



Research Article

STUDY ON TOLERANCE TO POST HARVEST DETERIORATION OF IMPROVED SUGARCANE CLONES

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Abstract: It is reported that, the field loss in Commercial Cane Sugar (CCS) some tones 1.0 unit/ day during late crushing period i.e., March onwards. It exceeds more than that, if it is billet harvesting rather than whole stalk green cane harvesting. Generally, cane quality deterioration depends cane quality, maturity status, size of billet, atmospheric condition, harvesting practices, pest and diseases, storage methods, cut to crush delay and moisture in cane. To evaluate canes to identify sugarcane clones tolerant to post harvest cane quality deterioration, a field experiment was conducted during 2018-19 and 2019-20 at RARS, Anakapalle (ANGRAU) duly following all crop management practices with juice analysis of 24 hrs interval up to 76 hours after cane harvest. Among 15 sugarcane clones tested for their cane quality deterioration at 76 hours after harvest (76 hah), in terms of sucrose reaction was low (< 10%) in sugarcane clones 2011A 294 (0.77%) and 2011A 252 (4.43%) in January cane harvest. Correspondingly 2006A 102 (5.81 %) and 2011A 313 (5.66%) recorded less percent of cane weight loss in 76 hah. In February cane harvest sugarcane clones 2011A 262 (6.24) and 2009A 252 (3.28%) recorded less percent sucrose reaction and less cane weight loss was recorded with 2011A 262 (11.43%) and 2011A 175 (5.41%) over 76 hah. In March cane harvest, sugarcane clones 2006A 223 (5.39%), 2010A 229 (5.96 %), 2011A 319 (7.03 %) and 2011A 260 (9.61%) recorded less percent sucrose reduction and sugarcane clones 2011A 319 (7.58 %) and 87A 298 (4.42%), 2009A 252 (4.37%) recorded less cane weight loss over 76 hah over other clones tested. Cane quality deterioration in terms of percent sucrose less, percent cane weight loss was high in March month cane harvest over January & February cane harvests due to atmospheric conditions.

Keywords: Cane quality deterioration, Sugarcane clones, % Sucrose, % Cane weight loss, Hours after cane harvest (76 hah), Dextran content, Reducing sugars

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Introduction

Cane quality deterioration after the harvest of sugarcane in the field, loading and transportation of cane a major thrust to the sugar industry. The time lag between harvest to milling of cane some weeks ranges between 3 to 4 days, which leads to loss in recoverable sugars due to cane quality deterioration of harvest of cane [1,2]. The quality loss in cane is primarily due to chemical (acids and enzymatic) inversion and those from microbial inversion through cut ends of damaged sites of stalks [3]. The enzyme inverted in the cane activated after harvest particularly under high temperature which in terms convert sucrose into invert sucrose loading to poor juice quality [4]. Bacteria also enters through cut ends and reduce juice quality by producing dextrans. Sugarcane varieties play a vital role in retaining recoverable sugars due to their degree of susceptibility in post-harvest cane quality deterioration [5]. Hence, identification of sugarcane clones tolerant to post harvest deterioration is essential to advise scientific supply and crushing schedule with minimal loss of recoverable sugars. Higher reducing sugar content in cane juice indicates immaturity of cane for crushing and presence of higher dextran impedes sugar recovery in sugar mills across the country [6].

Recent years, many sugarcane varieties are being released and their field stand is not up to the marks of old varieties, for that one of the reasons in lack of withstanding cane quality for longer period after cane harvest. Under these circumstances, a study was taken up to identify sugarcane clones tolerant to post harvest cane quality deterioration after cane harvest up to 76 hours after harvest.

Materials and methods

A field experiment was laid out during 2018-19 & 2019-20 with fifteen pre released sugarcane clones under RBD with two replications.

The crop was raised with following all best management practices and all safe profilicite plant protection measures. The crop was planted in January month of 2018-19 and 2019-20. The cane juice analysis was carried out for percent smut, percent reducing sugars, percent dextran content and cane weight loss with 24 hours interval up to 76 hours after cane harvest (stale cane) duly following standard procedures given by Chen and Chou (1993) [7]. Data was analysed by following standard methods of Panse and Sukhatme (1985) [8].

