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# Parameters of juice quality deterioration in sugarcane juice

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**Abstract**
Juice quality deterioration parameters *viz*., $P^H$, reducing sugars and dextrans determined at different time lag intervals of crushing (0, 24, 48 and 72 hrs. after harvest) and at different months of crop age ($10^{th}$, $11^{th}$, $12^{th}$ and $13^{th}$) revealed significant differences among clones for $P^H$, reducing sugars and dextrans. The $P^H$ in juice progressively decreased from 0 to 72 hrs. after crushing at all months of crop age and in all the clones tested. Percent reducing sugars showed a linear increase from $10^{th}$ to $13^{th}$ months of crop age and at all time lag intervals of crushing. Dextran content increased among the clones up to 12 months and declined at $13^{th}$ month of crop age. However, dextran content increased irrespective of clones studied from 0 to 72 hrs. of staling. The higher content of dextran in early maturing clones attributable to higher juice sucrose contrary to this reducing sugars were high in mid-late clones. Based on $P^H$, reducing sugars and dextrans in juice, it is suggested that early clones should be harvested by $11^{th}$ month and crushed within 24 hours of harvest while mid-late clones by $12^{th}$ month and within 48 hours of harvest. It is evident from the study that 2003V46 (TC), 2003V46 (S), COA14328 and 2016T7 in early and COA19322 in mid-late were found to have higher shelf life and tolerance to post harvest deterioration.

**Keywords:** Sugarcane, delayed harvests, post-harvest deterioration, reducing sugars, dextrans, PH

## Introduction

Postharvest deterioration of sucrose in canes becomes more pronounced as the time between harvesting and milling increases. The reduction in sucrose content over the time results in low sugar recovery and reducing sugar mills economy and cane farmers. Microbial agents are the major contributors for sucrose deterioration followed by enzymes and chemicals. Acid inversion or invertase enzymes hydrolyse sucrose into glucose and fructose. The cut ends of the canes facilitates the invasion of microbes particularly *Leconostoc* bacteria and converts sucrose in to dextran through dextran sucrase enzyme (Kim & Robyt, 1995) [6]. Inversion of sucrose by plant and microbial invertases, organic acids and dextrans formation by microorganisms largely influence loss of recoverable sugar after harvest of cane. Formation of organic acids by microorganisms leads to loss of sucrose and lowering of juice $P^H$. Dextransa polysaccharides a major contributor to sugarcane post harvest sucrose losses. Increase in dextrans leads to reduction in PH and sucrose. s Dextrans are formed due to utilisation of glucose by *Leuconostoc* bacteria leaving fructose as a by-product are the indicators of cane deterioration mostly associated with rise in viscosity (Eggleston *et al.* 2001 and Morel du boil, 1991) [3, 8]. Dextrans increase viscosity, reduce filterability, evaporation rate, flocculation rate, slow mud settling and poor crystallization. Dextrans increases under delayed crushing and higher ambient temperatures. The reduction in $P^H$ (Bhatia *et al.* 2009) [1] and increase in Percent reducing sugars was reported by Solomon *et al.* (2007 and 2008) [16-17] and Singh *et al.* (2012) [11] in sugarcane upon staling and delayed harvest. The genetic nature of the variety, morphological traits, climatic factors, crop ripening, biotic and abiotic stresses, cut to kill period, harvest mode, cane management practices, transport and storage systems affect post-harvest deterioration (Solomon *et al.* 2006 and 2009; Eggleston *et al.* 2008) [13, 13, 14]. Post-harvest deterioration in sugarcane after harvesting is a problem due to higher temperatures (>40 °C) and lower humidity (25% to 35%). The time lag between cutting and crushing has direct effect on quality of cane as a result of invertase and microbial activity (Eggleston, 2002) [2]. Immature or over mature canes deteriorate rapidly as compared to the matured canes.

The present study was carried out to assess the shelf life of clones under delayed harvest and their tolerance post-harvest deterioration at different time lag intervals o staling /storage.

