratoon keeping in sugarcane is economical for the farming community of which production cost is lower than plant crop by 25-30% along with saving of seed material. A ratoon crop matures prior to plant crop thus ensuring early supply of cane to mills. Under similar conditions sugarcane ratoon have a supplementary advantage of better juice quality and sugar recovery than plant crop of same variety (Yadav, 1991). Late maturing cultivars having good yield are suitable for growing ratoon but early maturing cultivars are poor ratooners. Spring harvested crop gives better ratoon than autumn harvested due to moderate temperature, which is most conducive for stubble sprouting.

The major cane growing countries normally take two or more ratoons (Shrivastava *et al*., 1992; Yadav, 1991). Some researchers (Singh and Dey, 2002) noticed varying response of different sugarcane genotypes for sprouting, millable canes and commercial cane sugar to ratooning. It has been reported earlier that proper development of ratoon crop depends upon sprouting of underground buds that stay behind after harvesting of plant crop (Hunsigi and Krishna, 1998). Bhatnagar *et al.* (2003) reported that sugarcane clones differ in their ability to survive and produce a profitable ratoon crop. Since the ratooning behaviour of sugarcane cultivar is the function of genotype and environment interaction. It is, therefore, necessary to identify availability of proper genotype with good ratooning ability for specific conditions (Singh and Singh, 1974). Genetic variation among sugarcane genotypes for ratooning potential has previously been reported by researchers (Bhatnagar *et al*., 2003). A declining trend in the yield of ratoons and difference in yield potential of the genotypes was reported by Shih and Gascho, 1980. Bumper yields from first and second ratoon crops of sugarcane under Faisalabad conditions have been reported by Saeed (1993) with proper crop management.

As ratoon crop occupies more cultivated area than plant crop of sugarcane in Pakistan, therefore, the prime objective of this study was to evaluate the ratooning ability and productivity of promising sugarcane genotypes at varying harvesting dates under the agro-climatic conditions of Faisalabad.

MATERIAL AND METHODS

The present study was carried out during 2010-2012 at the Sugarcane Research Institute, AARI, Faisalabad, situated at the Latitude of 31° 25’ N and Longitude of 73° 09’ E, the soil was loamy having pH of 7.8, EC (0.36 dsm^{-1}) and with organic matter of 0.90 (%). Replicated three times, the experiment was laid out in randomized complete block design (RCBD) with split plot

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arrangements. Four promising sugarcane genotypes S2003-US-778, S2003-US-127, S2006-US-641, S2006-US-832 along with check cultivar (HSF-240) were kept in main plot while five harvesting dates 1st Nov, 1st Dec, 1st Jan, 1st Feb and 1st March were placed in sub-plot. The experiment was planted in February 2010 and plant crop was harvested on different dates and kept as ratoon for first year. Planting was done in 120 cm apart trenches measuring a net plot size of 4m x 4.8m at a seed rate of 75000 double buded setts per hectare. The fertilizer was applied @ 168-112-112 kg NPK per hectare to fresh crop and ratoon crop was given 30% more NPK. All agronomic and plant protection measures were kept uniform.

The standard procedure was followed while recording the observations of number of sprouts per hectare, number of millable canes per hectare; canes yield tons per hectare and commercial cane sugar (CCS t ha^{-1}). Ten randomly selected canes were taken to the laboratory for qualitative analysis and were crushed in a power cane crusher for juice extraction. Brix readings were recorded by brix hydrometer standardized at 20°C. Sucrose percentage was determined by Horn's dry lead sub-acetate method of sucrose analysis (Anonymous, 1970). The commercial cane sugar (CCS %) was recorded in computerized laboratory using the following formula:

$$CCS\% = 3P/2 \{1-(F+5)/100\}-B/2 \{1-(F+3)/100\}$$

Where

P stands for pol percentage (sucrose percentage), F for fibre percentage and B for Brix percentage (Anonymous, 1970). The data recorded were analyzed statistically using Fisher's analysis of variance techniques and least significant difference test (LSD) was used to compare the treatment means (Steel *et al.*, 1997).

