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Assesement of post-harvest changes in reducing sugars of sugarcane crop as a result of various leaf extract sprays

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Abstract
Two early maturing varieties(CoS 08272, Co 0238) and two late maturing (CoS 08279,Co 05011) sugarcane varieties were tested for post-harvest changes in reducing sugars,studied (0-240 hrs) during late (maturing) milling period due to various leaf extracts sprays such as Harvested cane (T_1) control, Neem leaf extracts (T_2),oxalis leaf extracts (T_3), Castor leaf extracts (T_4), Jatropha leaf extracts (T_5), Clereodendron (T_6), Argemone leaf extracts (T_7), Datura leaf extracts (T_8), Oxalis leaf extracts (T_9) applied just after cane cut. There was gradual significant increase (>90%) in reducing sugars content as a result of delay in cut to crush period, upto 240 hrs. The impact of lantana leaf extracts (T_5) was noted most effective in minimizing reducing sugars formation followed by oxalis leaf extracts (T_9), Jatropha leaf extracts (T_4) and Neem leaf extracts (T_2). Variety Co 5011significantly respoded best.

Keywords: sugarcane, post-harvest, reducing sugars, leaf extracts

1. Introduction
The milling period of sugarcane in Indian subtropics ranges from November and lasts up to April or sometimes extands till may as per local conditions and availability of left out raw materials. After harvesting the stored sugar is extracted in the sugar mills. The delay in cut to crush occurring due to certain adverse non avoidable local conditions particularly during late milling period (April-May) due to higher atmospheric temperature mainly results in considerable great losses to cane growers as well as mill owners. A lot of work has been done on this aspect particularly of Solomon, *et al.* (1997) [2], Uppal and Sharma (1999) [3], Uppal *et al.* (2000) [4], Siddhant *et al.* (2009) [1]. Hence, the present author decided to assess post-harvest changes in reducing sugars and to minimise sugar losses if possible by using various leaf extracts sprays applied just after harvesting and observing upto 240 hrs to minimise sugar losses in selected early and late maturing sugarcane varieties.

Material and Method
This field experiment was conducted during spring planting 2015-2016 at Agriculture farm G.F. College, Shahjahanpur in sandy loam soil, poor in carbon content (0.25%).After harvest a bundle of 50 kg cane was taken for each treatment replicated thrice, made for ten days, 0 to 240 hrs studied at an interval of 24 hrs (milling period) for various cane and juice quality parameters to observe the effect of post-harvest juice quality changes by 5% aqueous solutions of certain organic/ leaf extracts (biocidal) (T_1– Harvested cane, Control, T_2 - Neem Leaf Extract; T_3 –Castor Leaf Extract, T_4 – Jatropha Leaf Extract, T_5 – Lantana camara Leaf Extract, T_6– Clereodendron Leaf Extract, T_7-Argemone Leaf Extract, T_8- Datura Leaf Extract, T_9– Oxalis Leaf Extract) applied just after harvesting and bundling. This field experiment was conducted (spring planting) according to factorial randomized block design. The objective of this experiment was to assess reducing sugars changes during post-harvest period at (0, 24, 48, 72, 96, 120, 144, 168, 192, 216, 240hrs) at 24hr interval upto 240 hrs during March 2016of late milling period. The results are as follow.

Results
The results showed significant gradual increase in reducing sugars content during (late milling) delay in cut to crush from 0 to 240 hrs (Table 1 to 11).there was >90% increase in reducing sugars upto 240 hrs (Table 11). The impact of Lantana leaf extract application (T_5) was noted best in mini Mising reducing sugar formation upto 240 hrs. It might be due to antioxidant, anti-bacterial, anti-microbial, insecticidal nature of this plant (Ved et.al. 2017) followed by oxalis leaf extracts (T_9) and Neem leaf extracts (T_2) as compared to untreated control (T_1).CoS 5011 recorded lowest formation of reducing sugars as compared to other varieties statistically equal to CoS 8272 almost throughout the study (Tables 1 to 11). It was remarkable to note that all the leaf extracts sprays (T_2 toT_5) treatments proved effective in minimizing sugar formation as compared to control (T_1) appearing to have biocidal properties (Table 1 to 11).