## Materials and Methods

Fifteen sugarcane clones comprising early and mid-late were tested in I plant crop under light soils with bore well irrigation during 2022-23 at Agricultural Research Station, Perumallapalle, Andhra Pradesh. Each clone was raised in four rows of five meters length adopting 80x20 cm spacing in a RBD with three replications. All the recommended package of practices for southern zone of the state was followed in raising a healthy crop. Twelve matured canes of uniform size were randomly selected for recording juice quality parameters *viz*., $P^H$, reducing sugars and dextrans at 24 hours intervals (0, 24, 48 and 72 hrs. after harvest) at each harvest of crop age *viz*., $10^{th}$, $11^{th}$, $12^{th}$ and $13^{th}$months to assess the shelf life of clones and also their tolerance to post harvest deterioration. $P^H$ in juice was determined using $P^H$ meter while Percent reducing sugars by Dinitrosalysilic acid reagent method (DNS) (Miller, 1959) [5]. Dextrans were determined using Dextran pocket refractometer (ATAGO). Data recorded on reducing sugars and dextrans were expressed in Percent. Statistical analysis was carried out separately for each character according to Panse and Sukhatme (1985) [9].

## Results and Discussion

Analysis of variance indicated that the clones tested differed significantly for all the parameters of juice quality at different months of crop harvest and time intervals of staling Mean data on $P^H$, Percent reducing sugars and dextrans recorded at different time lag intervals of staling and different months of crop age were presented in Table 1, 2 and 3, respectively.

### $P^H$ in Juice

The $P^H$ in juice decreased with increase in staling hours in all the clones at all months of crop harvest was observed. $P^H$ in juice decreased from 0 to 72 hrs. after crushing at all months of crop age/harvest irrespective of clones studied. $P^H$ was high in juice at 0 hrs. after harvest (immediately after harvest) and was low at 72 hrs. of crushing/staling. Similarly, $P^H$ was high at $10^{th}$ month and was low at $13^{th}$ month of crop harvest. $P^H$ decreased progressively from $10^{th}$ to $13^{th}$ month PH decreased from 5.35at $10^{th}$ month to.5.08 at $13^{th}$ months of harvest at 0 hrs. of crushing while they it decreased from 5.23 to 5.02 at $13^{th}$ months of harvest at 72 hrs. of crushing The clones 2008V257, 2009V89, CO86032 (mid-late) and COA19321, COA20324 (Early) registered lower $P^H$ suggesting that they are susceptible whereas 2016T7, COA14328, COA20321 COA 20327,2003V46 (TC) and 2003V46 (early)andCOA19322(mid late) registered higher $P^H$ revealing that they are relatively tolerant to post-harvest deterioration. All other clones *viz*; 2009V 89, 20058V 257, 2009V 127, 2013V 123, CO 0238, COA 19321, COA 20324and CO 86032 registered low ph-values. Bhatia *et al.* (2009) [1] reported a gradual decrease in $P^H$ of juice in all the genotypes during storage.

### Percent reducing sugars

Reducing sugars (RS) are one of the most important indicators of juice quality deterioration which is also used to determine the loss in Percent CCS (Uppal and Sharma 1999) [14]. In the present study gradual increase in reducing sugars from 0 to 72 hrs. of staling and from $10^{th}$ to $13^{th}$ month of crop age was recorded irrespective of clones. Mean percent reducing sugars increased from 0.17 at $10^{th}$ month to.0.57at $13^{th}$ months of harvest at 0 hrs. of crushing while they increased from 0.29 $10^{th}$ to 0.97 at $13^{th}$ months of harvest at 72 hrs. of crushing It was low at $10^{th}$ month and reached high at $13^{th}$ month (Table 2). Mid late clones recorded higher Percent reducing sugars as compared to the early clones. Among the clones COA14328,2003V46 (TC), 2003V46 (S) and 2016 $T_7$ in early and CO86032 and COA19322 in mid-late recorded lower reducing sugars revealing that the above clones are tolerant to post-harvest deterioration. The clones *viz* 2012V 123, 2009V 127, CO 0238, COA 19321,COA 20321 and COA 20327 in early and 2008 V257, COA 20324 and COA 19322, in mid late recorded higher Percent reducing sugars in juice and thus were found to be susceptible. Similar results of increase in Percent reducing sugars in juice on storage of harvested canes were reported by Solomon *et al.* (1997, 2007 and 2008) [18, 16-17]; Magdum *et al*. (1987) [7] and Singh *et al*. (2012) [11]. Verma *et al*. (2012) [15] attributed the increase in reducing sugars to enhanced activity of acid and neutral invertases.

