

Preventing Post-Harvest Deterioration of Sugarcane

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ABSTRACT

An experiment was conducted at the Sugarcane Research Institute (SRI) to study, in quantitative term, the prevention of deterioration of sugarcane after harvest. Stale cane, suffers from gradual qualitative deterioration in terms of increased brix, reduced cane weight, pol, purity and recoverable sugar. But these qualities were retained when stale cane were subjected to the three treatments, namely spraying with water or formalin and covering with sugarcane trash, were found statistically effective in preventing the deterioration of cane as compared with the cane left uncared (check). These treatments were proved to be highly effective in reducing the qualitative losses under different weather conditions.

INTRODUCTION

The sugar loss due to staleness over a period of six days varies from 34% to 54% under Bangladesh agroclimatic conditions (Haque *et al.*, 1979). Different scientists have viewed the phenomenon from different angles. Some attributed the deterioration to the organisms *Leuconostoc* entering the cut end and hence suggested spraying disinfectants like formalin (Parthasarathy, 1972 ; Bose *et al.*, 1974) while others considered it to be a physiological process of drying-up and suggested water spraying (Singh and Chatterjee, 1952 and Kapur and Kumar, 1976) or covering with suitable means e. g. trash (Fogliata, 1977).

Post harvest deteriorations of sugarcane, though a more acute problem in Bangladesh than any other countries of the world, have not been widely investigated and virtually no work was done in the past on the preventing measures. The present investigation was, therefore, undertaken to study the effectiveness of some of the most common and easily available processes in preventing the post harvest deterioration of sugarcane.

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MATERIALS AND METHODS

The experiment was conducted at SRI farm. The cane variety Co. 1158, planted on 15th November, 1976 was grown under rainfed conditions from planting to harvest and all standard managements, fertilizations and other intercultural practices were followed.

The experiment consisted of these independent trials at intervals of 40 days in order to represent early (December), mid (late January) and late (early March) crushing season. Consequently, the age of the crop varied from 388 days to 453 days.

Each of the above mentioned trials followed the same procedures out lined below :—

Random samples of 504 canes, representing average cane stand of the field, were harvested, detashed, grouped, equally into 84 bundles. Weight of each bundle was recorded. Twelve such bundles representing 4 treatments with 3 replications were reweighed and chemically analysed for brix, pol, purity and recovery on each day at 24 hours interval starting from the date of harvest as 00 hours over a period of 7 days.

The treatments were :

T₀—Control i. e. cane left in the sun without any care.

T₁—Cut ends of the cane sprayed with 1% formalin solution once on the first day.

T₂—Canes sprayed with water at 24 hours interval for the whole period of trial.

T₃—Canes covered with about 3" thick sugarcane trash.

For control or any treatment, the weight loss due to staleness was obtained by subtracting the final weight of canes at the time of chemical analysis from the initial weight of respective bundles. For brix, pol, purity or % recovery, the records obtained from the samples analysed on starting day were taken as initials. Loss in tons cane/a was calculated on the basis of assuming cane yield of 30 tons/a.

The effectiveness of any treatment in reducing deterioration was obtained through the quantitative difference between any parameter (pol, purity or % recovery etc.) of control and of a particular treatment (sprayed or covered.)

RESULTS AND DISCUSSION

The effects of staleness on weight, brix, pol, % purity, % recovery, TSA as well as on total sugar production were reported earlier (Haque *et al.*, 1979). The present work concerned with the effectiveness of some easily available practices on some of the above mentioned factors of sugar production over a variable weather conditions are summarized in Tables 1-6.

Table 1 shows that on 6th day of staleness, assuming a meagre yield of 30 TCA, about 2.5 TCA or more than 8% of the cane is lost in T₀, where no preventive measures

were adopted. On the other hand, in T_3 the loss is only 1.755 TCA or about 5.85% and more than 2% of the lost cane was saved just by covering the cane with trash. Other treatments namely spraying with formalin or water also resulted in substantial saving in the loss of cane. This loss in cane weight when coupled with the loss in sucrose recovery (%) manifests itself in huge loss of sugar as reported by Haque *et al.*, (1979) but the reduction in these losses by means of simply shading the canes or by spraying them with either water (regularly) or with fungicides (just once) was quite evident as seen from the same table.