Results

Performance of 15 sugarcane clones during 2018-19 and 2019-20 under post-harvest deterioration of cane quality during January, February and March months is given graphical representation of [Fig-1, 2 & 3] and [Table-1, 2 & 3]. Significant differences were noticed among the sugarcane clones tested for percent juice sucrose, percent reducing sugars, percent dextran content and cane weight loss at 24 hours interval up to 76 hah (stale cane).

Significant differences were noticed among sugarcane clones tested for percent juice sucrose, percent reducing sugar, percent dextran content and cane weight loss at 24 hours interval up to 76 hah of stale cane. The results were discussed in following paragraphs with months of cane harvesting January, February and March months of 11th, 12th and 13th months of stale cane.

January harvesting

The percent reduction in percent sucrose in terms of cane quality deterioration was less in sugarcane clone 2011A 294 (0.77%) and standard 87A 298 (0.10%). The percent increase in dextran content was recorded less percent in sugarcane clone 2009A 107 (0.99%) over 76 hah of stale cane.

Study on Tolerance to Post Harvest Deterioration of Improved Sugarcane Clones

Table-1 Sugarcane clones tolerant to post harvest cane quality deterioration (January harvesting / 11th month)

Sugarcane variety	Sucrose %			Per cent Dextran			Per cent reducing sugars			Cane weight loss (5 canes)		
	0 hah	76 hah	% < over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% < over 76 hah
2011A 175	19.41	17.24	11.17	19.30	28.40	47.15	0.31	0.62	100.00	16.37	15.60	4.70
2011A 252	17.16	16.27	5.19	14.60	21.20	45.21	0.34	1.06	211.80	12.81	12.16	5.07
2011A 260	16.89	14.49	14.20	17.70	19.80	11.86	0.33	0.74	124.00	12.51	11.88	5.26
2011A 262	14.19	16.50	14.00	14.80	21.60	45.94	0.33	0.29	139.30	19.05	18.06	5.19
2006A 102	17.54	13.36	23.83	14.80	21.95	48.31	0.60	0.74	23.33	13.25	12.48	5.81
2006A 223	18.03	14.45	19.86	16.70	20.40	22.15	0.79	0.84	6.33	15.97	15.32	4.07
2009A 107	19.74	11.77	40.37	20.20	20.40	0.99	0.38	0.43	13.15	14.8	14.26	3.65
2010A 229	21.06	17.63	16.28	21.00	23.40	11.42	0.40	0.24	2.50	14.76	14.13	4.27
87A298 (C)	20.94	20.92	0.10	23.20	25.10	8.18	0.34	0.39	12.80	13.82	13.13	4.99
2009A 252	18.39	10.73	41.65	16.95	19.50	15.04	0.35	0.45	28.57	18.35	17.03	7.19
2011A 222	18.89	8.25	56.13	11.50	18.30	59.13	0.44	0.46	4.60	12.55	11.91	5.07
2011A 319	16.04	14.80	7.73	17.20	18.60	8.13	0.59	0.64	8.50	15.92	14.88	6.53
2011A 313	15.50	11.42	26.32	16.80	24.60	46.42	0.33	0.55	66.70	9.36	8.83	5.66
2011A 294	19.38	19.23	0.77	20.40	24.90	22.06	0.27	0.36	33.30	8.79	8.20	6.71
83V 15 (C)	17.30	19.19	9.84	13.60	23.55	73.16	0.26	0.45	73.10	11.87	11.47	3.36
SEm±	NS	0.12		1.26	2.35		0.01	0.02		1.28	1.60	
CD (0.05)	-	0.37		3.92	7.21		0.03	0.06		3.93	4.91	

Table-2 Sugarcane clones tolerant to post harvest cane quality deterioration (February harvesting / 12th month)