### Percent Dextrans

The dextran content in the juice increased progressively from the $10^{th}$ to $12^{th}$ month of crop harvest age and then decreased at $13^{th}$ month of harvest. Mean dextrans increased from 9.64 at $10^{th}$ month to 17.82 at $12^{th}$ month and then declined to 10.89 at $13^{th}$ months of harvest at 0 hrs. of crushing while they increased from 12.36 to 20.25 from $10^{th}$ to $12^{th}$ month and decreased to 15.68 at $13^{th}$ months of harvest at 72 hrs. of crushing However, a linear increase in dextran content was observed from 0 to 72 hours of crushing at each harvest. Dextrans content were higher in early clones compared to mid late. Dextrans were low in 2016T7, COA 14328, 2003 V46 (TC), 2003 V46 (S) in early and2008V 257, 2009V 89, COA19322 in mid late and thus they were found to be tolerant to post harvest deterioration and delayed harvests. Dextrans were high in CO 0238, 2012V123, 2009V127, COA19321, COA20321, COA 20327 in early and COA20324 and CO 86032 in mid late recorded higher content of dextrans revealing that they were susceptible for delayed harvests and post-harvest deterioration. Higher contents of dextrans was observed at 48 hrs. of crushing in the most of the early clones could be due to higher concentration of sucrose. Higher Percent reducing sugars and dextrans during staling was also reported by Bhatia *et al.* 2009 [1] and Saxena *et al.* 2010 [10].

Percent reducing sugars in juice increased progressively irrespective of the clones tested at all months of crop age and all time lag intervals of crushing while dextrsans increased upto 12 months of crop age and then declined at $13^{th}$ month. However, dextrans also showed a similar trend of increase from 0 to 72 hrs. of crushing after harvest. Contrary to reducing sugars and dextrans, $P^H$ decreased with increasing staling period and age of crop harvest. Reducing sugars were high in mid-late whereas dextrans were high early maturing clones. The higher content of dextrans in early maturing clones may be attributable to higher sucrose content. Based on $P^H$, Percent reducing sugars and Dextran recorded at different months of crop age and time lag intervals of crushing the clones *viz*., the clones 2003V46

(TC), 2003V46 (S), COA14328 and 2016T7 in early and COA19322 in mid-late were found to have higher shelf life and tolerance to post harvest deterioration. Further it is also concluded that early clones should be harvested by $11^{th}$ month and crushed within 24 hours of harvest while mid-late clones by $12^{th}$ month and within 48 hours of harvest.

**Table 1:** Mean data for P$^H$ in juice at different months of crop age (I plant crop) and time intervals of crushing at Perumallapalle during 2022-23

