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Study on ratoon keeping of sugarcane crop at various harvesting dates

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Abstract
This research experiment was conducted at Sugarcane Research Institute, Faisalabad, Pakistan during crop season 2015-16. The objective of the experiment is to evaluate the ratooning ability of different sugarcane clones at various harvesting dates of cane plant crop. The trial was laid out in Randomized Complete Block Design (split plot arrangement) and replicated thrice. Five sugarcane clones i.e. S2003-US-633, S2006-US-469, S2006-US-658, S2006-US-832 and one check variety HSF-240 were sown in February, 2012 in main plots. The harvesting dates of plant crop *viz.*15th November, 15th December, 15th January, 15th February and 15th March were placed in sub-plots. The highest cane yield was recorded for S2006 US-832 (87.1t ha^{-1}) as against the lowest in S2006 US-469 (68.5t ha^{-1}). Among harvesting dates, the cane yield was maximum (91.9 t ha^{-1}) for 15th February harvested plant crop and was lowest for ratoon kept on 15th December (60.1t ha^{-1}). In interaction of these two factors, clone S2006-US-832 gave more cane yield (100.7 t ha^{-1}) when plant crop was harvested on 15th February.

Keywords: clone, harvesting dates, rationing ability, sugarcane

Introduction
Agriculture is the back bone for the Pakistan's economy, accounts for 19.5 percent of the gross domestic product (GDP), 42.3 percent of the labor employment. Its growth rate is 3.46 percent during the financial year 2016-17 (GOP, 2017) [7]. About 70% population is directly or indirectly related with agriculture. Sugarcane is a cash and main sugar-producing crop in Pakistan (Junejo *et al.,* 2010), and occupies an pivotal position in the economy of Pakistan and to drive the large sugar Mills sector of country. The share of cane in value addition of agriculture and GDP is 3.4 and 0.7 percent respectively. Sugarcane production was 73.6 million tones during 2016-17 with an upsurge of 12.4 percent against 4.23 percent last year (GOP, 2017) [7]. Pakistan titles 5th with respect to area, while it statuses 8th in respect of sugar making (FAO, 2012). About 99% of the country sugar is haul out from sugarcane to meet the demand at home level (Azam and Mukarram, 2010). Sugarcane is a sultry grass inherent to Asia where it has been developed in garden for over four thousand years. Cane tops are castoff as feed for farm animals when there is dearth of fodder (Fashihi and Malik, 1985) [5]. It is frequently valued for the juices take out from its stem from which sucrose or crystalline sugar is formed and thus it aids as basic raw material for sugar production. About half of world sugar is acquired from sugarcane crop (Braun, 1994).
Ratooning is a way of growing full cane crop from new growth of underground stubbles left in the field after reap of the plant crop. Ratoon crop is cost-effective for the farming communities of Pakistan because making cost is 30% less than plant crop with saving of seed material as an extra benifit. Though, it is necessary to use 25% more nitrogenous fertilizer above the endorsed dose of nitrogen for ratoon crop (Lal and Singh, 2008) [9].
Shukla *et al*. (2013) conveyed that ratooning in sugarcane protects the price of seedbed preparation, seed material and planting procedures. Nevertheless, ratoon crop yield is lower than the plant crop. More than 50% of total sugarcane area is retained as ratoon crop in the Punjab province (Malik, 1997) [10]. Its impact to the total cane production is about 25% (Rehman and Ehsanullah, 2008) [12]. Yet, more than 35% of its productivity is vanished due to improper attention of the farmers towards ratoons (Malik, 1997) [10]. Low yield of ratoon crop is mainly due to small and distinction ratooning prospective of cultivated varieties (Bhatnagar *et al.,* 2003; Rafiq *et al.,* 2006) [11, 4] and poor crop management practices.
A ratoon crop seasons prior to plant crop and so ensuring early stock of cane to mills. Similar ratoon crop has an auxiliary gain of better juice quality & sugar recovery than plant crop of similar variety (Yadav, 1991) [15]. Late ripening cultivars are apt for growing ratoon and early maturing cultivars are meagre ratooners. Plant crop gives better ratoon if harvested in spring than autumn harvesting due to judicious temperature, which is most helpful for stubble sprouting (Bashir *et al*., 2013) [3].
In world, sugarcane growing countries are taking two to three ratoons of sugarcane (Shrivastava *et al.,* 1992) [13]. Good improvement of ratoon crop be determined by high sprouting of underground buds after harvesting of plant crop (Hunsigi and Krishna, 1998) [8].
The ratooning behavior of sugarcane varieties depends upon genotype and environmental factors. The availability of suitable genotype with noble ratooning ability is necessary for specific environments. Similarly the genetic potential for ratooning is diverse among genotypes (Bhatnagar *et al*., 2003) [4].
The ratoon crop occupies more cropped area than plant crop in

