IMPACT STUDIES ON DELAYED CRUSH ON POST HARVEST DETERIORATION OF PROMISING SUGARCANE CLONES

ABSTRACT

The present study was conducted with five promising early maturing sugarcane clones at Regional Agricultural Research station, Rudrur [latitude of 18^{o}-300' north and 77^{o}-510' longitude to east at an elevation of 404 m above mean sea level], Nizamabad district, T.S., India during Rabi 2014-15. The key objective of the present investigation was to study the impact of delayed crush on postharvest deterioration of promising sugar cane clones. Different biochemical aspects like percent juice sucrose, commercial cane sugar percent, juiceextraction percent and reducing sugars % were assayed from 0-72 hrs. The results of the study indicated that the clones such as Co 99004 and 2011 R 42 indicated highest sucrose percent (22.29% & 20.87%) and CCS percent (15.84% & 14.87%) respectively, percent reduction in single cane weight of Co 99004 and 2010 R 305 (1.83 and 1.63) and juice extraction percent of clones were2010 R 305 & 2011 R1(55 & 53). Among the five clones tested 2010 R 305 maintained its cane quality up to 72 hours with minimum percent reduction of 4.05, 4.30, 2.80 and 4.25 with respect to sucrose content, CCS per cent, juice extraction percent and percent reduction in single cane weight, respectively followed by 2011 R 1 and Co 99004. Present study concluded that 2010 R 305 was found to possess tolerance to post harvest deterioration.

Keywords: Sugarcane; post-harvest deterioration; promising clones;

INTRODUCTION

Sugar has grown in importance as a commodity in the current era of economic liberalisation, both for human consumption and trade. One of the nation's largest economic enterprises is the sugarcane industry, which is regarded as one of its organised sectors. Sugarcane and sugarbeet are the main sources of sugar extraction. Sugarcane is the source of 70% of the world's white crystal sugar, earning the crop the nickname "kalpavriksha" (or "wonderful crop").

Sugar cane (Saccharum officinarum) is widely grown crop in India. In India, the crop is cultivated in almost all the states under diverse conditions area under sugar cane is 47.53 lakh ha, with 362.07 Mt production and productivity of 76.0 t/ha. In Telangana area under cultivation is 50,000 ha and the production is 2.45 Mt with productivity of 74.24 t/ha (DAC, NewDelhi, 20-2021). It provides employment to over a million people directly or indirectly besides contributing significantly to the national exchequer. However, sugarcane is a perishable commodity it should be processed in to sugar quickly after it is harvested. Sucrose losses after harvest of cane due to delayed transport and unfavorable environmental conditions are one of the most serious problems in sugar recovery process. One of the sugar industry's most concerning issues, post-harvest sugar loss has received a lot of attention recently. However, if cane is crushed within 24 hours following

harvesting, little damage is done. According to Solomon (2009), staling for longer than 24 hours causes a significant loss in cane weight due to moisture loss and a decrease in the sugar concentration of the juice. Sharma and Sunita (1994) claim that over one-fourth of the crushed cane used in Indian sugar refineries is of poor quality. It has been calculated that decreased sugar recovery will cost the Indian sugar sector an average of Rs. 1600 crores annually.

The study conducted by Reddy and Naga madhuri (2014) with seven promising early maturing sugarcane clones at Agricultural Research station, Perumallapalle, A.P., India during Rabi 2011-2012. Different biochemical aspects like percent juice sucrose, TSS, commercial cane sugar percent, reducing sugars %, juice pH & juice extraction percent were assayed from 0-120 hrs. The clones 2006T36 and 2006T3 were shown to be resistant to post-harvest deterioration and to have the greatest sucrose% (16.37%,15.18%) and lowest reducing sugars (2.50%,2.70%) values, respectively. While the 2006T23 clone had the highest reducing sugar content (3.72%) and lowest sucrose content (12.39%), these results showed a decline in quality. However, Co C 671 (1.64 kg), Co 94008 (1.42 kg), and 2006T36 (1.49 kg) had the highest cane yields. The sugar recovery is stable and which mainly depends on cane quality, efficiency of mills, planting and harvesting dates as well as stalling due to delay on crushing after harvest. Genetic particulars of a clone play a key role in determining the cane yield and sugar recovery (B. Vajantha *et al,* 2019).

