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By

Jagjeet Singh and Zafar Abbas Abbas

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Jagjeet Singh http://<u>www.sasjournals.com</u> http://<u>www.jbcr.co.in</u> jbiolchemres@gmail.com

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Post-harvest Changes in Acid Invertase activity as a result of some Chemicals Sprays in Sugarcane Cultivars

Jagjeet Singh and Zafar Abbas

Department of Botany, G.F. College (M.J.P. Rohilkhand University) Shahjahanpur 242001,

U.P. India

ABSTRACT

Effect of some chemicals (water spray, Sodium metasilicate (1%), Sodium azide (1%), Lime (1%), Trash covered, Ammonium bifloride(1%), Benzoice acid(100ppm), Ampicillin compound(500ppm), Zinc sulphate(1%), Salicyclic acid (1%) sprays applied on harvested cane to assess the magnitude of post-harvest acid invertase enzyme activity at an interval of 24 hrs upto 240 hours taking harvested cane separately as Control for comparisons. There was a marked decrease in acid invertase activity with the passage of time appreciably due to chemicals spray treatments including trash covered in all the four Sugarcane cultivars (CoS 8272, Co0238,CoS8279 and Co5011) as compared to untreated control harvested cane at all stages up to 240 hrs indicating possibly to minimize post-harvest sugar losses. Best treatments were significant particularly by application of Sodium Metasilicate, Ampicillin Compound and Trash Covered in minimizing sugar losses as compared to control. Variety Co5011 responded most to these treatments in sugar losses throughout the study.

Keywords: Post-Harvest, Acid Invertase Activity, Sugarcane and Chemical Sprays.

INTRODUCTION

Invertase is a hydrolase and cleaves sucrose into two monosaccharides during post harvest deterioration of Sugarcane stalks degrading most essential part sucrose of commercial cane suger (CCS). It becomes important for farmers and Sugar mills (the top priourity) to check losses during cut to crush period particulerly when time lag which sometimes exceeds more then 3 days or more entailing excessive losses in recoverable Sugar due to deterioration of harvested cane (Solomon et al. 2001), especially during late crushing season (temp. 38-42⁰ C). Sometime due to surplus cane production or due to late functioning of Sugarmills, extension of milling season is a very common phenomenon leading to tremendous loss in sugar recovery. In the past many authors have discussed and tried various physico-chemical methods in minimising the sucrose losses in Sugarcane (Chanda et al. 2012,Kumar and Devdas 2012,Mahadeviah and Ansari 2013,Misra et al 2017) .The present study was aimed to study the effect of some chemicals spray solutions applied on harvested cane to curtail acid invertase activity to cut down the post-harvest sucrose losses in Sugarcane from harvested cane upto 240hrs lag period.

MATERIALS AND METHODS

The experiment was conducted at the experimental field of G.F. College, Shahjahanpur U.P located at latitude 27^{0} -53 N, longitude 79^{0} -4'E, and at 154.53 meter. It has a semi-arid and sub-tropical climate of tarai region with hot dry summers and cold winters. Four Sugarcane varieties, (COS 8272 and Co0238)two early maturing

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and two(Cos 8279 and Co5011) late maturing were grown according to standard agronomic practices in 2016-17 to assess the acid invertase activity at an interval of 24 hrs up to 240 hours after treating harvested cane by water spray ,Sodium meta-silicate (1%),sodium azide (1%), Lime (1%) Trash covered Ammonium bifloride (1%), Benzoic acid (100 ppm), Ampicillin compound (500ppm), Zinc sulphate (1%) and Salicylic acid (1%) sprays.

The cane of uniform size were harvested, topped, detrashed and kept in separate bundles in small heaps under open field conditions in three replicates. Untreated harvested cane heap was kept in open and used as control.

Five canes from each heap were selected randomly from the heaps for each assay and juice was extracted at the interval of 0,24,48,72,96,120,144,168,192,216,and 240 hours respectively in a clean power operated vertical crusher. The primary expressed juice was assayed for acid invertase activity by Rosario and Santisoparsi (2003) method.

