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Assessing Ratooning Potential of Various Sugarcane Cultivars under Climatic Conditions of South Punjab

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ABSTRACT

Sugarcane ratooning is very common is Pakistan and subjected for many years due to high input cost. However, the selection of suitable strains for ratoon crop is essential. Due to low yielding of ratoon crop, it is difficult for farmers to meet input costs. Ratoon crop is early to mature, reduced input cost and high field brix (%). A field study was planned under Agro-climatic conditions of South Punjab during 2022-23 to investigate the ratooning potential of nine sugarcane varieties *viz* S2016SL-284, S2012SL-426, CP00-1101, S2008AUS-133, S2009SA-111, VMC-87/599, PSR 07-45, CPF-237 and CPF-253. Significant variations among ratooning performance of sugarcane genotypes were observed. The findings of study indicated that, the strain S2016SL-284 achieved maximum cane yield of 125.39 tones per hectare and 2.32 sprouts per plant. Furthermore, the strain also demonstrated excellent quality of field brix 22.57% which is closely followed with 22.33 and 21.87 of S2008-AUS-133 and S2012Sl-426.The Sugarcane strain S2016SL-284 produced 11.10 tons per hectare more cane yield than check variety CPF-253.Therefore, on the basis of above given results of this experiment it is recommended that, genotype S2016SL-284 has excellent ratooning ability and should be cultivated in climatic conditions of Southern Punjab as ratoon crop.

Keywords: Sugarcane Ratooning, Ratooning ability of strains, Cane yield, Sugar recovery.

INTRODUCTION

The prices of major agriculture inputs i.e., seed, fertilizer and pesticides are increasing day by day due to inflation. Sugarcane is a major cash crop which can be induced to ratooning for many years (Xu et al., 2021). The benefits of ratooning include cost reduction, improvement of quality, energy use and productivity enhancement (Rauf et al., 2024; Xu et al., 2021). The ratoon crop has several advantages over newly sugarcane crop including fast growth, early maturity and cost efficacy. Compared with newly planted cane, ratoon established strong root system and improve source of energy and carbon for early growth of plant (Pissolato et al., 2021).Ratoon crop has more efficient accumulation of temperature and elongated growth period resulted in early maturity whereas, new crop first requires to grow permanent root system which needs relatively high accumulation of temperature (Xu et al., 2021). Previous studies recommended that the too low or high temperature reduce the yield of ratoon crop (Gascho, 1973).

The profitability ratooning is effect by environment, crop management, and genetic potential of variety. Ability to undergo several valuable ratoon crop of sugarcane is referred as ratooning ability (RA). Ratooning ability is a genetic trait and directly linked with cane yield (Chapman et al., 1992; Ramburan et al., 2013), and it is important character which measure during selection of a new cultivar (Gravois et al., 2019; Shanthi et al., 2011). Many studies reported that the significant variation in sugarcane ratooning ability among cultivars. (Chapman et al., 1992; Chumphu et al., 2019; Ramburan et al., 2013). Ratoon plays significant role in sugarcane production. Ratoon crop have high sucrose percentage than first year crop due to early maturity which leads to enhanced sucrose content at mills (Bashir et al., 2012; Yadav, 1991). After harvesting, the underground lower portion of stalk produce a next crop of sugarcane, which is called ratoon crop. Sugarcane ratooning is major planting system of many countries; however, the ratoon numbers varies (table 1). The share of ratooning is 50% of overall cultivated area, and may reach to 75% in some counties (Table 1). The average percentage is 40-45% in subtropical areas, whereas, approximately 50-55% in tropical areas (Gomathi et al., 2013).

Punjab province of Pakistan has more than 50% of sugarcane crop kept under ratooning and produce 25-30% less yield than fresh crop (Rehman and Ullah, 2008).The reason of low yield in sugarcane ratooning is selection of suitable cultivars and improper attention of growers towards crop management. In sugarcane crop, genetic potential of cultivar if essential for high production (Arain et al., 2011). Due to high cost of sugarcane seed, farmers accept high yielding varieties for ratooning. Thus, present study was conducted to investigate sugarcane strains with good ratooning potential and must be promoted for cultivation. Cultivars with good ratooning are beneficial for farmers as it uses low input cost e.g. seed.

Table 1. The comparison of ratoon in major sugarcane growing countries.

Country Name	Ratoon Percentage (%)	Ratoon Age (Year)	References
America	80–85	2–3	14
Brazil	80-85	2-3	14
South Africa	80-90	4-5	14,15
China	50-70	2-3	15
India	50	1-2	7-10
Pakistan	25-30	1-2	12

MATERIALS AND METHODS

Experimental area

The experiment was performed at semi-arid conditions of Sugarcane Research Station Khanpur, District Rahim Yar Khan. The crop was planted in last week of February 2022 and remain it for ratoon in 2023.