Pakistan, therefore, the main objective of this research was to pinpoint the suitable ratooning ability and productivity of promising sugarcane genotypes at various harvesting dates under the agro-climatic circumstances of Faisalabad.

Materials and methods

The study was piloted at the Farm area of Sugarcane Research Institute, Faisalabad during crop season 2015-16. It is sited at the Latitude of 31° 25' N and Longitude of 73° 09' E. The soil is loamy with pH of 7.8, EC (0.36 dsm^{-1}) and organic matter of 0.90 (%). The experiment was arranged in RCBD (split plot arrangement) with three replications & plot size of 4 x 4.8 m. Five sugarcane clones i.e. S2003-US-633, S2006-US-469, S2006-US-658, S2006-US-832 and HSF-240 (control) were planted in February, 2015 in main plots. The harvesting dates of plant crop *viz.*15th November, 15th December, 15th January, 15th February and 15th March were positioned in sub-plots. Crop was sown in 120 cm apart trenches at a seed rate of 75000 double budded setts per hectare. The fertilizer was applied @ 168-112-112 kg NPK per hectare to fresh crop and 30% more NPK was given to ratoon crop. All agronomic and plant protection procedures were kept uniform. The standard procedure was followed in recording the observations like 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 haphazardly selected canes were taken to the laboratory for qualitative analysis and were crushed in a power cane crusher for juice extraction. Brix readings were documented by brix hydrometer standardized at 20°C. Sucrose percentage was determisned by Horn's dry lead sub-acetate method of sucrose analysis (Anonymous, 1970) [1]. The commercial cane sugar (CCS %) was recorded in the laboratory using the below formula:

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

Where

Pstands for pol percentage (sucrose percentage), F for fibre percentage and B for Brix percentage (Anonymous, 1970). The data was analyzed statistically. The treatment means was compared by Fisher's analysis of variance techniques and least significant difference test (Steel *et al.*, 1997) [14].

Results and discussion

Number of sprouts (000 ha^{-1})

The data existing in Table-1 shown that significant differences were witnessed among the genotypes and number of sprouts ranged from 80 to 101 (000 ha^{-1}) for harvesting dates and 82 to 89 (000 ha^{-1}). Sugarcane clone (S2006-US-832) created significantly highest number of sprouts of 104 (000 ha^{-1}) at 15-February harvesting date as in contradiction of the lowest in case of S2003-US-633 with value of 56 (000 ha^{-1}) with 15-December harvesting date. The difference in number of sprouts was due to diverse genetic backgrounds of the genotypes. Bashir *et al.* (2013) [3] described the significant variance among different sugarcane genotypes to the ratooning ability. As concerns harvesting dates, the highest number of sprouts was note down in the plant crop harvested on 15 February. The more number of sprouts in February might be due coming spring season which is most beneficial for stubble sprouting.

Table 1: Effect of harvesting dates on number of sprouts (000 ha^{-1}) of different sugarcane varieties / clones in ratoon crop

Varities / Clones	Harvesting Dates of Plant Crop					Average
	15-Nov	15-Dec	15-Jan	15-Feb	15-Mar	
S2003 US-633	79 g	56 k	77 g	101 ab	100 bc	83 C
S2006 US-469	76 g	60 j	76 g	100 bc	99 cd	82 C
S2006 US-658	82 f	66 i	82 f	100 bc	96 d	85 BC
S2006 US-832	85 e	70 h	84 ef	104 a	102 ab	89 A
HSF-240	82 ef	68 i	82 ef	101 bc	96 cd	86 AB
Average	81 C	64 D	80 C	101 A	99 B	

LSD at 0.05 (Varites = 3.014, Harvesting dates = 1.273, Varities X Harvesting dates = 2.847

Millable canes (000 ha^{-1})