We hypothesized that delayed crushing of sugarcane will greatly impact the postharvest deterioration of promising sugar cane clones. Therefore, our key objective was to evaluate the impact of delayed crush on post-harvest deterioration of promising sugarcane clones.

MATETIALS AND METHODS

Experimental Details

The experiment was carried out at Regional sugar cane and Rice research station, Rudrur during Rabi 2015-2018. The study area is located at the latitude of 18^{o}-300' north and 77^{o}-510' longitude to east at an elevation of 404 m above mean sea level. The mean maximum temperature goes up to 44.5^{o}C during May and the mean minimum temperature is 16.5^{o}C.

Five promising early sugarcane varieties from yield trials along with two checks were selected. The field experiment was laid out in RBD with three replications. The selected varieties were planted in the month of January with a seed rate of 40,000 three budded setts/ha along with irrigation. A spacing of 80 cm between furrows was followed. Atrazine @ 2kg a.i./ha was sprayed as pre-emergence herbicide at 2rd day after planting. Fertilizer dose of 224:112:112 of $N:P_2O_5:K_2O$ kg/ha was followed. Other cultural operations like hand weeding, earthing up, trash twist propping etc.., were practiced as per recommendation. The data on yield and juice quality parameters viz., Sucrose%, Brix%, Commercial cane sugar%, Reducing sugar% etc., were recorded after staling of cane from 0-72 hr.

Laboratory Analysis

The data on yield and juice quality paramaters viz.., sucrose percentage was analyzed in cane juice and expressed in per cent sucrose in juice by using Schmitz's table (Hawaiian Sugar Technology Association, 1931). Reducing sugars in cane juice were analysed colorimetrically by alkaline potassium ferricyanide method(Chiranjivi Rao and Asokan, 1974) and expressed in percentage. Juice extraction percent was calculatedfrom each treatment by taking the cane weight and weight of juice obtained after crushing and expressed as percentage.

Statistical Analysis

The data was subjected to statistically scrutiny by Randamazied block design method outlined by Panse and Sukhatme (1985). The standard deviation (SD) and standard error mean (SEM) values were analyzed by SPSS 17.0 Version software.

RESULTS AND DISCUSSION

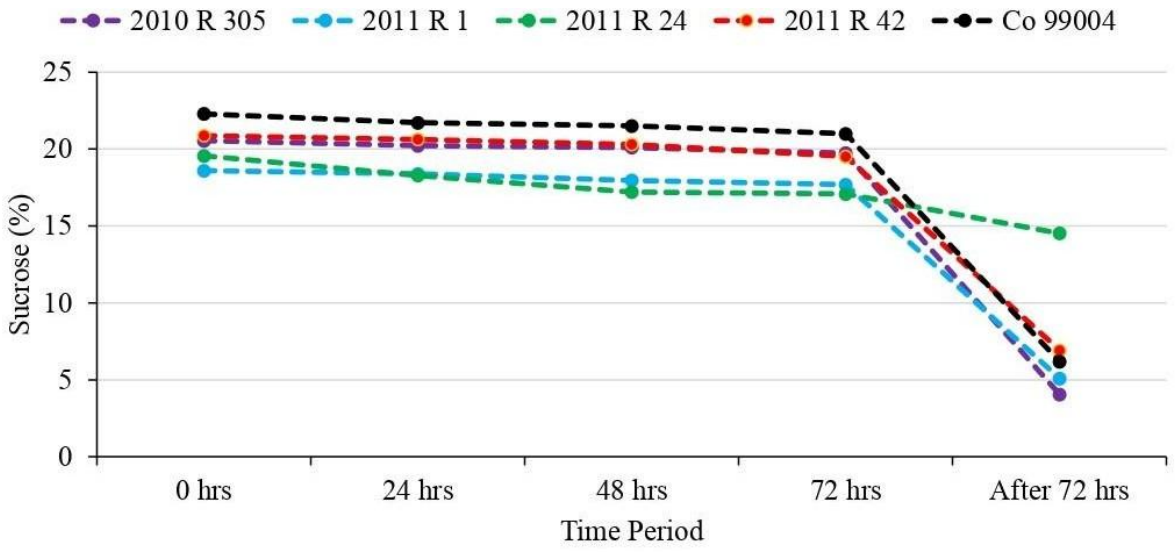
1. Effect of staling period on per cent juice sucrose

The sucrose content was significantly ($p<0.05$) influenced by varieties and stalling period (Figure 1). During storage, inversion of sucrose starts resulting in the formation of invert sugar which leads to loss of recoverable sugar. The data on effect of staling period on percent juice sucrose of sugarcane clones was presented in Table 1.

