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Genotypic differences in growth behavior and quality parameters of sugarcane (*Saccharum officinarum*) varieties under moisture stress conditions

POOJA[1], A S NANDWAL[2], MEHAR CHAND[3], ANITA KUMARI[4], BABITA RANI[5], VISHAL GOEL[6] and SAMAR SINGH[7]

Regional Research Station, CCS HAU, Karnal, Haryana 132 001

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ABSTRACT

A field experiment was conducted at CCS Haryana Agricultural University, Regional Research Station, Karnal to investigate the effect of available soil moisture regimes on productivity potential of sugarcane (*Saccharum officinarum* L.) varieties during 2014-15 and 2015-16. The experiment consists of three moisture regimes based on available soil moisture (ASM), i.e. irrigation at 50% ASM (control), 40% ASM (mild stress) and 30% ASM (severe stress) in main plots and four commercial sugarcane varieties differing in maturity duration, i.e. CoS 767 (Mid late), CoH 128 (Mid late), CoJ 64 (Early) and Co 0238 (Early) in sub plot was laid out in split-plot design with three replications. Soil moisture treatments were initiated after 45 days of planting (DAP). Higher germination was recorded in CoJ 64 (65.5%) and CoS 767 (58.0%) as compared to Co 0238 (49.0%) and CoH 128 (48.5%) at 45 DAP. At 30% ASM levels, higher reduction in stalk height was recorded in CoH 128 (33.6 and 85.96 cm) and CoJ 64 (36.33 and 83.03 cm) as compared to CoS 767 (41.83 and 107.06 cm) and Co 0238 (50.6 and 122.76 cm) in June and July, respectively. Total number of tillers was reduced by 12.99, 14.37 and 14.5% at 40% ASM level and 16.97, 24.29 and 20.04% at 30% ASM level as compared to irrigation at 50% ASM level in the month of May, June and July, respectively. Significantly higher values of brix, pol and CCS (%) were recorded in CoJ 64 and Co 0238 as compared to CoS 767 and CoH 128 at 8th, 10th and 12th month at all levels of ASM. Varieties and ASM levels had no effect on the specific activity of sucrose synthase. Sugar yield significantly reduced by 31.11 per cent at 40% ASM level and 40.57 per cent at 30% ASM level, respectively as compared to 50% ASM level. Co 0238 and CoS 767 showed minimum reduction in yield than CoH 128 and CoJ 64. From the present study it is concluded that Co 0238 and CoS 767 are identified relatively more tolerant at 30% and 40% ASM levels than CoH 128 and CoJ 64.

Key words: Juice quality, Sucrose synthase, Sugarcane, Sugar yield, Water deficit

Sugarcane (*Saccharum officinarum* L.), a crop of great economic importance, accounts for approximately 75% of the global sugar production (Commodity Research Bureau 2015). Being C_4 plant with a long life cycle, it utilizes higher amounts of water, nutrients, CO_2 and solar energy to produce considerably high biomass (Carr and Knox 2011). After Brazil, India is the second largest producer of sugar contributing about 17 per cent of the global sugar production (www.agricoop.nic.in 2014-15). Sugarcane is cultivated over a large area in tropical and sub-tropical region of India exhibiting contrasting climatic features in relation to growth, development and quality of sugarcane. The productivity of sugarcane is relatively higher in tropical than subtropical regions (Vision 2030, Sugarcane Breeding Institute, Coimbatore). In tropical region, Tamil Nadu stands first in productivity (110 tonnes ha) followed by Karnataka (90 tonne/ha), whereas in subtropics, Haryana (73 tonnes/ha) stands first followed by Punjab (71 tonnes/ha) and lowest in Uttar Pradesh (58 tonnes/ha). The low productivity in sub tropical region may be attributed to unfavorable climatic conditions prevailing during the crop growth period.