The data in table-2 point out that both genotypes and harvesting dates had noteworthy influence on the number of millable canes. The clone S2006-US-832 made highest number of millable canes with 102 (000 ha^{-1}) in 15 February harvesting date. The lowest numbers of millable canes were noted in S2006-US-469 with 46.67 (000 ha^{-1}) canes at 15 December harvesting date. The fluctuating response of sugarcane genotypes was ascribed to genetic potential under the prevalent environmental conditions (Bhatnagar *et al.*, 2003) [4]. Amongst harvesting dates, the plant crop harvested on 15 February showed the utmost potential with 97 (000 ha^{-1}) number of millable canes in following ratoon crop and found bottom in 15 December harvesting with mean value of 55 (000 ha^{-1}) canes. The maximum number of millable canes perceived in February harvested ratoon crop and it was credited to frost period that had been ended before the start of the month which impede the growth of crop plant. But due to presence of frost from November to January harvested crop resulted in less number of millable canes. These results are in line with Bashir *et al.* (2012) [2] who found highest number of millable canes in February harvested ratooned crop.

Table 2: Effect of harvesting dates on no. of canes of different sugarcane varieties / clones in ratoon crop

Varities / Clones	Harvesting Dates of Plant Crop					Average
	15-Nov	15-Dec	15-Jan	15-Feb	15-Mar	
S2003 US-633	71 fg	50.33 l	71.33 fg	95 cd	92.67 d	76 BC
S2006 US-469	66.67 hi	46.67 l	65.67 hi	95 cd	93 d	73 C
S2006 US-658	71 fg	54.67 k	69.67 gh	94.67 cd	92 d	77 BC
S2006 US-832	77 e	65.33 i	76 e	102 a	99.67 ab	84 A
HSF-240	74.67 ef	61 j	71 fg	97.33 bc	93 d	79 B
Average	72 C	55 D	71 C	97 D	94 B	

LSD at 0.05 (Varites = 4.135, Varities X Harvesting dates = 4.141 Harvesting dates = 1.852)

Cane yield (t ha^{-1})

The data in table-3 revealed that clone S2006-US-832 produced more ratoon cane yield (100.7 t ha^{-1}) while harvesting on 15th February. As about sugarcane clones, highest cane yield was documented for S2006-US-832 (87.1t ha^{-1}) as against the lowest in S2006-US-469 (68.5t ha^{-1}). Amongst harvesting dates, the cane yield was maximum (91.9 t ha^{-1}) for 15th February harvested plant crop and was lowest for ratoon retained on 15th December (60.1t ha^{-1}). The diverse tonnage of canes for different genotypes could be due to their dissimilar genetic make-up and potential for the taking advantage of edaphic and aerial factors of crop production. These results are in line with the outcomes of Bashir *et al.* (2012) [2].

Table 3: Effect of harvesting dates on cane yield (t ha^{-1}) of different sugarcane varieties / clones in ratoon crop

Varities / Clones	Harvesting Dates of Plant Crop					Average
	15-Nov	15-Dec	15-Jan	15-Feb	15-Mar	
S2003 US-633	69.5 i	54.9 l	68 ij	87.2 e	84 f	72.7 C
S2006 US-469	62.8 k	51.4 m	63.9 k	83.8 f	80 g	68.5 D
S2006 US-658	78.8 gh	65.3 jk	76.7 h	91.3 c	88.2 de	80.1 B
S2006 US-832	85.7 ef	64.2 k	85.8 ef	100.7 a	99 ab	87.1 A
HSF-240	79.2 gh	64.6 k	77.7 gh	96.8 b	90.6 cd	81.1 B
Average	75.2 C	60.1 D	74.4 C	91.9 A	88.5 B	

LSD at 0.05 (Varites = 3.398, Harvesting dates = 1.312) Varities X Harvesting dates = 2.933

Commercial cane sugar (t ha^{-1})

It is clear from data in table-4 that both genotypes and harvesting dates were found significant for CCS (t ha^{-1}). HSF-240 contributed the highest sugar yield of 14.7 (t ha^{-1}) at 15 February harvesting date which was followed by HSF-240 with 15 March harvesting date 14 (t ha^{-1}) as contrary to the lowest in case of S2006-US-469 (7.6 t ha^{-1}) with 15 December harvesting date of plant crop. Similarly, February ratooned crop generated highest CCS (13.6 t ha^{-1}) sugar however lowest was observed in December harvested ratoon crop (8.8 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 was stated by Bashir *et al.* (2013) [3].