Table 1: Studies on rate of post-harvest deterioration in promising sugarcane clones

Varieties	Sucrose %					CCS %				
	0 hrs	24 hrs	48 hrs	72 hrs	% reduction after 72 hrs	0 hrs	24 hrs	48 hrs	72 hrs	% reduction after 72 hrs
2010 R 305	20.54	20.22	20.10	19.74	4.05	14.8	14.61	14.55	14.19	4.30
2011 R 1	18.59	18.39	17.96	17.69	5.09	13.26	13.01	12.69	12.54	5.74
2011 R 24	19.56	18.28	17.21	17.08	14.52	13.88	13.32	13.12	12.74	8.95
2011 R 42	20.87	20.62	20.3	19.52	6.92	14.87	14.48	14.32	14.09	5.54
Co 99004	22.29	21.71	21.5	20.99	6.19	15.84	15.44	15.17	14.88	6.45

All the clones showed decreasing trend in per cent juice sucrose with increase of staling period from 0 hrs to 72 hrs. During storage, inversion of sucrose starts resulting in the formation of invert sugar which leads to loss of recoverable sugar (Reddy, 2014). Significantly the highest per cent juice sucrose was observed at 0 hrs (20.37) after harvest buta significant decrease was observed after 72 hrs of staling period and the lowest per cent juice sucrose was observed at 72 hrs (7.35) of staling period. The decline in sucrose per cent was slow during first two days of storage, but it was faster later (Magdum *et al.*, 1996). Interaction effect of clones and staling period was noticed.



	0 hrs	24 hrs	48 hrs	72 hrs	After 72 hrs
Mean	20.37	19.84	19.41	19.00	7.35
SD	1.40	1.48	1.77	1.60	4.15
SEM	0.624	0.663	0.793	0.713	1.857

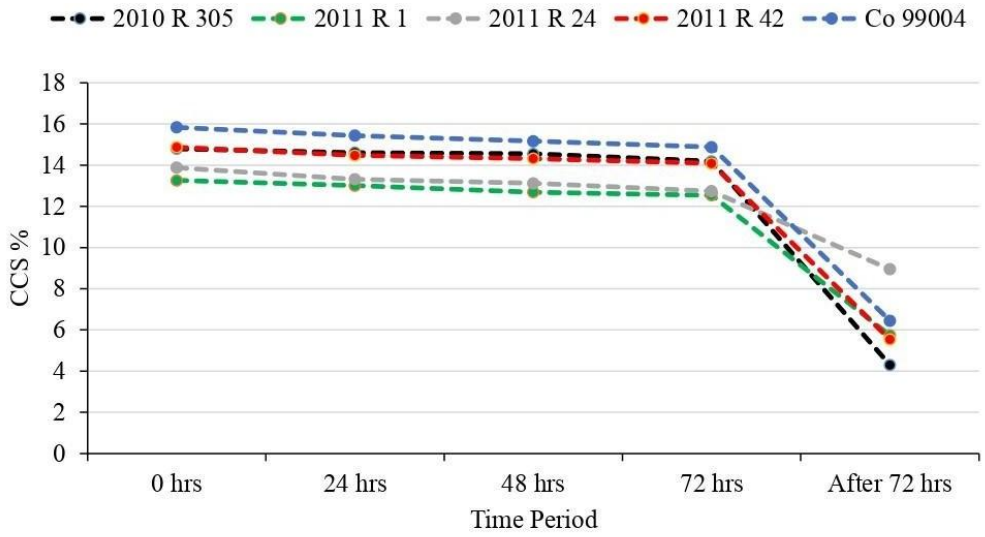
Figure 1. Effect of staling period on percent juice sucrose

2. Effect of staling period on commercial cane sugar per cent

There was progressive decrease of CCS% with the increase of staling period from 0 hrs to 72hrs as mentioned in Table 1 & Figure 2. With regard to clones Co 99004 (15.84) recorded the highest CCS% followed by 2011 R 42 (14.87), 2010 R 305 (14.80) and lowest was noticed in 2011 R 1 (13.26)indicating its higher quality deterioration. The CCS % has decreased from 1st day to 5th day in all the early and midlate clones (Reddy and Nagamadhuri, 2014). Similar results were reported by Indrajith and Natarajan (2011) for promising sugarcane clones.