Sugarcane variety	Sucrose %			Per cent reducing sugars			Dextran (%)			Cane weight loss (5 canes)		
	0 hah	76 hah	% < over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% < over 76 hah
2011A 175	20.89	11.50	44.95	0.59	0.61	3.38	20.6	24.2	17.48	10.49	9.95	5.41
2011A 252	20.59	11.41	44.58	0.26	0.37	42.31	20.8	24.4	17.31	6.26	5.85	6.45
2011A 260	14.89	12.29	17.46	0.33	0.57	72.72	15.7	20.0	27.95	4.87	4.43	9.06
2011A 262	19.08	17.89	6.24	0.33	0.67	103.0	15.4	22.4	45.45	8.53	8.14	4.34
2006A 102	19.23	15.33	20.28	0.46	2.21	380.6	17.6	21.8	23.86	7.35	6.88	6.34
2006A 223	19.11	13.86	27.47	0.22	0.75	240.1	17.8	21.6	21.34	8.11	7.69	5.04
2009A 107	20.97	17.62	15.98	0.26	1.17	350.0	19.4	24.6	23.71	6.42	5.96	7.21
2010A 229	18.93	12.17	35.71	0.42	0.65	54.8	13.2	19.6	28.94	6.98	6.43	6.53
87A298 (C)	22.07	16.70	24.33	0.27	0.51	88.9	16.0	22.6	41.25	5.43	5.04	7.15
2009A 252	18.66	15.24	18.33	0.28	0.66	135.7	18.6	20.9	12.36	9.26	8.19	8.87
2011A 222	20.34	11.03	45.77	0.61	1.05	72.1	13.6	19.2	41.18	3.92	4.75	12.16
2011A 319	17.25	8.39	51.36	0.50	0.68	36.0	11.4	17.2	50.88	6.32	5.93	6.09
2011A 313	19.60	15.72	19.79	0.50	0.88	76.0	15.4	21.2	37.66	3.65	3.17	13.16
2011A 294	20.05	9.26	53.82	0.37	1.11	70.3	15.0	21.5	43.33	5.76	5.21	9.49
83V 15 (C)	21.86	18.81	13.95	0.35	0.77	120.0	13.0	20.0	53.84	6.89	6.34	9.15
SEm±	0.88	0.54		0.03	0.07		NS	1.11		0.52	0.41	
CD (0.05)	2.72	1.65		0.09	0.21		-	3.40		1.62	1.28	

Table-3 Sugarcane clones tolerant to post harvest cane quality deterioration (March harvesting / 13th month)

Sugarcane variety	Sucrose %			Per cent reducing sugars			Dextran (%)			Cane weight loss (5 canes)		
	0 hah	76 hah	% < over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% > over 76 hah	0 hah	76 hah	% < over 76 hah
2011A 175	19.66	17.44	11.29	0.25	0.69	176.0	20.7	30.3	46.37	7.36	6.65	9.65
2011A 252	19.23	16.74	12.94	0.24	1.08	350.0	22.6	26.1	15.48	8.06	7.48	7.19
2011A 260	18.72	16.92	9.61	0.42	0.58	38.09	24.2	26.7	10.33	6.31	5.86	7.21
2011A 262	16.54	13.27	14.06	0.87	0.99	13.79	24.2	25.4	4.95	7.76	7.39	4.76
2006A 102	16.14	14.82	8.18	0.59	0.86	45.76	24.3	28.4	16.87	8.14	7.45	8.48
2006A 223	17.24	16.31	5.39	0.91	1.02	12.08	21.4	25.1	17.28	5.85	5.55	5.12
2009A 107	17.14	15.18	11.43	0.42	0.95	126.19	25.5	28.4	11.37	6.81	6.41	5.87
2010A 229	17.28	16.25	5.96	0.35	0.59	66.66	18.8	24.8	31.80	7.95	7.37	7.29
87A298 (C)	16.21	15.02	7.34	0.25	0.88	252.0	20.1	26.9	33.83	7.47	7.14	4.42
2009A 252	17.14	15.02	12.36	0.25	0.94	276.0	19.4	23.7	22.16	6.85	6.55	4.37
2011A 222	15.79	13.22	16.28	0.59	1.48	150.84	16.8	21.9	30.35	6.07	5.65	6.91
2011A 319	17.48	15.15	7.03	0.30	0.89	151.28	18.5	27.3	47.56	7.26	6.71	7.58
2011A 313	16.35	16.03	13.32	0.47	0.55	22.22	22.9	24.9	8.73	7.16	6.73	6.00
2011A 294	16.81	14.54	13.50	0.43	0.59	40.48	21.2	25.5	20.28	7.00	6.62	5.42
83V 15 (C)	18.57	16.38	11.79	0.39	0.68	74.35	16.5	22.7	37.57	6.61	6.17	6.66
SEm±	0.151	0.51		0.033	0.082		0.298	2.842		0.082	0.757	
CD (0.05)	0.463	1.50		0.102	0.250		0.911	NS		0.250	NS	