RESULTS AND DISCUSSION

Significant decrease was noted in acid invertase activity during late milling season (lag period between cut to crush) under different treated cane stalks during post-harvest deterioration as compared to untreated harvested cane serving as control (Table 1-11). This decrease in chemicals treated canes on decreased deterioration indicating their inhibiting effect on acid invertase activity. The higher acid invertase activity forced sucrose inversion which is responsible for loss of sucrose in the harvested stored cane (Solomon 2001, 2009). It has been noticed that soon after harvesting the harvested cane, endogenous invertase get activated due to loss of moisture and lack of any physiological and biochemical control mechanism (Solomon et al. 1990). The acid invertase are involved in sucrose inversion and decline in cane quality. A sharp increase in acid invertase leads to inversion reducing sugar and consequently there is a drop in commercial cane sugar (Solomon et al. 1997). Eggleston and Legendre (2003) advocated that the enhanced activity of acid invertase control due to mobilization of cell invertases, possible synthesis of cut induced invertase and decreased activities of sucrose synthesizing enzymes is induced by pH change. The positive impact of Sodium metasilicate and Trash covered treatments is significantly decreasing acid invertase activity about 49% is due to decreased moisture loss from harvested cane and about 50.92% decrease by Ampicillin compound possibly due to decreased microbial activities at 240 hrs is quite understandable. The most responsive cultivar seems to be Co5011 for significant decrease in acid invertase activity throughout the study (Table 1-11).

					(Mean of	three replic	ates)					
	Treatments											
Varieties	Harvested Cane	Water Spray	Sodium Metasilicate	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Me an
	Ti	T ₂	T3	T ₄	T₅	T ₆	T ₇	Τ ₈	T9	T ₁₀	T ₁₁	
COS8272	1.01±0.02	1.01±0.01	1.02±0.03	1.01±0.02	1.02±0.01	1.03±0.03	1.02±0.06	1.01±0.01	1.02±0.03	1.02±0.02	1.01±0.01	1.02
CO0238	1.02±0.02	1.02±0.02	1.03±0.02	1.03±0.02	1.02±0.02	1.03±0.02	1.01±0.02	1.02±0.03	1.03±0.02	1.01±0.02	1.02±0.02	1.02
COS8279	1.03±0.01	1.02±0.01	1.03±0.01	1.02±0.01	1.01±0.01	1.02±0.01	1.02±0.01	1.03±0.01	1.03±0.01	1.02±0.01	1.01±0.01	1.02
CO5011	1.02±0.03	1.02±0.02	1.01±0.01	1.02±0.03	1.01±0.05	1.02±0.01	1.01±0.03	1.02±0.02	1.01±0.01	1.02±0.03	1.01±0.02	1.02
Mean	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.01	
					-							

Table 1. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (μg sucrose hydrolysed/mg of protein/hr) at harvest in sugarcane varieties.

C.D. at 5%

Treatment	=	ns
Varieties	=	ns
Treatment X Varieties	=	ns
N.S. Non-significant		

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Table 2. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (µg sucrose
hydrolysed/mg of protein/hr) at 24 hr in sugarcane varieties.

	(Mean of three replicates)														
					Т	reatments									
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium bifloride	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Mean			
	Ti	T ₂	T3	T ₄	T ₅	T ₆	T ₇	T ₈	Tg	T ₁₀	T ₁₁				
COS8272	1.60±0.02	1.55±0.03	1.40±0.04	1.54±0.02	1.50±0.01	1.38±0.04	1.52±0.02	1.58±0.02	1.39±0.03	1.58±0.04	1.58±0.02	1.51			
CO0238	1.66±0.07	1.60±0.05	1.52±0.02	1.58±0.04	1.60±0.05	1.50±0.04	1.58±0.03	1.60±0.05	1.48±0.03	1.62±0.02	1.60±0.05	1.58			
COS8279	1.52±0.01	1.48±0.03	1.40±0.05	1.46±0.01	1.48±0.01	1.36±0.01	1.44±0.03	1.46±0.02	1.38±0.01	1.46±0.03	1.46±0.03	1.45			
CO5011	1.48±0.05	1.44±0.02	1.40±0.01	1.44±0.04	1.44±0.02	1.32±0.01	1.44±0.03	1.46±0.02	1.40±0.01	1.44±0.04	1.46±0.02	1.43			
Mean	1.57	1.52	1.43	1.51	1.51	1.39	1.50	1.53	1.41	1.53	1.53				