The grouped data on staling period revealed that there was progressive decrease in CCS% with increase of staling period. The highest CCS% was recorded at 0 hrs (14.53) after harvest indicating the quality of juice, while the lowest was recorded at 72 hrs (6.20) after staling indicating the deterioration of juice quality. Similar results were reported by Bhite *et al.* (2007) recorded reduction in CCS% from 14.53 to 6.20 on staling. Interaction effect was recorded as significant among the clones and staling period.

Figure 2. Effect of staling period on commercial cane sugar per cent



	0 hrs	24 hrs	48 hrs	72 hrs	After 72 hrs
Mean	14.53	14.17	13.97	13.69	6.20
SD	0.99	1.00	1.03	1.01	1.72
SEM	0.444	0.446	0.462	0.450	0.771

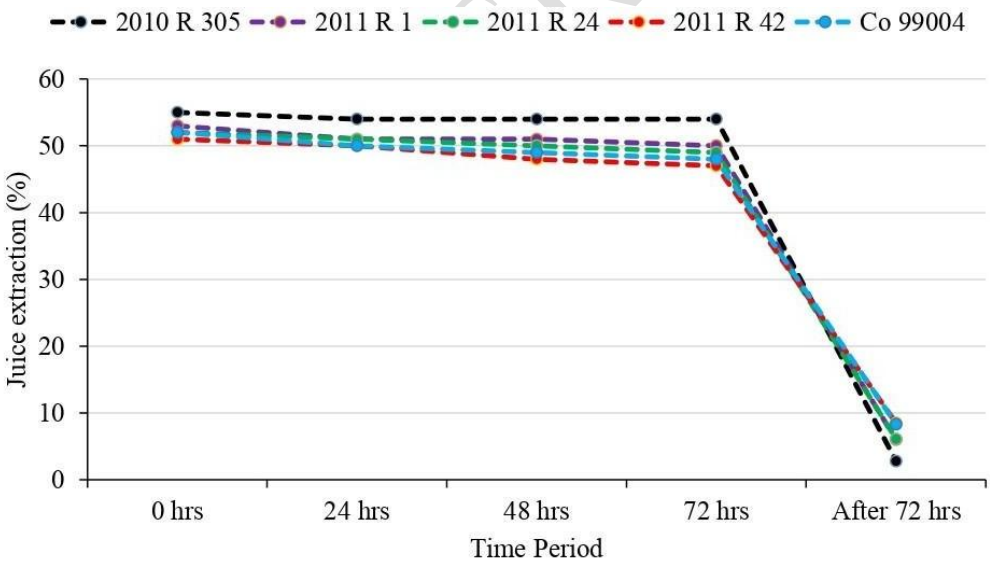
3. Effect of staling period on juice extraction per cent

There was progressive decrease in juice extraction per cent with increase of staling period as shown in table 2 & Figure 3. The datarevealed that the clone 2010 R 305 (55) recorded significantlythe highest juice extraction per cent followed by 2011 R 42 (51) recorded low juice extraction per cent. Similar results were reported by Thangavelu (2004) for other promising sugarcane clones.

The data revealed that the highest juice extraction per cent was noticed at 0 hrs (52.60) and significant reduction was noticed after 72 hrs of staling period, while the lowest juice extraction per cent was noticed at 72 hrs (6.35) of staling period. A gradual decrease in juice extraction per cent was noticed with simultaneous increase in TSS%, Titrable acidity, Dextran and activities of acid and neutral invertases with increase of staling period was reported by Bhatia *et al.* (2009). However, significant interaction effect was found between clones and staling period.