Table - 1. Effects of different treatments in preventing loss in tons cane per acre (assuming 30 TCA) as affected by different duration of staleness in the early crushing season.

Treatments staleness (days)	Cane loss per acre (Tons)				Mean
	T_0	T_1	T_2	T_3	
0	0.00	0.00	0.00	0.00	0.00
1	0.735	0.612	0.666	0.660	0.668 a*
2	0.747	0.621	0.879	0.747	0.748 a
3	0.990	0.795	0.934	0.942	0.915 a
4	1.938	1.140	1.077	1.356	1.378 b
5	2.391	1.848	1.713	1.797	1.915 c
6	2.469	2.024	1.782	1.755	2.010 c
Mean	1.324a	1.007c	1.007c	1.007c	

*Figures accompanied by the same letter are not significantly different at .05 level as per DNMR-test.

So far as the treatment effects are considered, keeping the canes covered with trash was found to be superior to the other two treatments. Spraying with water or formalin also significantly (1% level) decreased cane loss in almost equal magnitude. Covering the harvested canes with trash (Fogliata, 1977) or spraying them with formalin (Krishnamurti, 1959 and Bose *et al.*, 1974) or with water (Kapur and Kumar, 1977) was reported to reduce post harvest deterioration significantly and recommended for large scale usage. Of these, effectiveness of spraying water in preventing post harvest deterioration of sugarcane is a well studied and established phenomenon. Kapur and Kumar (1977) observed that daily spraying of water to the heaped stalk of harvested, topped and stripped off canes reduced the deterioration in terms of sugar content, purity and reducing sugar. The other two treatments, shading with trash or spraying with fungicides, though did not differ much from each other, also reduced the loss in comparison with check. These two processes have been studied in rather detail for their effectiveness in reducing the deterioration.

Effects of the treatments in preventing deterioration of qualitative factors like brix, pol, % purity and % recovery were also studied and are reported here (Table 2). The trend of effects of the treatments on these factors too was similar. In all the cases i.e., in brix, pol, purity or % recovery, staleness resulted in a successive deterioration of the parameters and shading or spraying prevented the same. The effects of different treatments on % recovery may be cited as an example. In T_0 , % recovery came down from 7.80% to 4.00% at the end of staleness duration studied but the same decreased only

Table 2. Effects of different treatments in preventing deterioration of Brbc, Pol, Purity and Recovery as affected by different duration of staleness in the early crushing season.

Treat- ments Stale- ness (days)	Brix					Pol					Purity (%)					Recovery (%)				
	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean
0	16.40	16.77	16.62	16.75	16.62cd	14.34	14.74	14.55	14.66	14.57a	87.43	87.89	87.55	87.53	87.59a	7.80	7.97	7.73	7.81	7.83a*
1	16.65	16.42	16.43	16.72	16.55cd	14.39	14.44	14.34	14.61	14.44a	86.39	87.92	87.26	87.41	87.24ab	7.46	7.82	7.65	7.73	7.65a
2	16.60	16.83	16.48	16.77	16.67c	14.25	14.73	14.34	14.64	14.49a	85.88	87.49	86.99	87.25	86.90ab	6.85	7.24	6.85	7.24	7.05b
3	17.09	16.45	16.45	16.36	16.59cde	13.00	14.05	13.66	13.34	13.51b	76.09	85.45	83.00	81.57	81.52c	5.55	6.68	6.41	6.15	6.20c
4	17.39	16.81	16.88	17.05	17.03b	12.31	13.84	13.76	13.86	13.44b	70.85	82.42	81.53	81.30	79.02d	4.78	6.29	6.26	6.17	5.86c
5	17.62	16.78	17.26	17.05	17.18a	12.17	13.57	13.30	13.31	13.09c	69.02	80.88	77.09	78.05	76.26e	4.44	5.81	5.40	5.56	5.30d
6	16.96	17.27	17.12	16.63	16.99ab	11.41	13.80	13.31	12.92	12.96d	67.26	79.92	76.49	77.71	75.34e	4.00	5.50	5.45	5.35	5.10d
Mean	16.95	16.74	16.74	16.76		13.12bc	14.66a	13.89b	13.95b		77.56c	84.56a	82.84ab	82.97ab		5.84c	6.77a	6.53ab	6.57ab	