Table 4: Effect of harvesting dates on CCS (t ha^{-1}) of different sugarcane varieties / clones in ratoon crop

Varities / Clones	Harvesting Dates of Plant Crop					Average
	15-Nov	15-Dec	15-Jan	15-Feb	15-Mar	
S2003 US-633	10.5 gh	8.4 jk	10.5 g	13.5 bc	12.7 cd	11.1 B
S2006 US-469	8.9 ij	7.6 k	9.5 i	12.4 de	11.9 ef	10 C
S2006 US-658	11.5 f	9.7hi	11.4 f	13.7 b	12.7 cd	11.8 A
S2006 US-832	11.5 f	8.4 jk	11.6 ef	13.9 b	13.7 b	11.8 A
HSF-240	11.6 ef	9.6 i	11.5 f	14.7 a	14 ab	12.3 A
Average	10.8 C	8.8 D	10.9 C	13.6 A	13 B	

LSD at 0.05 (Varites = 0.5692, Harvesting dates = 0.369) Varities X Harvesting dates = 0.825

Conclusion

The study determined that plant crop of sugarcane should first be harvested in February for succeeding better ratoon crop with more cane and sugar yield. It will fetch more economic return not only for the farmers but also for the sugar industry.

References

1. Anonymous. Laboratory Manual for Queens Land Sugar Mills. (5th Ed.) Watson, Ferguson and Co, 1970, 94-150.
2. Bashir S, N Fiaz, A Ghaffar, F Khalid. Ratooning ability of sugarcane genotypes at different harvesting dates. International Sugar Journal. 2012; 114(1360):273-276.
3. Bashir S, M Hassan, N Fiaz, Z Khan, Z Ali. Ratooning Potential of different promising sugarcane genotypes at varying harvesting dates. Journal of Agricultural and Biological Science. 2013; 8 (05):437-440.
4. Bhatnagar PK, Khan AQ, Singh A, Khan KA. Studies on genetic variability, heritability and genetic advance in plant and ratoon crops of sugarcane. Indian Sugar LIII. 2003; (3):183-185.
5. Fasihi S, Malik KB. Fifty Years of Research. Agri. Dept,

Govt. of the Punjab, Pakistan, 1985, 85.
6. FAO Stat. Statistical Database. Food and Agriculture Organization (FAO), 2005. www.faostat.fao.org.
7. Government of Pakistan. (GOP). Pakistan Economic Survey, Ministry of Food, Agriculture and Livestock, Federal Bureau of Statistics, Islamabad, 2016-17.
8. Hunsigi G, Krishna KR. Science of Field Crops. Oxford and IBH Publishing Co., (Pvt.), Ltd. New Delhi, India, 1998, 328-352.
9. Lal M, Singh AK. Multiple ratooning for high cane productivity and sugar recovery. In: Proceedings of National Seminar on varietal planning for improving productivity and sugar recovery in sugarcane held at G.B.P.U.A. & T. Pantnagar. 2008; 14(15):62-68.
10. Malik KB. Profitable cultivation of sugarcane. Directorate of Agri. Information, Agri. Dept. Punjab, Lahore, Pakistan, 1997, 49.
11. Rafiq M, AA Chatta, MR Mian. Ratooning potential of different sugarcane genotypes under Faisalabad conditions. J Agric. Res. 2006; 44(4):269-275.
12. Rehman A, Ehsanullah. Increasing yield of ratoon sugarcane. DAWN-Business, 2008, 07.
13. Shrivastava AR, Ghosh AK, Agnihotri VP. Sugarcane Ratoons. Oxford and Singh R.K. and Dey P.2002. Genetic variability in plant and ratoon of sugarcane genotypes grown under saline conditions. Indian Sugar. LI. 1992; (10):725-727.
14. Steel RGD, Torrie JH, Dickey DA. Principles and procedures of statistics. A biometrical approach. 3rd Ed. McGraw Hill Book Co., Inc. New York, USA, 1997, 400-428.
15. Yadav RL. Sugarcane Production Technology; Constraints and Potentialities. Oxford and IBH Publishing Co. (Pvt.) Ltd. Bombay, India, 1991, 204.