| S. No. | Clone | At $10^{th}$ month of crop age | | | | At $11^{th}$ month of crop age | | | | At $12^{th}$ month of crop age | | | | At $13^{th}$ month of crop age | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. |
| 1 | 2008V257 | 5.40 | 5.36 | 5.37 | 5.35 | 5.27 | 5.25 | 5.21 | 5.19 | 5.20 | 5.20 | 5.17 | 5.11 | 5.08 | 5.07 | 5.05 | 4.96 |
| 2 | 2009V89 | 5.40 | 5.33 | 5.30 | 5.26 | 5.22 | 5.20 | 5.20 | 5.19 | 5.17 | 5.15 | 5.13 | 5.10 | 5.09 | 5.07 | 5.05 | 4.97 |
| 3 | 2009V127 | 5.27 | 5.20 | 5.20 | 5.20 | 5.19 | 5.18 | 5.18 | 5.14 | 5.11 | 5.10 | 5.07 | 5.05 | 5.03 | 5.00 | 4.98 | 4.98 |
| 4 | 2012V123 | 5.25 | 5.21 | 5.21 | 5.22 | 5.18 | 5.18 | 5.17 | 5.16 | 5.12 | 5.11 | 5.08 | 5.07 | 5.06 | 5.05 | 5.03 | 5.01 |
| 5 | 2016T7 | 5.52 | 5.51 | 5.26 | 5.20 | 5.19 | 5.19 | 5.17 | 5.15 | 5.16 | 5.13 | 5.11 | 5.10 | 5.09 | 5.07 | 5.05 | 5.05 |
| 6 | CO 0238 | 5.23 | 5.22 | 5.21 | 5.19 | 5.16 | 5.14 | 5.12 | 5.11 | 5.11 | 5.10 | 5.09 | 5.08 | 5.06 | 5.04 | 5.01 | 5.00 |
| 7 | COA14328 | 5.31 | 5.31 | 5.31 | 5.29 | 5.29 | 5.22 | 5.22 | 5.20 | 5.21 | 5.20 | 5.19 | 5.18 | 5.16 | 5.15 | 5.14 | 5.11 |
| 8 | COA19321 | 5.28 | 5.20 | 5.20 | 5.18 | 5.19 | 5.17 | 5.17 | 5.15 | 5.12 | 5.11 | 5.08 | 5.09 | 5.08 | 5.04 | 5.02 | 4.98 |
| 9 | COA19322 | 5.40 | 5.22 | 5.23 | 5.21 | 5.20 | 5.19 | 5.18 | 5.15 | 5.12 | 5.11 | 5.11 | 5.10 | 5.09 | 5.09 | 5.07 | 5.03 |
| 10 | COA20321 | 5.39 | 5.31 | 5.29 | 5.20 | 5.21 | 5.19 | 5.19 | 4.12 | 5.11 | 5.10 | 5.10 | 5.10 | 5.07 | 5.06 | 5.06 | 5.04 |
| 11 | COA20324 | 5.29 | 5.26 | 5.19 | 5.16 | 5.17 | 5.12 | 5.13 | 5.12 | 5.11 | 5.11 | 5.10 | 5.09 | 5.06 | 5.03 | 4.98 | 4.96 |
| 12 | COA20327 | 5.41 | 5.30 | 5.22 | 5.20 | 5.19 | 5.18 | 5.19 | 5.18 | 5.17 | 5.14 | 5.12 | 5.10 | 5.08 | 5.06 | 5.05 | 5.03 |
| 13 | 2003V46 (TC) | 5.41 | 5.40 | 5.39 | 5.29 | 5.21 | 5.16 | 5.15 | 5.13 | 5.11 | 5.09 | 5.09 | 5.08 | 5.07 | 5.06 | 5.04 | 5.03 |
| 14 | 2003V46 © | 5.46 | 5.39 | 5.41 | 5.26 | 5.24 | 5.20 | 5.21 | 5.20 | 5.20 | 5.19 | 5.18 | 5.18 | 5.16 | 5.15 | 5.14 | 5.11 |
| 15 | CO86032 © | 5.26 | 5.23 | 5.20 | 5.19 | 5.17 | 5.14 | 5.12 | 5.10 | 5.10 | 5.09 | 5.07 | 5.06 | 5.05 | 5.04 | 4.99 | 4.98 |
| | Mean | 5.35 | 5.30 | 5.27 | 5.23 | 5.20 | 5.18 | 5.17 | 5.09 | 5.14 | 5.13 | 5.11 | 5.10 | 5.08 | 5.07 | 5.04 | 5.02 |
| | S.E$_m$ | 0.011 | 0.009 | 0.008 | 0.007 | 0.007 | 0.007 | 0.008 | 0.257 | 0.005 | 0.005 | 0.005 | 0.005 | 0.006 | 0.007 | 0.008 | 0.008 |
| | CD @ 5% LOS | 0.031 | 0.025 | 0.024 | 0.021 | 0.021 | 0.021 | 0.022 | 0.746 | 0.014 | 0.015 | 0.016 | 0.015 | 0.017 | 0.020 | 0.023 | 0.023 |
| | CV (%) | 0.343 | 0.281 | 0.268 | 0.241 | 0.236 | 0.244 | 0.260 | 8.767 | 0.158 | 0.170 | 0.181 | 0.180 | 0.200 | 0.231 | 0.276 | 0.269 |
| | Min | 5.233 | 5.200 | 5.190 | 5.163 | 5.160 | 5.120 | 5.120 | 4.117 | 5.100 | 5.087 | 5.067 | 5.050 | 5.030 | 5.003 | 4.983 | 4.960 |
| | Max | 5.52 | 5.51 | 5.41 | 5.35 | 5.29 | 5.25 | 5.22 | 5.20 | 5.21 | 5.20 | 5.19 | 5.18 | 5.16 | 5.15 | 5.14 | 5.11 |