Table 1: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at harvest in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
CoS08272	0.70±0.04	0.72±0.02	0.74±0.02	0.70±0.02	0.68±0.02	0.70±0.03	0.72±0.02	0.70±0.03	0.72±0.02	0.71
Co0238	0.68±0.02	0.70±0.02	0.68±0.02	0.67±0.04	0.70±0.02	0.68±0.04	0.70±0.02	0.66±0.02	0.68±0.01	0.68

CoS08279	0.60±0.01	0.62±0.03	0.60±0.03	0.62±0.04	0.60±0.02	0.62±0.02	0.60±0.02	0.62±0.02	0.62±0.04	0.61
Co05011	0.68±0.03	0.70±0.03	0.68±0.02	0.70±0.02	0.72±0.03	0.68±0.02	0.70±0.02	0.72±0.03	0.68±0.01	0.70
Mean	0.67	0.69	0.68	0.67	0.68	0.67	0.68	0.68	0.68	
	C.D. at 5%									
Treatment	=	0.011	ns							
Varieties	=	0.007	**							
Treatment X Varieties	=	0.023	**							
* Significant										
N.S. Non-significant										

Table 2: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 24 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	0.90±0.04	0.80±0.02	0.88±0.01	0.78±0.02	0.82±0.02	0.86±0.04	0.88±0.03	0.86±0.04	0.80±0.02	0.84
Co0238	0.88±0.02	0.82±0.02	0.86±0.02	0.84±0.03	0.82±0.03	0.86±0.04	0.88±0.02	0.88±0.02	0.82±0.02	0.85
CoS08279	0.96±0.02	0.90±0.04	0.92±0.03	0.88±0.04	0.84±0.02	0.94±0.02	0.92±0.03	0.94±0.01	0.84±0.03	0.90
Co05011	0.99±0.03	0.92±0.04	0.96±0.02	0.90±0.02	0.88±0.03	0.94±0.02	0.96±0.04	0.94±0.03	0.88±0.03	0.93
Mean	0.93	0.86	0.91	0.85	0.84	0.90	0.91	0.91	0.84	
	C.D. at 5%									
Treatment	=	0.012	**							
Varieties	=	0.008	**							
Treatment X Varieties	=	0.024	**							
* Significant										
N.S. Non-significant										

Table 3: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 48 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	14.80±0.39	10.20±0.56	12.80±0.64	10.10±0.44	10.00±0.44	13.10±0.69	13.00±0.56	13.20±0.33	11.40±0.81	12.07
Co0238	16.90±0.71	11.50±0.39	14.70±0.35	11.80±0.77	11.20±0.50	14.40±0.23	14.20±0.88	14.50±0.39	12.10±0.29	13.48
CoS08279	17.30±0.69	12.10±0.50	14.90±0.50	12.00±0.58	11.90±0.62	14.80±0.39	14.80±0.64	14.90±0.50	12.10±0.44	13.87
Co05011	17.90±0.40	13.25±0.65	14.95±0.56	13.10±0.29	12.40±0.71	15.10±0.44	14.95±0.35	14.95±0.83	12.80±0.33	14.38
Mean	16.73	11.76	14.34	11.75	11.38	14.35	14.24	14.39	12.10	
	C.D. at 5%									
Treatment	=	0.23	**							
Varieties	=	0.15	**							
Treatment X Varieties	=	0.47	**							
* Significant										
N.S. Non-significant										

Table 4: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 72 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	18.90±0.39	12.40±0.56	16.60±0.64	12.30±0.44	12.10±0.44	16.80±0.69	16.70±0.56	16.90±0.79	12.50±1.44	15.02
Co0238	17.80±0.71	12.80±0.39	15.90±0.92	12.40±0.77	12.30±0.50	16.10±0.23	15.90±0.31	16.20±0.21	12.30±0.69	14.63
CoS08279	20.90±1.27	12.40±0.50	18.40±0.50	13.80±0.58	12.90±0.62	17.90±0.39	18.10±1.04	17.80±0.27	13.30±0.79	16.17
Co05011	20.70±0.40	12.60±0.65	17.10±0.56	13.50±0.29	12.90±0.71	17.80±1.02	17.90±0.12	17.90±0.54	13.40±0.79	15.98
Mean	19.58	12.55	17.00	13.00	12.55	17.15	17.15	17.20	12.88	
	C.D. at 5%									
Treatment	=	0.4	**							
Varieties	=	0.27	**							
Treatment X Varieties	=	0.81	**							