Planting material

Sugarcane clones used for assessing ratooning potential were S2016SL-284, S2012SL-426, CP00-1101, S2008AUS-133, S2009SA-111, VMC-87/599, PSR 07-45, CPF-237 and CPF-253. The experiment was laid out through RCBD having tree replications.

Layout

The crop was planted by using 4 feet apart double row trench having plot size 3.6 x 10 meter at seed rate of @ 75000 DBS ha^{-1}. After harvesting of first year crop shaver was applied to remove the disease part of left-over stubbles and also promote sprouting of ratoon crop.

Agronomic practices

The recommended dose of N:P:K fertilizers i.e., 218-146-146 for ratoon crop, were used an it is 30% more than the general first year crop. Full dose of potash, phosphorus and one third of nitrogen fertilizer was applied at start during sprouting time. The remaining 2/3 of nitrogen was applied with 45 days interval equally. Irrigation was given according to weather conditions and requirement of crop. Weeds were removed through inter-culture operations which also soften the upper layer of soil and help root entablement for development of more sprouts per plant. Pesticides applied at start, 45 and 90 days of first application respectively.

Parameters studied

Parameters including, sprouts per plant, tilers, crop yield and brix were noted during crop growth period.

Statistical analysis

All data were analyzed statistically through Analysis of Variance (ANOVA) and Least Significance Difference (LSD) to compare the means of all treatment at 5% of probability (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Number of sprouts per plant

Sprouts per plant plays vital role in ratooning as the final yield of sugarcane crop depends on number of productive tillers (Rauf et al., 2024). Spouting capacity also enhance millable cane stand in sugarcane. Many factors affect the sprouting of sugarcane buds including environmental conditions, ratooning potential, typeand vigor of first year crop plant. Data given in (Table-1) showing that the strains showed significantly differ from each other for plants sprouts. Maximum and minimum range among 2.32and1.28sprouts per plant. Sugarcane cultivar S2016SL-284 had highest sprouts of 2.32 per plant and were significantly maximum than CP00-1101 (2.13 per plant). Besides that, the minimum sprouts were noted in sugarcane strain S2009SA-111 (1.28) (Table 2, Figure 1). The variation among sprouts per plant due to different ratooning capacity of tested cultivars and it was genetically described in nature (Rauf et al., 2024). The following results are similar to Aslam et al. (2013). Bashir et al. (2012) was also reported that the significant variation between different genotypes towards the ratooning ability of sugarcane.

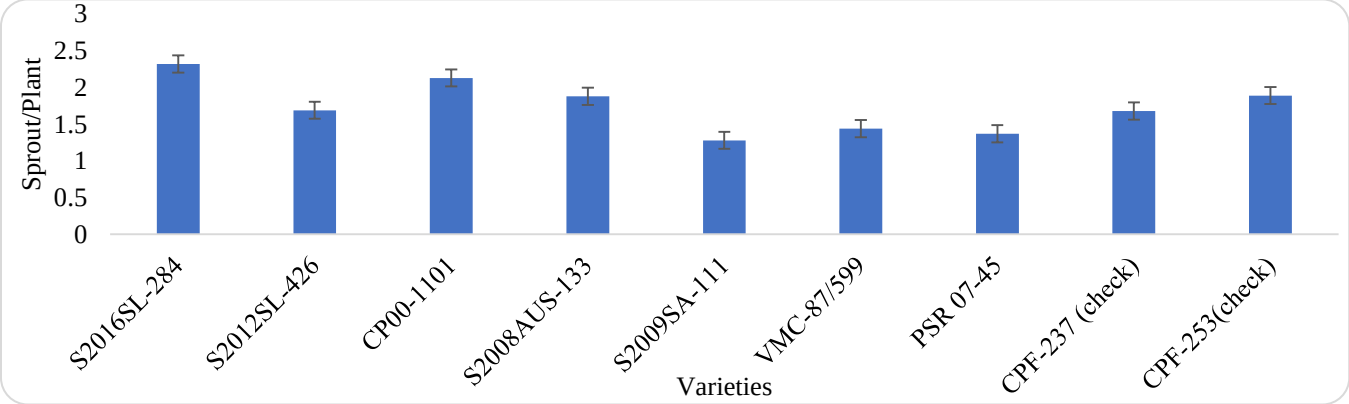

Figure 1. The number of sprouts per plant of various sugarcane strains under rationing.