Table 2 : Studies on rate of post-harvest deterioration in promising sugarcane clones

Varieties	Juice extraction %					Percent reduction in single cane weight at				
					%					%
	0 hrs	24	48	72	reduction after 72 hrs	0 hrs	24	48	72	reduction after 72 hrs
		hrs	hrs	hrs			hrs	hrs	hrs	
2010 R 305	55	54	54	54	2.8	1.63	1.61	1.6	1.58	3.5
2011 R 1	53	51	51	50	6	1.47	1.44	1.43	1.42	4
2011 R 24	52	51	50	49	6.12	1.33	1.32	1.3	1.29	3.6
2011 R 42	51	50	48	47	8.51	1.22	1.2	1.18	1.17	5
Co 99004	52	50	49	48	8.33	1.83	1.8	1.79	1.77	3.7



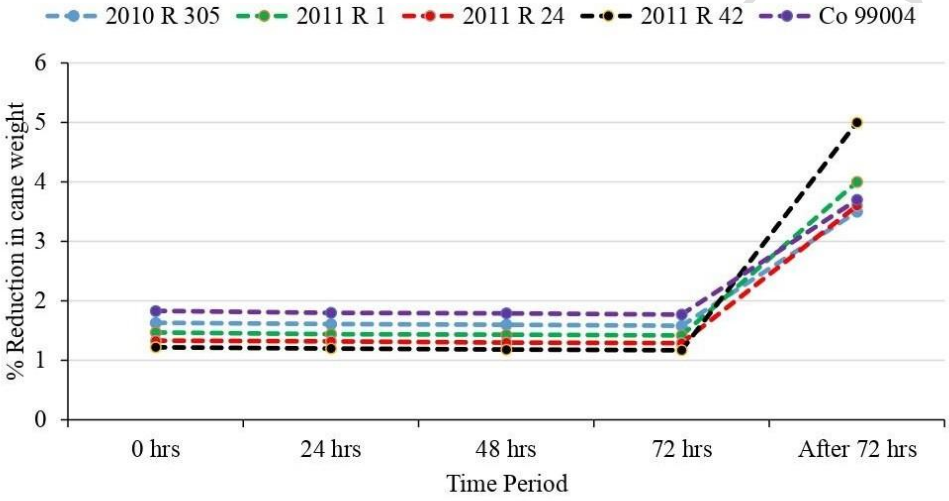
	0 hrs	24 hrs	48 hrs	72 hrs	After 72 hrs
Mean	52.60	51.20	50.40	49.60	6.35
SD	1.52	1.64	2.30	2.70	2.31
SEM	0.678	0.735	1.030	1.208	1.034

Figure 3. Effect of staling period on juice extraction per cent

4. Effect of staling period on single cane weight

The data on effect of staling period on single cane weight is presented in table 2 & Figure 4. The datarevealed that the clone Co 99004 recorded significantly the highest single cane weight (1.83 kg)when compared to other clones but on par with 2010 R 305 (1.63 kg) and 2011 R 1 (1.47 kg), whereas the clone 2011 R 42 (1.22 kg) recorded the lowest single cane weight.

The cane weight was decreased with increasing stalling period from 1st day to 5th day. Cane weight loss is mainly attributed to evaporation loss and respiratory losses (B. Vajantha et al, 2019). All the clones showed decreasing trend in cane weight with increase of staling period from 0 to 72 hrs. The results were in similar with findings of Siddhant *et al.* (2008) and Reddy et al.(2014). However, higher fresh cane weight was recorded immediately after harvest at 0 hrs (1.50 kg) after 72 hrs single cane weight loss was observed indicating the effect of staling period on cane weight. Cane weight is mainly attributed to evaparatory loss and respiratory losses (Alexander, 1973). Interaction effect of clones and staling period was found significant between the clones and staling period.



	0 hrs	24 hrs	48 hrs	72 hrs	After 72 hrs
Mean	1.50	1.47	1.46	1.45	3.96
SD	0.24	0.24	0.24	0.24	0.61
SEM	0.108	0.106	0.108	0.106	0.273

Figure 4. Effect of staling period on per cent reduction in cane weight

CONCLUSION:

Based on results from the present study, it was found that the clone 2010 R 305 maintained its cane quality upto 72 hours with minimum percent reduction of sucrose content, CCS per cent, juice extraction percent and percent reduction in single cane weight, followed by 2011 R 1 and Co 99004. Thus, it is concluded that 2010 R 305 was found to possess tolerance to post harvest deterioration. Therefore, 2010 R 305 clone can be recommended for general cultivation for delayed crushing.

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