*Figures followed by same letter are not significantly different at 0.05 level as per DNMR-test.

upto 5.35% for the same period when covered with trash. Thus, a net saving of about 17% in the recovery is done through this treatment. Similarly, when almost 20% loss is caused in % purity over a period of 6 days of staleness with no preventive measures, only 10 - 12% loss would occur if any preventive measure is taken. Same was the case with pol and a significant check in its qualitative deterioration with any treatment was observed (Table 2). Changes in brix is not as clear as those in other factors. This factor has shown rather an erratic pattern due to staleness and the effects of the treatments were not significant. Except on brix, the preventive effects were found to be highly significant on all other factors and these results were in conformity with the observations made by Bose *et. al.*, (1974). They studied the effects of spraying formalin as a measure to arrest the deterioration of harvested sugarcane on storage. They reported much less fall in purity of the juice from stored cane treated with formalin in comparison with the cane kept without any treatment.

To study the trend of the effects of the treatments under weather conditions, the experiment was repeated exactly in the same pattern during mid and late crushing seasons. Data obtained were almost identical and are presented in tables 3-6. The only variation observed was amongst the treatments but the trend was the same. It is worth noting that covering with trash, which was found to be the best in preventing the loss due to staleness during the early crushing season, lost its importance in other two crushing periods. During the mid season, spraying with water (T_2) was found to be the best followed by trash covering. In late crushing season, formalin spray (T_1) out yielded the other two treatments. The reason behind these variations of the treatments in reducing the loss in TCA during different period of crushing could not be ascertained. However, age of canes or climatic factors prevalent during the period of study or a combination of both might have some bearing on the findings. However, it was clear that staleness (T_0) significantly affected sugar producing parameters when compared with the normal one. Any treatment such as spraying with water (T_2) or formalin (T_1) or covering with trash (T_3) can most significantly prevent that deterioration if practiced throughout the crushing season (irrespective of early, mid or late part). Moreover the cost involvement is also minimum.

Table - 3. Effects of different treatments in preventing loss in tons cane per acre (assuming 30 TCA) as affected by different durations of staleness in the mid crushing season.

Treatments staleness (days)	Cane loss per acre (Tons)				Mean
	T_0	T_1	T_2	T_3	
0	0.00	0.00	0.00	0.00	0.00
1	0.687	0.501	0.534	0.477	0.550e*
2	1.176	1.014	0.851	0.915	0.989d
3	1.653	1.473	1.377	1.335	1.460c
4	1.791	1.653	1.401	1.434	1.570c
5	1.896	1.821	1.698	1.755	1.792b
6	2.541	2.178	2.157	2.076	2.238a
Mean	1.392a	1.234ab	1.145abc	1.142abc	

*Figures followed by same letter are not significantly different at .05 level as per DNMR-test.

Table 4. Effects of different treatments in preventing deterioration of Brix, Pol, Purity and Recovery as affected by different duration of staleness in the mid crushing season.