Millable cane density

Yield of sugarcane mainly depends on tiller per plant or millable cane density which directly contribute in final cane yield of crop. Millable canes production depend on sprouting of underground cane buds which emerge out from soil and grows into millable canes. The vigorous density of millable cane enhance per unit production and yield of crop as well. The density of millable cane of cultivars ranged among 130.11 to 85.59 (000 ha^{-1}). The highest millable canes 130.11 thousand per hectare was found in sugarcane strain S2016SL-284, whereas, lowest millable canes density 85.59(000 ha^{-1}) was produced in VMC-87/599 (Table-2 Figure-2). So, the difference among millable canes of sugarcane strains studied under ratoon crop shown due to genetic potential. The cane production in ratoon depends upon sprouting of stubbles, millable cane density, height & weight of cane stalk. The results are similar to Rauf et al., 2024, Aslam et al. (2013) and Rafiq et al. (2006) who stated that the differ among sugarcane millable canes due to genetic potential of cultivars.

Field brix (%)

The findings of this study revealed that the field brix (%) in ratooning is more than newly plated first year sugarcane crop. Growers interested in high yielding sugarcane strains but, while sugar mills prefer varieties with good sugar recovery. Different behavior in sugarcane brix was observed in experiment for sugarcane cultivars. The maximum brix 22.57 had recorded in S2016SL-284 followed by S2008AUS-133 (22.33), S2012SL-426 (21.87), CPF-253(21.56) and CP00-1101 (21.39) under field conditions. Whereas, the minimum field brix 20.1 was found in PSR 07-45. The variation among first year and ratoon crop for different cultivars of this study are aligned with results of El-Hinnawy and Masri (2009). In another study, Chapman, Ferraris, and Ludlow (1988) found that the ratoon crop usually mature early than first year crop due to this the brix concentration has only marginal affect by crop age. Sugar recovery is the main genetic factor in sugarcane crop

which required to sugar mills for more profitability and growers to get more prices to some extent. Ratoon crop is early to mature, reduced input cost and high field brix (%).

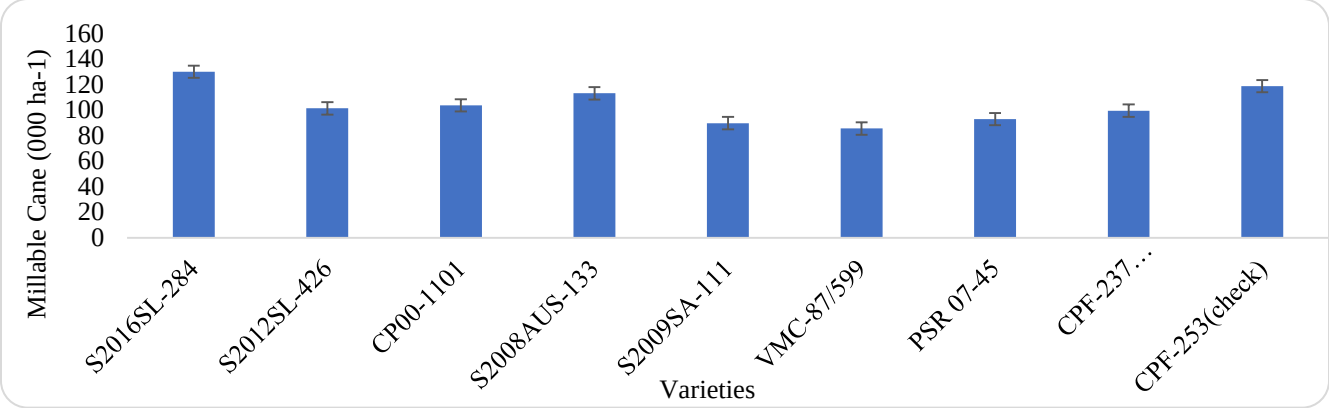

Figure 2. The millable cane density of different sugarcane strains under rationing.