* Significant										
N.S. Non-significant										

Table 5: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 96 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	39.60±0.85	19.50±0.79	28.90±1.04	20.10±0.27	19.10±0.79	25.60±1.50	26.40±0.85	27.30±1.31	20.90±1.62	25.27
Co0238	38.40±1.11	20.50±0.79	30.40±0.69	22.50±1.11	21.50±1.37	26.60±0.69	24.90±1.11	25.70±0.79	21.40±0.69	25.77
CoS08279	44.90±1.04	27.50±0.85	34.40±0.79	24.30±1.04	22.40±0.85	30.50±0.79	28.40±1.04	29.30±0.85	22.90±0.79	29.40
Co05011	45.60±0.69	20.70±0.77	34.90±0.79	28.70±0.69	24.30±1.11	32.90±1.37	34.40±0.69	33.90±1.11	24.40±1.37	31.09
Mean	42.13	22.05	32.15	23.90	21.83	28.90	28.53	29.05	22.40	
	C.D. at 5%									
Treatment	=	0.39	**							
Varieties	=	0.26	**							
Treatment X Varieties	=	0.78	**							
* Significant										
N.S. Non-significant										

Table 6: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 120 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	47.70±1.74	20.90±0.79	34.90±2.77	22.80±1.43	22.40±0.79	36.10±1.04	36.40±0.85	38.10±0.79	24.30±1.04	31.51
Co0238	46.40±1.11	22.40±1.37	38.10±0.69	24.60±0.83	22.90±0.79	38.40±0.69	36.90±1.11	36.70±0.79	26.30±0.46	32.52
CoS08279	40.30±2.19	24.10±0.85	38.80±0.79	26.40±1.04	24.10±0.56	39.40±0.79	40.30±2.19	38.90±0.68	26.90±0.68	33.24
Co05011	49.90±0.69	26.40±1.11	39.10±0.79	28.40±1.85	26.40±1.97	38.90±0.79	39.40±0.69	39.90±1.77	28.40±0.39	35.20
Mean	46.08	23.45	37.73	25.55	23.95	38.20	38.25	38.40	26.48	
	C.D. at 5%									
Treatment	=	0.84	**							
Varieties	=	0.56	**							
Treatment X Varieties	=	0.168	**							
* Significant										
N.S. Non-significant										

Table 7: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 144 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	
CoS08272	54.30±2.00	30.90±1.37	41.40±1.04	32.60±0.85	30.20±0.79	40.40±1.62	40.20±0.85	39.40±0.79	30.00±1.04	37.71
Co0238	53.80±1.11	31.40±0.79	42.10±0.69	31.90±1.11	30.10±0.79	42.10±0.12	43.40±1.11	41.40±0.79	32.30±1.62	38.72
CoS08279	56.70±1.04	32.90±0.85	41.90±1.95	32.10±2.19	30.40±0.85	44.10±0.79	42.40±2.19	44.40±0.85	34.10±0.79	39.89
Co05011	58.30±0.69	30.40±1.97	40.80±0.79	33.10±0.69	30.10±1.11	40.90±0.79	40.90±0.69	42.40±1.11	36.10±1.95	39.22
Mean	55.78	31.40	41.55	32.43	30.20	41.88	41.73	41.90	33.13	
	C.D. at 5%									
Treatment	=	0.75	**							
Varieties	=	0.5	**							
Treatment X Varieties	=	1.51	**							
* Significant										
N.S. Non-significant										

Table 8: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 168 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	Treatments									Mean
	Harvested Cane	Neem Leaf Extract	Caster Leaf Extract	Jatropha Leaf Extract	Lantana Leaf Extract	Clereodendron Leaf Extract	Argemone Leaf Extract	Datura Leaf Extract	Oxalis Leaf Extract	
	0	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
CoS08272	58.90±0.85	34.90±0.79	48.10±1.04	32.30±0.85	34.40±0.79	46.10±1.04	47.20±1.74	48.00±0.62	33.10±1.04	42.56
Co0238	56.70±1.11	35.10±0.79	47.60±1.62	34.40±1.11	32.80±0.79	44.90±0.69	48.20±1.11	47.60±0.79	32.60±0.69	42.21
CoS08279	59.99±2.19	38.10±1.74	48.90±0.79	36.80±2.19	38.20±1.74	46.10±0.79	47.20±1.04	46.30±0.85	31.90±1.95	43.72
Co05011	60.30±0.69	36.40±1.11	48.10±0.79	34.40±0.69	36.30±1.11	44.90±0.79	48.10±0.69	46.90±1.97	33.10±1.37	43.17
Mean	58.97	36.13	48.18	34.48	35.43	45.50	47.68	47.20	32.68	
	C.D. at 5%									
Treatment	=	0.76	**							
Varieties	=	0.49	**							
Treatment X Varieties	=	1.52	**							
* Significant										
N.S. Non-significant										