**Table 2:** Mean data for Percent reducing sugars in juice at different months of crop age (I plant crop) and time intervals of crushing at Perumallapalle during 2022-23

| S. No. | Clone | At $10^{th}$ month of crop age | | | | At $11^{th}$ month of crop age | | | | At $12^{th}$ month of crop age | | | | At $13^{th}$ month of crop age | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. |
| 1 | 2008V257 | 0.56 | 0.60 | 0.64 | 0.66 | 0.68 | 0.70 | 0.71 | 0.75 | 0.86 | 1.00 | 1.02 | 1.12 | 1.21 | 1.41 | 1.49 | 1.69 |
| 2 | 2009V89 | 0.15 | 0.18 | 0.20 | 0.24 | 0.26 | 0.30 | 0.32 | 0.34 | 0.35 | 0.38 | 0.42 | 0.45 | 0.48 | 0.62 | 0.64 | 0.71 |
| 3 | 2009V127 | 0.15 | 0.19 | 0.29 | 0.33 | 0.33 | 0.35 | 0.39 | 0.41 | 0.42 | 0.46 | 0.47 | 0.59 | 0.62 | 0.64 | 0.76 | 1.01 |
| 4 | 2012V123 | 0.08 | 0.19 | 0.20 | 0.29 | 0.30 | 0.38 | 0.38 | 0.40 | 0.42 | 0.49 | 0.52 | 0.54 | 0.58 | 0.62 | 0.79 | 1.19 |
| 5 | 2016T7 | 0.10 | 0.11 | 0.12 | 0.14 | 0.17 | 0.18 | 0.18 | 0.19 | 0.21 | 0.22 | 0.26 | 0.27 | 0.29 | 0.31 | 0.43 | 0.68 |
| 6 | CO 0238 | 0.34 | 0.36 | 0.45 | 0.48 | 0.50 | 0.51 | 0.53 | 0.55 | 0.54 | 0.55 | 0.56 | 0.61 | 0.65 | 0.77 | 0.82 | 1.15 |
| 7 | COA14328 | 0.19 | 0.20 | 0.20 | 0.22 | 0.25 | 0.28 | 0.30 | 0.33 | 0.36 | 0.39 | 0.42 | 0.47 | 0.59 | 0.62 | 0.66 | 0.73 |
| 8 | COA19321 | 0.15 | 0.18 | 0.22 | 0.24 | 0.26 | 0.27 | 0.29 | 0.31 | 0.33 | 0.40 | 0.42 | 0.44 | 0.52 | 0.56 | 0.62 | 1.38 |
| 9 | COA19322 | 0.09 | 0.12 | 0.14 | 0.16 | 0.18 | 0.23 | 0.23 | 0.26 | 0.26 | 0.27 | 0.33 | 0.34 | 0.36 | 0.41 | 0.44 | 0.54 |
| 10 | COA20321 | 0.15 | 0.24 | 0.25 | 0.27 | 0.32 | 0.36 | 0.39 | 0.43 | 0.47 | 0.49 | 0.53 | 0.57 | 0.62 | 0.76 | 0.89 | 1.15 |
| 11 | COA20324 | 0.11 | 0.14 | 0.26 | 0.28 | 0.32 | 0.36 | 0.38 | 0.41 | 0.43 | 0.45 | 0.51 | 0.55 | 0.62 | 0.80 | 0.89 | 1.20 |
| 12 | COA20327 | 0.17 | 0.28 | 0.44 | 0.50 | 0.52 | 0.56 | 0.60 | 0.62 | 0.68 | 0.72 | 0.90 | 0.92 | 0.97 | 1.13 | 1.22 | 1.52 |
| 13 | 2003V46 (TC) | 0.10 | 0.13 | 0.15 | 0.16 | 0.17 | 0.17 | 0.20 | 0.21 | 0.22 | 0.23 | 0.25 | 0.27 | 0.34 | 0.38 | 0.39 | 0.45 |
| 14 | 2003V46 © | 0.11 | 0.15 | 0.18 | 0.19 | 0.23 | 0.25 | 0.24 | 0.26 | 0.24 | 0.25 | 0.28 | 0.30 | 0.37 | 0.40 | 0.41 | 0.53 |
| 15 | CO86032 © | 0.13 | 0.16 | 0.19 | 0.22 | 0.25 | 0.27 | 0.27 | 0.29 | 0.30 | 0.32 | 0.35 | 0.36 | 0.36 | 0.38 | 0.55 | 0.63 |
| | Mean | 0.17 | 0.22 | 0.26 | 0.29 | 0.32 | 0.34 | 0.36 | 0.38 | 0.41 | 0.44 | 0.48 | 0.52 | 0.57 | 0.65 | 0.73 | 0.97 |
| | S.E$_m$ | 0.006 | 0.004 | 0.005 | 0.005 | 0.008 | 0.008 | 0.004 | 0.005 | 0.007 | 0.012 | 0.006 | 0.005 | 0.006 | 0.014 | 0.009 | 0.014 |
| | CD @ 5% LOS | 0.017 | 0.012 | 0.014 | 0.014 | 0.024 | 0.024 | 0.013 | 0.015 | 0.021 | 0.034 | 0.019 | 0.016 | 0.019 | 0.040 | 0.025 | 0.040 |
| | CV (%) | 5.817 | 3.420 | 3.091 | 2.932 | 4.598 | 4.186 | 2.109 | 2.284 | 3.021 | 4.601 | 2.302 | 1.784 | 1.940 | 3.654 | 2.053 | 2.491 |
| | Min | 0.083 | 0.110 | 0.120 | 0.137 | 0.167 | 0.173 | 0.183 | 0.190 | 0.210 | 0.220 | 0.253 | 0.273 | 0.290 | 0.310 | 0.393 | 0.450 |
| | Max | 0.56 | 0.60 | 0.64 | 0.66 | 0.68 | 0.70 | 0.71 | 0.75 | 0.86 | 1.00 | 1.02 | 1.12 | 1.21 | 1.41 | 1.49 | 1.69 |