C.D. at 5%			
Treatment	=	0.025	**
Varieties	=	0.015	**
Treatment X Varieties	=	0.051	*

* Significant

Table 3. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (μg sucrose hydrolysed/mg of protein/hr) at 48 hr in sugarcane varieties.

	(Mean of three replicates)												
						Treatments							
Varieties	Harveste d Cane	Water Spray	Sodium <u>Metasilicat</u> e	Sodium Azide	Lime	Trash Covered	Ammoniu m <u>bifloride</u>	Benzoic Acid	Ampicillin Compoun d	zinc <u>Sulphate</u>	Salicylic Acid	Mea n	
	T1	T ₂	T₃	T ₄	T ₅	T ₆	T ₇	T ₈	Tg	T ₁₀	T ₁₁		
COS827 2	1.72±0.06	1.60±0.0 3	1.50±0.05	1.62±0.0 6	1.64±0.0 6	1.48±0.0 5	1.58±0.02	1.62±0.0 2	1.50±0.05	1.62±0.0 4	1.64±0.0 1	1.59	
CO0238	1.78±0.04	1.74±0.0 7	1.68±0.05	1.72±0.0 2	1.72±0.0 4	1.66±0.0 3	1.72±0.05	1.72±0.0 6	1.64±0.02	1.70±0.0 5	1.72±0.0 2	1.71	
COS827 9	1.58±0.04	1.52±0.0 1	1.46±0.02	1.49±0.0 3	1.50±0.0 6	1.48±0.0 5	1.49±0.05	1.50±0.0 3	1.68±0.03	1.52±0.0 4	1.54±0.0 2	1.52	
CO5011	1.55±0.05	1.50±0.0 4	1.44±0.01	1.49±0.0 3	1.52±0.0 4	1.46±0.0 3	1.49±0.05	1.52±0.0 2	1.42±0.06	1.50±0.0 6	1.49±0.0 5	1.49	
Mean	1.66	1.59	1.52	1.58	1.60	1.52	1.57	1.59	1.56	1.59	1.60		
C.D. at 5%	, , ,												
Treatmen	t	=	= 0.	029 **	*								
Varieties		=	= 0.	017 *'	ĸ								
Treatmen	t X Varie	ties =	= 0.	058 **	ĸ								
* Significa	nt												

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Table 4. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (µg sucrose
hydrolysed/mg of protein/hr) at 72 hr in sugarcane varieties.

					(Mean d	of three repl	cates)					
						Treatments	•					Mean
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	
	T1	T ₂	T₃	T ₄	T ₅	T ₆	T ₇	T ₈	T۹	T ₁₀	T ₁₁	
COS8272	1.80±0.03	1.64±0.01	1.54±0.07	1.66±0.02	1.62±0.01	1.56±0.03	1.67±0.02	1.68±0.01	1.55±0.03	1.64±0.03	1.66±0.03	1.64
CO0238	1.99±0.02	1.78±0.06	1.74±0.02	1.80±0.03	1.79±0.03	1.72±0.06	1.82±0.05	1.80±0.04	1.70±0.05	1.78±0.09	1.80±0.05	1.79
COS8279	1.68±0.01	1.60±0.01	1.58±0.03	1.62±0.01	1.60±0.01	1.56±0.01	1.64±0.06	1.66±0.03	1.54±0.07	1.60±0.03	1.62±0.01	1.61
CO5011	1.60±0.05	1.52±0.06	1.46±0.02	1.56±0.05	1.58±0.05	1.56±0.03	1.50±0.06	1.48±0.05	1.48±0.03	1.56±0.03	1.54±0.05	1.53
Mean	1.77	1.64	1.58	1.66	1.65	1.60	1.66	1.66	1.57	1.65	1.66	

C.D. at 5%

Treatment	=	0.035**
Varieties	=	0.021**
Treatment X Varieties	=	0.07**

* Significant

Table 5. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (μg sucrose hydrolysed/mg of protein/hr) at 96 hr in sugarcane varieties.