Table 9: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 192 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	Treatments									Mean
	Harvested Cane	Neem Leaf Extract	Caster Leaf Extract	Jatropha Leaf Extract	Lantana Leaf Extract	Clereodendron Leaf Extract	Argemone Leaf Extract	Datura Leaf Extract	Oxalis Leaf Extract	
	0	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
CoS08272	81.90±0.85	45.60±0.79	61.30±1.04	44.80±0.85	46.20±0.79	60.30±2.19	61.30±0.85	62.80±0.79	41.70±1.04	56.21
Co0238	94.60±3.02	46.30±0.79	60.80±2.42	46.30±2.27	48.20±0.79	67.30±0.69	64.80±1.11	66.10±0.79	44.30±1.85	59.86
CoS08279	80.30±1.04	48.10±2.00	63.20±0.79	48.60±1.04	47.20±0.85	64.10±0.79	61.30±1.04	62.40±0.85	41.90±0.79	57.46
Co05011	78.90±4.73	46.90±1.11	66.10±0.79	47.10±0.69	48.90±1.11	65.90±0.21	64.30±0.69	64.80±1.11	44.30±0.79	58.58
Mean	83.93	46.73	62.85	46.70	47.63	64.40	62.93	64.03	43.05	
	C.D. at 5%									
Treatment	=	1.22	**							
Varieties	=	0.81	**							
Treatment X Varieties	=	0.245	**							
* Significant										
N.S. Non-significant										

Table 10: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 216 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	Treatments									Mean
	Harvested Cane	Neem Leaf Extract	Caster Leaf Extract	Jatropha Leaf Extract	Lantana Leaf Extract	Clereodendron Leaf Extract	Argemone Leaf Extract	Datura Leaf Extract	Oxalis Leaf Extract	
	0	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
CoS08272	119.90±1.54	70.10±0.56	98.10±4.68	70.10±1.21	68.90±0.50	101.30±1.66	99.90±0.50	98.60±1.04	70.80±1.62	88.63
Co0238	135.40±3.02	80.30±0.96	110.10±0.35	80.30±1.50	74.90±2.56	104.30±4.07	101.80±1.37	104.30±0.69	80.10±5.31	96.83
CoS08279	122.30±1.27	81.90±1.46	105.60±1.71	84.30±2.49	72.30±0.81	100.10±1.21	102.30±2.00	101.80±2.00	78.30±1.37	94.32
Co05011	116.70±3.87	69.90±0.65	96.80±3.77	69.40±0.96	68.10±0.29	100.20±1.50	99.90±1.11	102.60±1.11	72.80±1.37	88.49
Mean	123.58	75.55	102.65	76.03	71.05	101.48	100.98	101.83	75.50	
	C.D. at 5%									
Treatment	=	1.82	**							
Varieties	=	1.21	**							
Treatment X Varieties	=	3.65	**							
* Significant										
N.S. Non-significant										

Table 11: Effect of some leaf extracts sprays on post-harvest deterioration in reducing sugars (mg/ml) at 240 hr in sugarcane varieties.

(Mean of three replicates)										
Varieties	**Treatments**									**Mean**
	Harvested Cane	**Neem Leaf Extract**	**Caster Leaf Extract**	**Jatropha Leaf Extract**	**Lantana Leaf Extract**	**Clereodendron Leaf Extract**	**Argemone Leaf Extract**	**Datura Leaf Extract**	**Oxalis Leaf Extract**	
	0	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
CoS8272	142.30±6.62	79.80±0.79	101.10±6.24	78.40±1.62	72.40±0.85	106.10±2.00	108.40±0.79	104.40±1.04	78.90±1.62	96.87
Co 0238	168.90±4.58	81.80±6.56	110.10±0.69	82.40±1.85	76.40±1.11	108.40±1.11	102.40±1.37	109.90±0.69	84.90±1.85	102.80
CoS8279	130.70±1.62	84.60±0.85	107.40±2.00	90.10±0.79	79.90±3.35	104.80±1.62	108.80±0.85	109.10±2.00	81.90±0.79	99.70
Co5011	126.90±1.85	88.30±1.11	101.80±3.42	78.40±1.37	76.90±0.69	102.80±1.85	101.40±1.11	106.40±5.97	78.80±1.37	95.74
Mean	142.20	83.63	105.10	82.33	76.40	105.53	105.25	107.45	81.13	
	C.D. at 5%									
Treatment	=	2.5	**							
Varieties	=	1.68	**							
Treatment X Varieties	=	5	**							
* Significant										
N.S. Non-significant										

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