**Table 3:** Mean data for Dextrans in juice at different months of crop age (I plant crop) and time intervals of crushing at Perumallapalle during 2022-23

| S. No. | Clone | At 10th month of crop age | | | | At 11th month of crop age | | | | At 12th month of crop age | | | | At 13th month of crop age | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 0 hrs. | 24 hrs. | 48 hrs. | 72 hrs. |
| 1 | 2008V257 | 9.15 | 13.50 | 13.97 | 14.13 | 15.10 | 15.30 | 17.20 | 19.12 | 17.18 | 17.73 | 18.17 | 20.58 | 10.82 | 11.18 | 13.20 | 15.27 |
| 2 | 2009V89 | 9.30 | 13.03 | 13.90 | 14.40 | 14.23 | 15.37 | 16.50 | 20.08 | 16.98 | 17.90 | 18.90 | 18.65 | 10.60 | 11.73 | 13.67 | 15.36 |
| 3 | 2009V127 | 9.80 | 11.90 | 12.20 | 12.05 | 13.83 | 17.10 | 19.20 | 21.27 | 18.15 | 19.00 | 20.00 | 21.15 | 11.10 | 12.03 | 14.13 | 15.90 |
| 4 | 2012V123 | 10.08 | 11.20 | 11.60 | 11.90 | 13.00 | 17.37 | 19.30 | 20.75 | 18.32 | 18.70 | 19.30 | 21.20 | 11.15 | 12.02 | 14.40 | 16.00 |
| 5 | 2016T7 | 8.90 | 9.17 | 9.70 | 10.15 | 11.90 | 13.17 | 15.70 | 16.80 | 14.62 | 15.20 | 16.07 | 17.92 | 9.68 | 10.65 | 12.23 | 13.90 |
| 6 | CO 0238 | 10.10 | 12.50 | 12.70 | 13.02 | 13.70 | 18.10 | 20.00 | 22.18 | 20.20 | 21.03 | 21.17 | 22.20 | 12.25 | 13.02 | 15.17 | 17.20 |
| 7 | COA14328 | 8.22 | 9.93 | 10.70 | 11.08 | 11.17 | 12.37 | 15.43 | 18.00 | 15.72 | 16.17 | 17.20 | 17.62 | 9.85 | 10.92 | 13.30 | 15.47 |
| 8 | COA19321 | 10.40 | 13.00 | 13.63 | 14.03 | 14.80 | 16.47 | 20.03 | 20.08 | 18.08 | 19.13 | 19.87 | 22.65 | 12.65 | 13.78 | 16.13 | 17.97 |
| 9 | COA19322 | 8.88 | 9.60 | 10.33 | 10.82 | 10.73 | 13.23 | 15.10 | 17.92 | 15.90 | 16.27 | 17.53 | 17.40 | 9.48 | 10.92 | 12.10 | 14.07 |
| 10 | COA20321 | 10.28 | 11.50 | 12.50 | 12.82 | 13.00 | 16.60 | 20.07 | 22.00 | 20.02 | 20.90 | 21.07 | 22.28 | 11.52 | 12.62 | 14.53 | 16.33 |
| 11 | COA20324 | 10.17 | 12.50 | 13.00 | 13.38 | 13.50 | 17.07 | 20.70 | 21.15 | 20.10 | 20.47 | 20.77 | 23.10 | 12.62 | 13.80 | 15.97 | 17.57 |