The percent increased reducing sugars 2011A 222 (4.60%) and sugarcane clone 2010A 229 (2.50%). Regarding cane weight loss the percent reduction was less in sugarcane clone 2006A 223 (4.07%), 2010A 229 (4.27%) and standard 87A 298 (4.99%) over other clones tested at 76 hah of stale cane.

February harvesting

The percent reduction was less in sugarcane clone 2011A 262 (6.24%) over other clones tested of 76 hah of stale cane. The percent reducing sugars increase at 76 hah stale cane as low in sugarcane clones 2011A 175 (3.39%) over other clones tested. The percent increase in dextran percent was low in sugarcane clones 2011A 222 (12.36%), 2011A 252 (17.31%) and 2011A 175 (17.48%) over other clones tested. Regarding reduction in cane weight loss over 76 hah was less in sugarcane clones 2011A 262 (4.34%) and 2011A 175 (5.41%) over other clones tested of 76 hah of stale cane.

March harvesting

The sucrose percent reduction over hah of stale cane was less in sugarcane clones 2006A 223 (5.39%) and 2010A 229 (5.96%). The increase of reducing sugars was less over 76 hah of stale cane in sugarcane clone 2011A 262 (13.79%) over other clones tested. The percent increase in dextran content was low in sugarcane clone 2011A 262 (4.95%) over other clones tested at 76 hah of stale cane. Regarding percent decrease in cane weight loss over 76 hah of stale cane was low in sugarcane clones 2009A 252 (4.37%) and 2011A 262 (4.76%) which are on par with standard 87A 298 (4.42%). Further, among different months of cane harvesting of January, February, and March months cane quality deterioration in terms of percent sucrose reduction, percent dextran increase, percent cane weight loss and percent reducing sugars increase was high in March month of harvest than in January and February months of cane harvest at 76 hah of stale cane due to prevailing weather conditions.