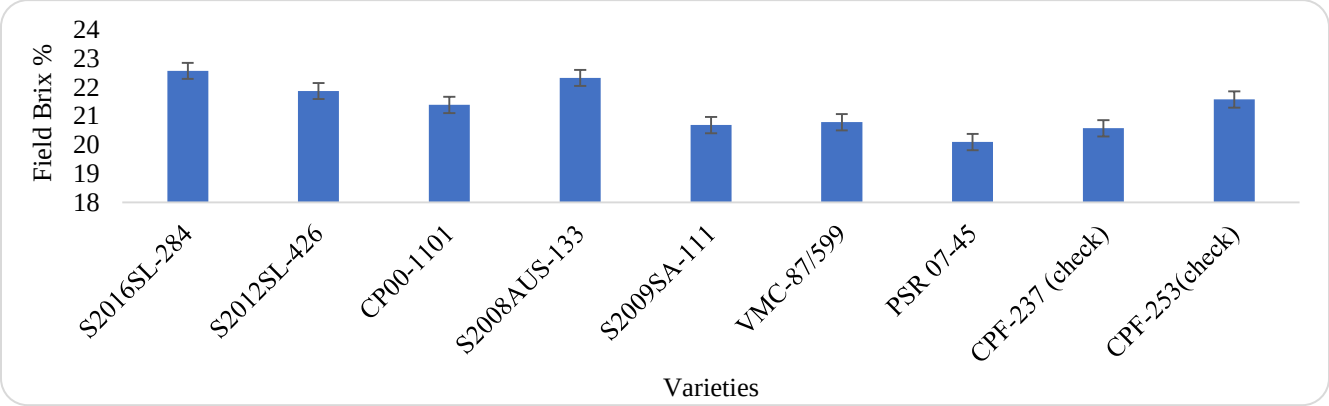

Figure 3.Percentage of field brix in different sugarcane strains under rationing.

Stripped cane yield

The highest yield of 125.39 tons ha^{-1} was observed in clone S2016SL-284 that produced11.10 tons ha^{-1}more cane yield as compared to CPF-253 (check). Whereas, lowest cane yield of 85.36tons ha^{-1} had produced by VMC-87/599 (Table 2, Figure 4). The present study showed huge difference between sugarcane clones for ratoon yield due to varied genetic potential under available resources. The results are in line with Rauf et al., 2024, Aslam et al. (2011) and Khan et al. (2007).

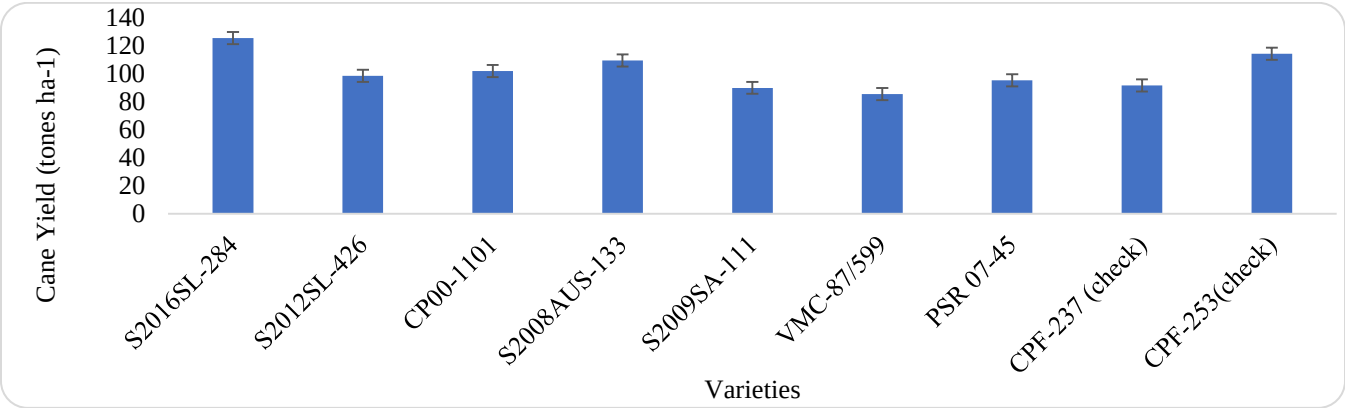

Figure 4. The stripped cane yield of different sugarcane varieties under rationing.

CONCLUSION

It is concluded that sugarcane genotypes have differ ratooning potential for yield and quality under similar management practices in environmental conditions of south Punjab. The cane production in ratoon depends upon sprouting of stubbles, millable cane density, height & weight of cane stalk. In following study as ratoon crop, S2016-SL-284 produced 11.10 tons per hectare more cane yield than check or standard variety. Accordingly, it is suggested that the cultivar S2016SL-284 is maximum ratooning ability. In following study, S2016-SL-284 ratoon crop produced 11.10 tons per hectare more cane yield than standard. So, the cultivar S2016SL-284 is maximum ratooning ability in agro- climatic conditions of Southern Punjab.

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AUTHOR CONTRIBUTIONS

TQ, HAR and MS recorded the data, performed experiment and wrote the manuscript. TM, MAM and MF generate the idea and reviewed the manuscript. IA and RU reviewed and proofread the manuscript. SAM, MAS, AB and AI performed data analysis and visualization.

COMPETING OF INTEREST

The authors declared that there is no conflict of interest about the publication of the research paper. The research was conducted objectively and without any external financial or personal influences that could have affected the findings or interpretation of the results.