| 12 | COA20327 | 11.15 | 12.57 | 13.00 | 13.60 | 13.20 | 17.50 | 20.90 | 22.40 | 21.08 | 21.23 | 21.83 | 23.30 | 11.88 | 12.82 | 14.60 | 16.50 |
| 13 | 2003V46 (TC) | 8.95 | 9.20 | 10.53 | 10.88 | 11.43 | 13.30 | 15.90 | 17.78 | 15.25 | 15.97 | 16.50 | 17.38 | 9.65 | 10.48 | 12.20 | 13.87 |
| 14 | 2003V46 © | 9.08 | 9.33 | 10.72 | 11.03 | 11.57 | 13.27 | 16.00 | 17.87 | 15.65 | 16.07 | 16.90 | 17.48 | 9.78 | 10.65 | 12.40 | 14.03 |
| 15 | CO86032 © | 10.13 | 11.33 | 11.83 | 12.08 | 13.10 | 14.17 | 16.03 | 22.00 | 20.02 | 20.57 | 21.30 | 20.90 | 10.25 | 11.95 | 13.56 | 15.70 |
| | Mean | 9.64 | 11.35 | 12.02 | 12.36 | 12.95 | 15.36 | 17.87 | 19.96 | 17.82 | 18.42 | 19.10 | 20.25 | 10.89 | 11.90 | 13.84 | 15.68 |
| | $S.E_m$ | 0.042 | 0.059 | 0.062 | 0.056 | 0.107 | 0.082 | 0.071 | 0.132 | 0.053 | 0.061 | 0.060 | 0.045 | 0.042 | 0.056 | 0.083 | 0.068 |
| | CD @ 5% LOS | 0.121 | 0.172 | 0.179 | 0.163 | 0.309 | 0.237 | 0.206 | 0.383 | 0.154 | 0.177 | 0.173 | 0.130 | 0.121 | 0.162 | 0.241 | 0.197 |
| | CV (%) | 0.755 | 0.907 | 0.889 | 0.791 | 1.425 | 0.922 | 0.688 | 1.149 | 0.518 | 0.574 | 0.540 | 0.384 | 0.668 | 0.816 | 1.041 | 0.751 |
| | Min | 8.217 | 9.167 | 9.700 | 10.150 | 10.733 | 12.367 | 15.100 | 16.800 | 14.617 | 15.200 | 16.067 | 17.383 | 9.483 | 10.483 | 12.100 | 13.867 |
| | Max | 11.15 | 13.50 | 13.97 | 14.40 | 15.10 | 18.10 | 20.90 | 22.40 | 21.08 | 21.23 | 21.83 | 23.30 | 12.65 | 13.80 | 16.13 | 17.97 |

## Conclusions

Percent reducing sugars and ph in juice increased progressively at all intervals of crushing from 0 hrs. to 72 hrs. of staling period irrespective of clones tested and harvesting periods. Dextrans content increased up to 12 months of crop age and then declined at 13th months of crop age in the clones studied and at all intervals of cane crushing. The clones 2003V 46 (TC), 2003V 46 (s), 2016T 7, COA 14328 and COA 19322 were identified as tolerant clones for deterioration in juice quality under delayed harvests and crushing.