RESULTS AND DISCUSSIONS

Number of sprouts per hectare

The data presented in Table-1 revealed that significant differences were observed among the genotypes and harvesting dates for number of sprouts which ranged 60.58 to 86.15 (000 ha^{-1}) for genotypes. On an average, the check clone (HSF-240) produced significantly highest number of sprouts of 86.15 (000 ha^{-1}) as against the lowest in case of S2006-US-641 with value of 60.58 (000 ha^{-1}). The difference in number of sprouts was due to different genetic backgrounds of the genotypes used in the study. Bashir *et al.* (2012) reported the significant difference among different sugarcane genotypes towards the ratooning ability.

As regards harvesting dates, although the highest number of sprouts was recorded in the plant crop harvested on 1st February yet the difference could not reach to the significant level. The more number of sprouts in February might be due upcoming spring season which is most conducive for stubble sprouting.

Table-1. Number of sprouts as influenced by harvesting date of plant crop in the subsequent ratoon crop.

Genotypes	Harvesting dates of plant crop (000 ha^{-1})					Average
	1st Nov	1st Dec	1st Jan	1st Feb	1st Mar	
S2003-US-778	79.61	72.33	73.24	98.38	88.81	76.47 AB
S2003-US-127	75.46	69.37	78.85	96.00	90.38	76.01 AB
S2006-US-641	60.80	56.75	60.14	70.83	54.39	60.58 B
S2006-US-832	56.70	55.93	55.80	72.06	62.45	60.59 B
HSF-240	96.97	91.15	78.41	104.99	101.21	86.15 A
Average	73.91	68.71	68.09	80.45	74.65	

LSD at 0.05 (Genotypes) = 18.70 LSD at 0.05 (Harvesting dates) = 12.65

Number of millable canes per hectare

Table-2 indicated that both genotypes and harvesting dates had significant influence on the number of millable canes. The clone HSF-240 produced highest number of millable canes with an average of 86.45 (000 ha^{-1}) for all harvesting dates but it was immediately followed by S2003-US-127 and S2003-US-778. While lowest number of millable canes were observed for S2006-US-641 of 54.87 (000 ha^{-1}). The varying response of sugarcane genotypes was attributed to genetic varying potential under the prevailing environmental conditions. (Anjum, 1991 and Bhatnagar *et al.*, 2003).

Among harvesting dates, the plant crop harvested in February exhibited the highest potential with 80.46 (000 ha^{-1}) number of millable canes in subsequent ratoon crop and found lowest in December harvesting with mean value of 62.71 (000 ha^{-1}). The highest values of number of millable canes observed in February harvested ratoon crop was attributed to frost period that had been over before the start of the month in most of the semi arid sugarcane growing areas which inhibit or stopped the growth of crop plant. But same was not the case for ratoons from November to January harvested crop that resulted in reduced numbers of millable canes. Similar results were

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reported by Bashir *et al.* (2012) who found highest number of millable canes in February ratooned crop.

Table-2. Number of millable canes as influenced by harvesting date of plant crop in the subsequent ratoon crop.

Genotypes	**Harvesting dates of plant crop** (000 ha^{-1})					Average
	1st Nov	**1st Dec**	**1st Jan**	**1st Feb**	**1st Mar**	
S2003-US-778	72.65	65.73	66.27	89.00	81.14	74.96 A
S2003-US-127	68.72	63.31	72.37	90.63	82.39	75.48 A
S2006-US-641	54.59	51.42	54.48	64.19	49.67	54.87 B
S2006-US-832	52.60	51.03	51.96	65.34	56.96	55.58 B
HSF-240	89.62	82.04	70.91	93.14	92.52	86.45 A
Average	67.64 BC	62.71 C	63.20 C	80.46 A	72.54 B	