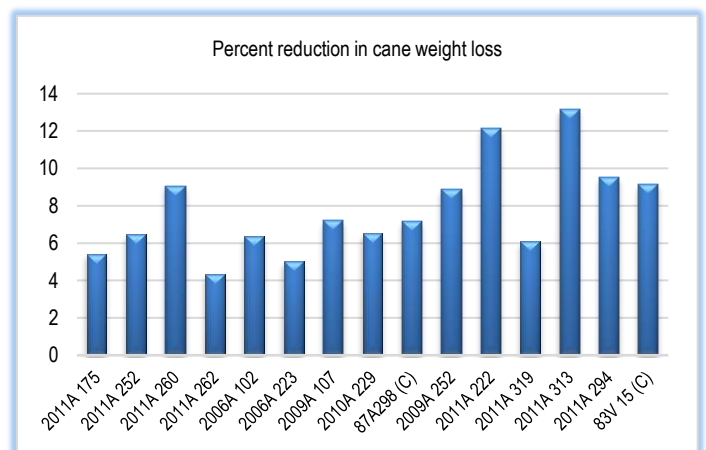
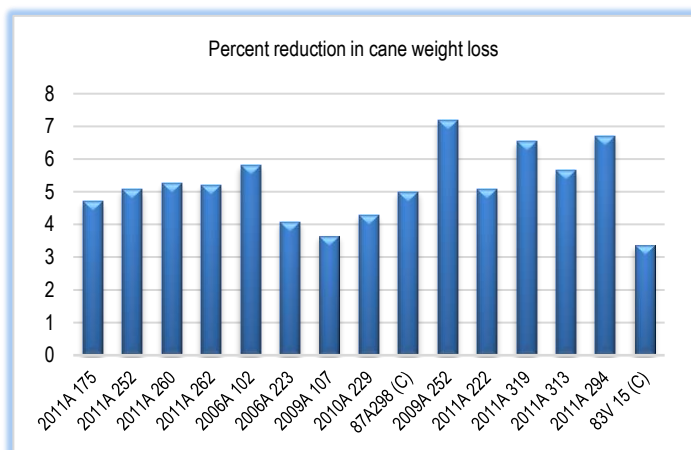
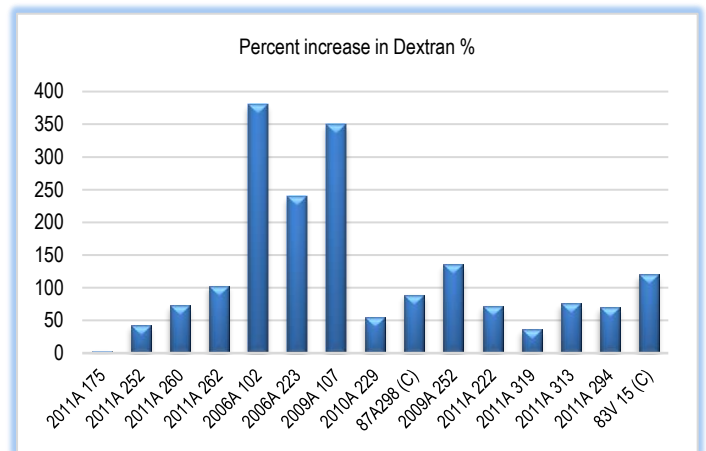
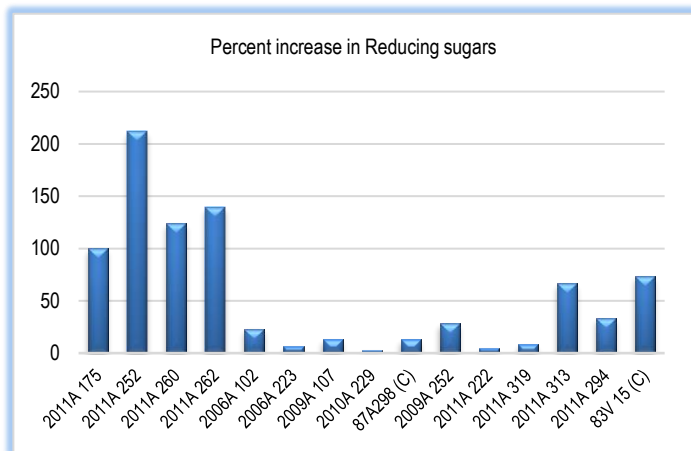