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## Author's Contribution

Conceptualization and designing of the research work (Naidu N V); Execution of field/lab experiments and data collection (Naidu N V and Sridhar M); Analysis of data and interpretation (Sabitha N, Vajantha B); Preparation of manuscript (Naidu N V, Sridhar M Sabitha N, Hemalatha T.M and Vajantha B).

## Competing Interests

The authors have no conflict of interest related to the publication of the manuscript

## References


1. Bhatia S, Jyoti, Uppal SK, Thind KS, Batta SK. Post-harvest quality deterioration in sugarcane under different environmental conditions. Sugar Technology. 2009;11(2):154-156.
2. Eggleston G. Determination of sugarcane juice sources and indicators. Food Chemistry. 2002;78(1):95-103.
3. Eggleston G, Legendre B, Richard C. Effect of harvest method and storage time on sugarcane deterioration I: Cane quality changes. International Sugar Journal. 2001;103(1232):331-338.
4. Eggleston G, Morel PG, Walford SN. A review of sugarcane deterioration in the United States and Africa. Proceedings of the South African Sugar Technologists' Association. 2008;81:72-85.
5. Miller GL. Use of Dinitrosalicylic acid reagent for determination of reducing sugar. Annals of Chemistry. 1959;31:426–428.
6. Kin D, Robyt JF. Production, selection and characterization of mutants of Leuconostocmesenteroides B742. Constitutive of dextransucrase. Enzyme and Microbial Technology. 1995;17:689-695.
7. Magdum DN, Kadam SK, Patil MD. Post-harvest deterioration of sugarcane under different storage conditions and consequent losses. Cooperative Sugar. 1987;18(7):453–460.
8. Morel du Boil PG. The role of oligosaccharides in crystal elongation. In Proceedings of the South African Sugar Technologists Meeting. 1991;65:171-178.
9. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research; c1985.
10. Saxena P, Srivastava RP, Sharma ML. Impact of cut to crush delay and biochemical changes in sugarcane. Australian Journal of Crop Science. 2010;4(9):692-699.
11. Singh RK, Jha A, Singh CK, Singh K. Optimization of process and physico-chemical properties of ready-to-serve (RTS) beverage of cane juice with Curd. Sugar Tech. 2012;14(4):405-411.
12. Solomon S. Post-harvest deterioration of sugarcane. Sugar Tech. 2009;11(2):109-123.
13. Solomon S, Banerjii R, Shrivastava AK, Singh P, Singh I, Verma M, *et al*. Post-harvest deterioration of sugarcane and chemical methods to minimize sugar losses. Sugar Tech. 2006;8(1):74-78.

14. Uppal SK, Sharma S. Relative performance of sugarcane genotypes to post-harvest inversions in subtropical regions. Indian Sugar. 1999;49(5):345-348.
15. Verma AK, Singh SB, Agarwal AK, Solomon S. Influence of post-harvest storage temperature, time and invertase enzyme activity on sucrose and weight loss in sugarcane. Postharvest Biology and Technology. 2012;73:14-21.
16. Solomon S, editor. Climate change 2007-the physical science basis: Working group I contribution to the fourth assessment report of the IPCC. Cambridge university press; c2007 Sep 10.
17. Solomon R. Contrast-induced acute kidney injury: is there a risk after intravenous contrast?. Clinical journal of the American Society of Nephrology: CJASN. 2008 Sep;3(5):1242.
18. Solomon DA, Keller MB, Leon AC, Mueller TI, Shea MT, Warshaw M, *et al*. Recovery from major depression: a 10-year prospective follow-up across multiple episodes. Archives of general psychiatry. 1997 Nov 1;54(11):1001-1006.