	(Mean of three replicates)													
						Treatments	5					Mean		
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid			
	Ti	T ₂	T3	T ₄	T ₅	T ₆	T ₇	T ₈	Tg	T ₁₀	T ₁₁			
COS8272	2.01±0.06	1.90±0.01	1.74±0.05	1.88±0.02	1.90±0.01	1.78±0.03	1.86±0.07	1.88±0.01	1.70±0.08	1.90±0.02	1.88±0.05	1.86		
CO0238	2.10±0.06	1.89±0.07	1.70±0.06	1.89±0.07	1.96±0.08	1.72±0.02	1.88±0.02	1.90±0.08	1.72±0.02	1.90±0.08	1.92±0.06	1.87		
COS8279	1.80±0.06	1.72±0.01	1.64±0.01	1.70±0.01	1.74±0.01	1.66±0.06	1.72±0.07	1.70±0.01	1.66±0.01	1.76±0.01	1.74±0.04	1.71		
CO5011	1.78±0.09	1.68±0.02	1.60±0.06	1.72±0.07	1.70±0.06	1.58±0.01	1.68±0.03	1.66±0.02	1.58±0.06	1.60±0.03	1.64±0.04	1.66		
Mean	1.92	1.80	1.67	1.80	1.83	1.69	1.79	1.79	1.67	1.79	1.80			

C.D. at 5%

Treatment=0.042**Varieties=0.025**Treatment X Varieties=0.085** Significant

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Table 6. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (μg sucrose hydrolysed/mg of protein/hr) at 120 hr in sugarcane varieties.

					(Mean o	of three repli	cates)					
						Treatments						
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Mean
	T ₁	T ₂	T₃	T ₄	T ₅	T ₆	T ₇	T ₈	T۹	T ₁₀	T ₁₁	
COS8272	2.30±0.14	1.99±0.13	1.50±0.06	1.90±0.06	1.85±0.03	1.60±0.03	1.89±0.02	1.90±0.07	1.72±0.03	1.92±0.08	1.90±0.06	1.86
CO0238	2.60±0.06	2.05±0.02	1.90±0.02	2.10±0.02	1.99±0.02	1.89±0.05	1.99±0.08	2.10±0.02	1.89±0.02	1.99±0.13	2.09±0.02	2.05
COS8279	2.10±0.06	1.78±0.05	1.68±0.05	1.78±0.05	1.80±0.01	1.66±0.01	1.78±0.01	1.82±0.06	1.66±0.06	1.86±0.01	1.84±0.06	1.80
CO5011	2.05±0.03	1.78±0.02	1.64±0.06	1.76±0.03	1.78±0.07	1.66±0.03	1.80±0.09	1.78±0.05	1.60±0.06	1.76±0.06	1.78±0.02	1.76
Mean	2.26	1.90	1.68	1.89	1.86	1.70	1.87	1.90	1.72	1.88	1.90	

Table 7. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (μg sucrose hydrolysed/mg of protein/hr) at 144 hr in sugarcane varieties.