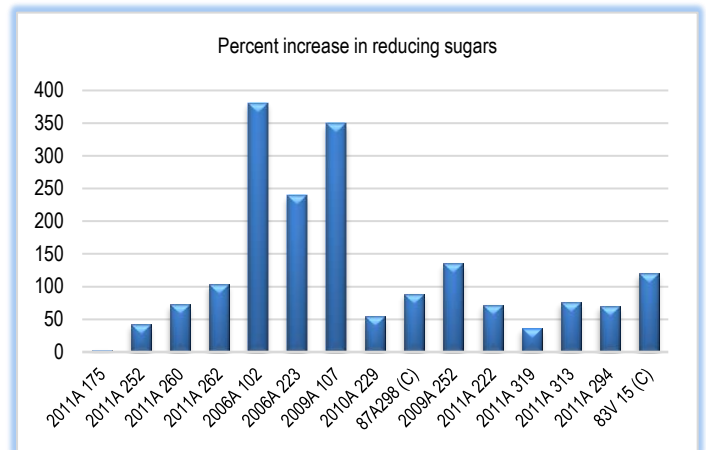
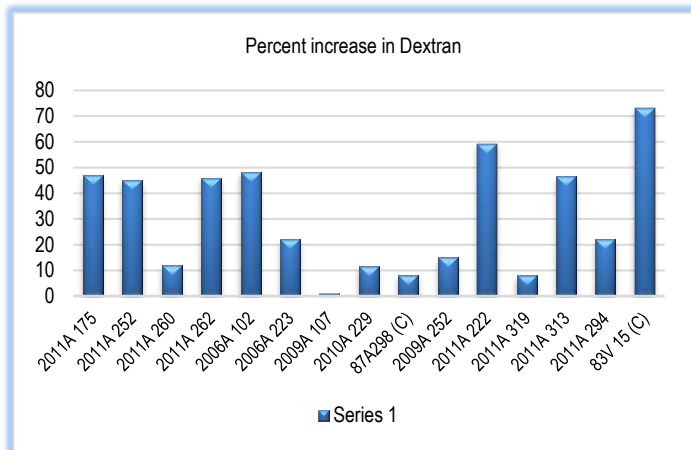
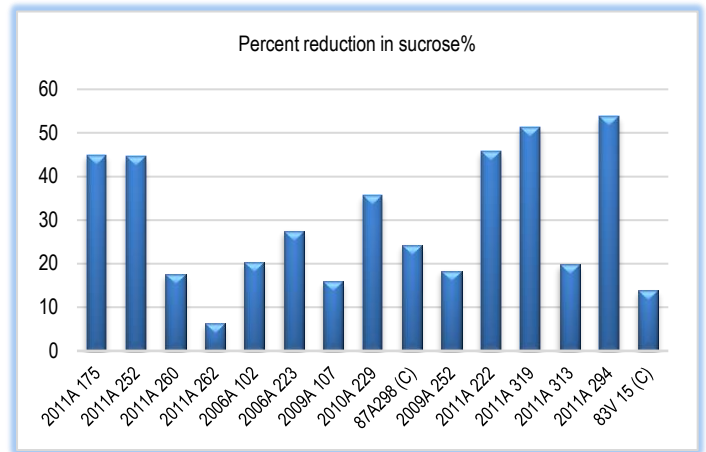
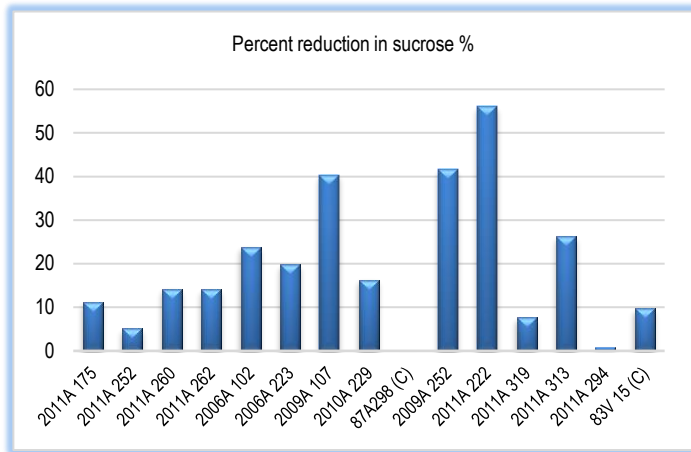