Treat- ments Stale- ness days)	Brix					Pol					Purity (%)					Recovery (%)				
	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean
0	17.19	17.41	17.77	17.53	17.43 _a	15.50	15.56	15.91	15.84	15.70 _a	90.19	89.35	89.57	90.36	89.95 _a	7.63	7.76	7.79	7.79	7.74 _a *
1	17.96	17.68	17.70	18.04	17.82 _b	15.69	15.81	15.56	16.21	15.97 _a	88.46	89.10	90.19	89.85	89.48 _{ab}	7.33	7.39	7.55	7.60	7.46 _{ab}
2	17.55	18.09	18.29	18.02	17.99 _c	15.36	16.17	16.12	15.86	15.88 _a	87.52	89.36	88.13	87.59	88.25 _{abc}	6.61	7.35	7.46	7.14	7.13 _{bc}
3	18.55	18.30	18.70	18.08	18.41 _d	15.70	16.18	16.29	15.74	15.98 _a	84.67	88.41	87.15	87.06	86.81 _c	6.56	7.16	7.40	7.09	7.05 _c
4	18.22	18.27	18.20	17.56	18.06 _c	14.63	15.61	15.20	14.83	15.07 _b	80.27	85.44	83.55	84.57	83.45 _d	5.85	6.91	6.63	6.43	6.41 _d
5	18.69	18.55	18.40	18.52	18.54 _f	14.69	15.67	15.19	15.47	15.26 _b	78.67	84.52	82.62	83.56	82.34 _d	5.67	6.64	6.25	6.31	6.22 _d
6	19.17	18.60	18.37	18.90	18.81 _g	14.16	15.15	14.83	14.93	14.77 _b	73.92	80.66	80.75	78.97	78.57 _e	4.95	6.00	5.97	6.82	6.68 _e
Mean	18.19	18.16	18.19	18.09		15.13	15.74	15.64	15.56		83.38 _a	86.78 _b	85.99 _{bc}	86.04 _{bc}		6.37 _c	7.00 _a	6.99 _a	6.88 _{ab}	

*Figures followed by same letter are not significantly different at 0.05 level as per DNMR—test.

Table 5. Effects of different treatments in preventing loss in tons cane per acre (assuming 30 TCA) as affected by different durations of staleness in the late crushing season.

Treatments staleness (days)	Cane loss per acre (Tons)				
	T ₀	T ₁	T ₂	T ₃	Mean
0	0.00	0.00	0.00	0.00	0.00
1	0.735	0.537	0.450	0.420	0.5355 _e *
2	1.215	0.567	0.816	0.597	0.7986 _e
3	1.578	1.212	1.254	1.071	1.2790 _d
4	2.751	2.753	2.232	1.833	2.392 _c
5	2.991	2.841	2.895	2.457	2.7960 _b
6	3.417	3.351	3.060	2.718	3.1365 _a
Mean	1.812 _a	1.609 _b	1.530 _b	1.299 _c	

*Figures followed by same letter are not significantly different at 0.05 level as per DNMR—test.

Table - 6. Effects of different treatments in preventing deterioration of Brix, Pol, Purity and Recovery as affected by different duration of staleness in the late crushing season.

Treatments Staleness (days)	B r i x					P o l					P u r i t y (./.)					R e c o v e r y (./.)				
	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean	T ₀	T ₁	T ₂	T ₃	Mean
0	18.65	18.45	18.47	18.80	17.48a	16.46	16.27	16.34	16.56	16.41a	88.23	88.19	88.43	88.13	88.24a	7.99	7.94	8.04	7.98	7.99a*
1	18.43	18.53	18.42	18.47	17.82b	15.94	16.29	16.20	16.38	16.20a	86.47	87.89	87.01	87.76	87.28a	7.40	7.73	7.69	7.87	7.67a
2	18.55	19.12	18.78	18.43	17.99c	14.98	16.10	15.26	15.25	15.40b	80.74	84.22	81.19	82.68	82.20b	6.48	7.20	6.66	6.88	6.80b
3	18.77	19.42	19.30	19.33	18.41d	14.87	15.96	15.31	15.67	15.45b	78.74	82.19	79.33	81.07	80.33b	6.25	6.83	6.43	6.74	6.56b
4	20.43	20.05	19.67	19.00	18.06e	15.23	15.46	14.71	14.85	15.08b	74.52	77.10	74.78	78.15	76.13c	5.47	5.79	5.79	6.09	5.78c
5	20.43	20.28	20.27	19.67	18.54f	14.04	14.58	13.75	14.49	14.22c	68.71	71.79	68.49	73.65	70.66d	4.65	5.18	4.51	5.55	4.97d
6	20.37	21.07	20.50	20.23	18.81g	13.63	15.07	13.99	15.03	14.43c	66.78	71.53	68.26	73.29	69.96d	4.21	5.79	4.99	5.81	4.69d
Mean	18.19a	18.16a	18.19a	18.09ab		17.74b	15.68a	15.08a	15.46a		77.74b	80.41a	78.21b	80.67a		6.06bc	6.49ab	6.16bc	6.73a	

*Figures followed by same letter are not significantly different at 0.05 as per DNMR—test.

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