					(Mean o	f three repli	cates)					
						Treatments						
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Mean
	T ₁	T ₂	T3	T ₄	T ₅	T ₆	T ₇	T ₈	T۹	T ₁₀	T ₁₁	
COS8272	3.10±0.02	2.05±0.07	1.60±0.08	1.95±0.14	1.99±0.01	1.66±0.08	1.95±0.07	1.99±0.13	1.70±0.09	1.99±0.12	2.05±0.13	2.00
CO0238	3.90±0.13	2.10±0.07	1.80±0.02	2.19±0.08	2.20±0.13	1.89±0.07	2.05±0.08	2.01±0.13	1.94±0.13	1.99±0.08	2.10±0.08	2.20
COS8279	2.90±0.12	1.98±0.18	1.88±0.13	2.05±0.07	1.99±0.12	1.72±0.07	1.90±0.12	1.96±0.12	1.70±0.07	1.92±0.07	2.01±0.14	1.99
CO5011	2.80±0.03	1.88±0.07	1.76±0.01	1.96±0.14	1.89±0.07	1.74±0.02	1.90±0.09	1.94±0.14	1.72±0.06	1.99±0.09	1.96±0.02	1.96
Mean	3.18	2.00	1.76	2.04	2.02	1.75	1.95	1.98	1.77	1.97	2.01	

C.D. at 5%

Treatment = 0.077** Varieties = 0.046** Treatment X Varieties = 0.154**

* Significant

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Table 8. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (µg sucrose hydrolysed/mg of protein/hr) at 168 hr in sugarcane varieties.

(Mean of three replicates)												
	Treatments											
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Mean
	T ₁	T ₂	T₃	T ₄	T ₅	T ₆	T ₇	T ₈	T۹	T ₁₀	T ₁₁	
COS8272	3.90±0.14	2.80±0.12	2.08±0.12	2.70±0.14	2.74±0.13	2.10±0.14	2.90±0.06	2.96±0.13	2.05±0.14	2.99±0.20	2.98±0.13	2.74
CO0238	4.30±0.13	2.98±0.13	2.10±0.08	3.01±0.13	3.05±0.19	2.60±0.06	2.99±0.19	3.10±0.13	2.65±0.13	3.10±0.13	3.17±0.13	3.01
COS8279	3.60±0.07	2.30±0.12	2.00±0.13	3.08±0.13	3.10±0.06	2.50±0.13	3.10±0.01	3.05±0.03	2.69±0.05	3.00±0.13	3.10±0.06	2.87
CO5011	3.52±0.07	2.15±0.12	1.90±0.11	2.80±0.06	2.90±0.14	2.05±0.12	2.89±0.20	2.90±0.14	2.10±0.06	2.99±0.14	3.01±0.14	2.66
Mean	3.83	2.56	2.01	2.90	2.95	2.31	2.99	3.00	2.37	3.02	3.07	

C.D. at 5%

Treatment = 0.075** Varieties = 0.045** Treatment X Varieties =0.15** * Significant

Table 9. Effect of some chemicals sprays on post-harvest deterioration in acid invertase(µg sucrose hydrolysed/mg of protein/hr) at 192 hr in sugarcane varieties.

(Mean of three replicates)												
	Treatments											
Varieties	Harvested Cane	Water Spray	Sodium <u>Metasilicate</u>	Sodium Azide	Lime	Trash Covered	Ammonium <u>bifloride</u>	Benzoic Acid	Ampicillin Compound	zinc <u>Sulphate</u>	Salicylic Acid	Mean
	T ₁	T ₂	T3	T ₄	T ₅	T ₆	T ₇	T ₈	T۹	T ₁₀	T ₁₁	
COS8272	4.10±0.07	2.90±0.12	2.15±0.09	2.99±0.14	3.01±0.06	2.40±0.06	2.90±0.14	2.99±0.05	2.05±0.03	3.01±0.14	3.10±0.06	2.87
CO0238	4.40±0.19	3.05±0.08	2.52±0.13	3.30±0.06	3.40±0.06	3.10±0.07	3.60±0.13	3.90±0.06	2.95±0.13	3.40±0.06	3.35±0.13	3.36
COS8279	3.99±0.18	3.10±0.06	2.20±0.07	3.15±0.06	3.20±0.06	2.60±0.06	3.30±0.06	3.20±0.06	2.40±0.06	3.05±0.07	3.10±0.06	3.03
CO5011	3.90±0.14	2.35±0.14	2.10±0.06	2.95±0.13	3.01±0.08	2.20±0.06	2.99±0.14	3.05±0.14	2.30±0.06	3.01±0.14	3.21±0.08	2.82
Mean	4.10	2.85	2.24	3.10	3.16	2.58	3.20	3.29	2.43	3.12	3.19	

C.D. at 5%

Treatment= 0.07**Varieties= 0.042**Treatment X Varieties= 0.14*** Significant

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Table 10. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (µg sucrose hydrolysed/mg of protein/hr) at 216 hr in sugarcane varieties.