Fig-1 Post harvest cane quality deterioration in sugarcane clones over 76 hah in January month harvest

Fig-2 Post harvest cane quality deterioration in sugarcane clones over 76 hah in February month harvest

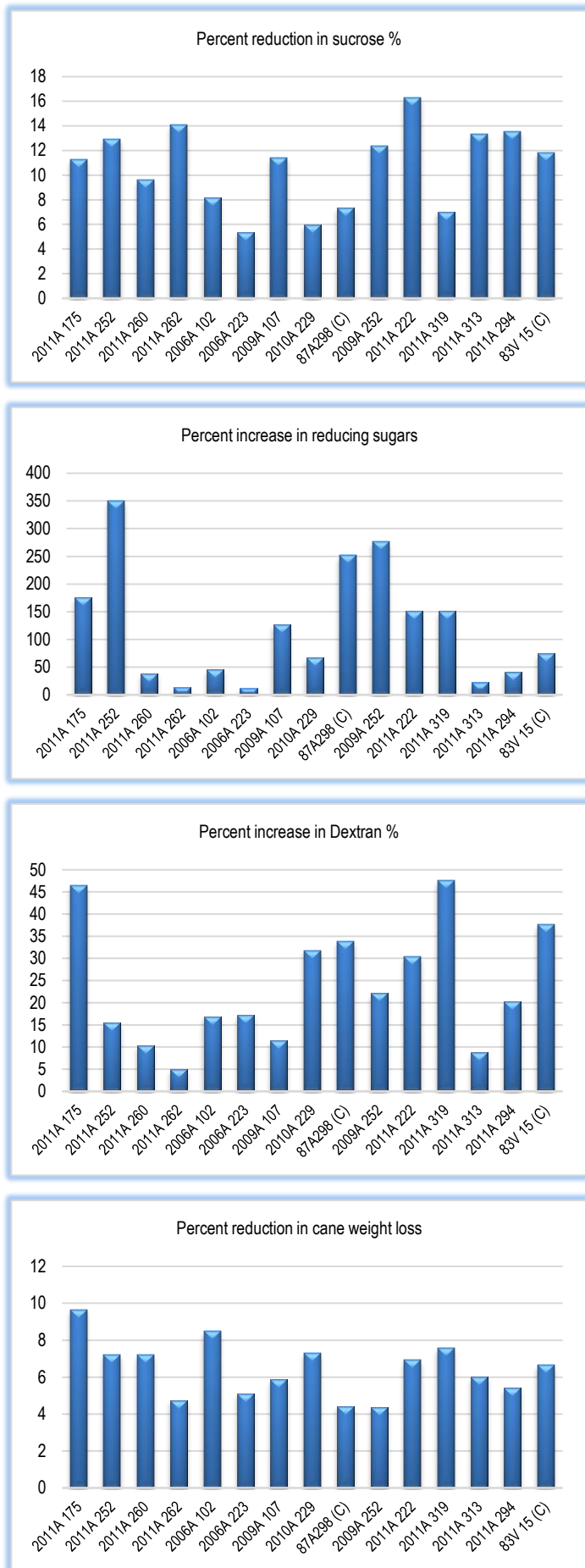


Fig-3 Post harvest cane quality deterioration in sugarcane clones over 76 hah in March month harvest

Discussion

Similar type of results was presented in sugarcane cane quality deterioration under stale cane with 96 hours after cane harvest was given by Mukunda Rao Ch., *et al.*, (2008) [9], Mukunda Rao Ch., *et al.*, (2010) [10], Mukunda Rao Ch., *et al.*, (2021) [11]. The prevailing temperatures which influences moisture loss from cane and allow scope for bacterial entry coupled with activation of invertase enzyme are the main reasons for cane quality deterioration under stale cane. Moreover, this is confirmed with more cane quality deterioration in terms of percent reduction in sucrose, percent increase in dextran, percent increase in reducing sugars and percent reduction in cane weight loss values. More in march month harvest (stale cane) compared to February and January months cane harvest.

Conclusion

Based percent sucrose reduction, percent increase in dextran, percent increase in reducing sugars and percent reduction in cane weight loss values the sugarcane clones 2009A 107, 2009A 319, 2009A 252, 2011A 262 and 2011A 294 are comparatively less prone to cane quality deterioration under stale cane of 76 hah.

Future scope

Study of enzymatic activity (Invertase) under stale cane is also a prime most point to study to arrest cane quality deterioration under stale cane. Further, arresting inversion on cane quality deterioration by chemical means also a great stage to study further under cane quality deterioration of stale cane.

Application of research

The clones identified in this study will be utilized for crossing programme of sugarcane by the sugarcane breeders and also adoption of sugarcane clones by the sugar industry to cultivate in their sugar factory operational areas with cane quality deterioration tolerance clones under stale cane.

Research Category: Crop Physiology

Abbreviations: hah-hours after harvest

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Research project name or number: Studies on tolerance to post harvest deterioration of improved sugarcane clones

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Regional Agriculture Research Station, Anakapalle, 531001

Cultivar / Variety / Breed name: Sugarcane – Pre-release sugarcane clones

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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