LSD at 0.05 (Genotypes) = 11.52 LSD at 0.05 (Harvesting dates) = 5.524

Cane yield tons per hectare

Table-3 showed that the clone HSF-240 was found to be superior with maximum cane yield of 59.80 t ha^{-1} but it could not differ significantly from S2003-US-127 and S2003-US-778 as against the lowest in case of S2006-US-641 37.59 t ha^{-1}. The varied tonnage of canes for different genotypes could be due to their different genetic make up and potential for the exploitation of edaphic and aerial factors of crop production as has been reported by some previous researchers (Ahmad, 1990; Anjum, 1991; Yadav, 1991; Saeed, M. 1993). Ongin *et al.* (2011) also observed that test clones differed significantly among each other in agronomic parameters.

Alternatively, the ratoon of February harvested plant crop yielded the highest cane production (56.25 t ha^{-1}) while the lowest was observed in December ratooned crop (43.23 t ha^{-1}) but later was statistically at par with January and November. The data for cane yield followed the similar trend that of number of millable canes in Table-2. These results are in line with the findings of Bashir *et al.*, who found similar trend in cane yield of sugarcane ratooned at varying harvesting dates.

Table-3. Cane yield as influenced by harvesting date of plant crop in the subsequent ratoon crop.

Genotypes	**Harvesting dates of plant crop** (t ha^{-1})					Average
	1st Nov	**1st Dec**	**1st Jan**	**1st Feb**	**1st Mar**	
S2003-US-778	50.08	45.85	46.83	62.13	56.10	52.00 A
S2003-US-127	47.69	43.74	49.94	62.77	57.25	52.28 A
S2006-US-641	37.22	35.11	37.47	43.99	34.16	37.59 B
S2006-US-832	36.03	34.91	35.55	44.85	38.96	38.06 B
HSF-240	62.49	56.52	48.19	67.52	64.28	59.80 A
Average	46.70 BC	43.23 C	43.39 C	56.25 A	50.15 B	

LSD at 0.05 (Genotypes) = 8.16 LSD at 0.05 (Harvesting dates) = 3.791

Commercial cane sugar tons per hectare

It is clear from Table-4 that both genotypes and harvesting dates were found significant for CCS (t ha^{-1}). HSF-240 gave the highest sugar yield of 7.93 t ha^{-1} which was followed by S2003-US-127 (7.08 t ha^{-1}) as against the lowest in case of S2006-US-641 (4.86 t ha^{-1}). Similarly, February ratooned crop yielded highest CCS (7.35 t ha^{-1}) whereas lowest was observed in December harvested ratoon crop (5.66 t ha^{-1}). An increase in CCS t ha^{-1} was attributed to highest cane production and CCS % in the relevant genotypes. Similar variation in genotypes and harvesting dates for CCS t ha^{-1} was reported by Bashir *et al.* (2012).

Table-4. Commercial cane sugar (CCS) as influenced by harvesting date of plant crop in the subsequent ratoon crop.

Genotypes	Harvesting dates of plant crop (t ha^{-1})					Average
	1st Nov	1st Dec	1st Jan	1st Feb	1st Mar	
S2003-US-778	6.25	5.71	6.02	7.98	6.92	6.55 B
S2003-US-127	6.37	5.83	6.95	8.55	7.69	7.08 AB
S2006-US-641	4.74	4.50	4.94	5.79	4.35	4.86 C
S2006-US-832	4.77	4.73	4.92	5.90	5.26	5.12 C
HSF-240	8.31	7.52	6.50	8.56	8.77	7.93A
Average	6.09 BC	5.66 C	5.84 C	7.35 A	6.60 B	

LSD at 0.05 (Genotypes) = 1.123 LSD at 0.05 (Harvesting dates) = 0.5413

CONCLUSIONS

The study led to the conclusion that plant crop of all the sugarcane genotypes grown in Punjab (Pakistan) should preferably be harvested in February for subsequent better ratooning and more cane and sugar yield. Therefore, it brings more economic return not only for the farmers but also for the sugar industry.

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