(Mean of three replicates)													
	Treatments												
Varieties	Harvested Cane	Water Spray	Sodium Metasilicate	Sodium Azide	Lime	Trash Covered	Ammonium bifloride	Benzoic Acid	Ampicillin Compound	zinc Sulphate	Salicylic Acid	Mean	
	T 1	T₂	T ₃	T ₄	T ₅	T 6	T ₇	T ₈	T۹	T ₁₀	T ₁₁		
COS8272	4.90±0.14	2.99±0.18	2.39±0.14	3.01±0.14	3.10±0.06	2.45±0.09	3.12±0.08	3.22±0.07	2.55±0.20	3.01±0.14	3.10±0.18	3.08	
CO0238	5.30±0.13	2.90±0.08	2.40±0.13	3.20±0.13	3.30±0.13	2.60±0.06	3.35±0.13	3.40±0.13	2.44±0.08	3.23±0.13	3.35±0.02	3.22	
COS8279	4.60±0.18	2.98±0.12	2.24±0.13	3.10±0.13	3.30±0.06	2.30±0.07	3.10±0.01	3.22±0.06	2.60±0.06	3.10±0.13	3.12±0.01	3.06	
CO5011	4.60±0.19	2.88±0.02	2.13±0.11	3.30±0.06	3.20±0.08	2.40±0.12	3.20±0.09	3.15±0.12	2.40±0.06	3.40±0.09	3.20±0.02	3.08	
Mean	4.85	2.94	2.29	3.15	3.23	2.44	3.19	3.25	2.50	3.19	3.19		

C.D. at 5%

Treatment = 0.083** Varieties = 0.05** Treatment X Varieties = 0.166**

* Significant

Table 11. Effect of some chemicals sprays on post-harvest deterioration in acid invertase (µg sucrose hydrolysed/mg of protein/hr) at 240 hr in sugarcane varieties.

(Mean of three replicates)												
	Treatments											
Varieties	Harvested Cane	Water Spray	Sodium Metasilicate	Sodium Azide	Lime	Trash Covered	Ammonium bifloride	Benzoic Acid	Ampicillin Compound	zinc Sulphate	Salicylic Acid	Mean
	Ti	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T9	T ₁₀	T ₁₁	
COS8272	5.30±0.14	3.10±0.06	2.60±0.14	3.30±0.14	3.35±0.13	2.72±0.07	3.75±0.14	3.30±0.07	2.58±0.13	3.35±0.14	3.38±0.13	3.34
CO0238	6.30±0.08	3.15±0.12	2.70±0.13	3.40±0.13	3.30±0.13	2.79±0.13	3.30±0.06	3.25±0.12	2.60±0.12	3.40±0.13	3.45±0.12	3.42
COS8279	5.10±0.01	3.30±0.12	2.80±0.06	3.20±0.03	3.35±0.06	2.80±0.18	3.30±0.06	3.32±0.11	2.70±0.16	3.30±0.11	3.40±0.11	3.32
CO5011	5.05±0.14	3.05±0.14	2.85±0.12	3.25±0.09	3.40±0.14	2.75±0.18	3.40±0.14	3.35±0.14	2.80±0.11	3.35±0.13	3.45±0.12	3.34
Mean	5.44	3.15	2.74	3.29	3.35	2.77	3.44	3.31	2.67	3.35	3.42	

C.D. at 5%

1

= 0.067**

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Varieties = 0.04**
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Treatment X Varieties = 0.134**

* Significant

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Corresponding author: Jagjeet Singh, P.G. Department of Botany, G.F. College (M.J.P. Rohilkhand University) Shahjahanpur 242001, U.P. India

Email: jagjitsinghsidhu63@gmail.com

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