Environmental conditions play a major role in influencing the growth rate of sugarcane crop. Abiotic stresses such as drought, salinity, temperature are the primary causes limiting crop growth and productivity (Lawlor and Cornic 2002). Of these, drought is the most important environmental stress limiting sugarcane productions to a greater extent both physiologically and compositionally, water is the major constituent of cane. Water is a scarce commodity in many parts of the world and predicted climate changes will further aggravate the situation (Intergovernmental Panel on Climate Change 2007). The indiscriminate use of irrigation water to satisfy

[1]Scientist (e mail: poojadhansu@gmail.com), [2]Professor (e mail: nandwalas@gmail.com), [4]Scientist, [5]Ph D Scholar, CCS Haryana Agricultural University, Hisar, Haryana 125 004. [6]Technical officer, ICAR-Sugarcane Breeding Institute, Regional Centre, Karnal 132 001.[7]Professor and Regional Director, Regional Research Station, CCS HAU, Karnal 132 001. [3]Professor, ICAR-CSSRI, Karnal, Haryana 132 001.

the crop requirements led to depletion in ground water table and quality (Konikow and Kendy 2005, Oki and Shinjiro 2006). Approximately 2.97 lakh ha of cane area is drought prone affecting the crop at one or other stage of growth in every state of India (Vision 2030 Sugarcane Breeding Institute, Coimbatore). Soil moisture deficit coincide with summer period, creating imbalance of water potential in plant tissues, affecting crop growth and development leading to drastic reductions in cane growth and quality (Meena *et al*. 2013). Taking into consideration imparting drought during formative phase of crop growth may be useful in identifying drought tolerant genotypes because growth behavior of different varieties remains in different soil and agro-climatic conditions in response to change in rhizospheric environment under irrigated and un-irrigated conditions. Therefore, determination of performance of different sugarcane varieties at different soil moisture levels is an important strategy to identify sugarcane varieties suitable for stage specific moisture deficit conditions for sustainable sugarcane production.

MATERIALS AND METHODS

Present study was carried out on four sugarcane varieties belonging to different maturity group during Spring season of 2014-15 and 2015-16 at experimental research farm, Chaudhary Charan Singh Haryana Agricultural University, Regional Research Station, Uchani, Karnal, Haryana, India. Average annual rainfall of the station is 600 mm during short time span between July to September. Maximum temperature during summer month (May and June) may rise up to 46^0C while minimum temperature during winter month (December and January) may decline up to 3^0C. To study the effect of irrigations at different available soil moisture (ASM) levels on four sugarcane varieties, the experiment was conducted in split-plot design with 3 replications. Two budded setts of four sugarcane varieties, two under mid late group, viz. CoH 128, CoS 767 and two under early group, viz. Co 0238 and CoJ 64 were planted by half ridge irrigation method. After complete germination (40 days after planting), three levels of available soil moisture (ASM) regimes were created, i.e. irrigation at 50% ASM level (control), irrigation at 40% ASM level (mild stress) and irrigation at 30% ASM level (severe stress). These ASM levels were imposed only during pre-monsoon (in the months of April, May and June) period by withholding irrigation and later on during post monsoon period (in the month of July), the crop was irrigated for stress revival as per requirement.

Planting was done following half ridge irrigation method using two budded setts (seed rate 87.5 q/ha) in dry furrows followed by irrigation upto half of the ridge and then planking after 3-4 days of planting. All other cultural practices, i.e. fertilizer, irrigation, weed and plant protection were adopted as per the crop requirement. Biometric observations including per cent germination was recorded at 30 and 45 day after planting (DAP) while stalk height and number of productive tillers were recorded at monthly intervals (April, May, June and July). Juice quality parameters [Brix (%), Pol (%), Purity (%), Commercial cane sugar (%)] was recorded after 8^{th}, 10^{th} and 12^{th} month of planting. Sucrose synthase activity was done during 10^{th} month of crop according to Batta and Singh (1986) method. All the data were subjected to variance analysis using the SAS (Version 9.3, SAS Institute Inc., Cary, NC, USA). Least significant difference test was applied at 5 per cent probability level to compare the mean differences. Correlation analysis was performed to determine the relationship between the traits using the Pearson coefficient procedure.

RESULTS AND DISCUSSION

Morphological parameters

Germination is considered as one of the best indices for evaluating plant response to environment stress. Data presented in Fig 1 showed that germination per cent did not differ significantly before the imposition treatment effect of available soil moisture regimes at 30 and 45 DAP during the both year (2014-15 and 2015-16). The maximum germination was recorded at 45 DAP in all the varieties. Significantly higher germination was recorded in varieties CoJ 64 (57.4 and 64.6%) and CoS 767 (49.6 and 55.9%) as compared to varieties Co 0238 (40.9 and 47.2%) and CoH 128 (41.7 and 47.1%) at 30 and 45 DAP, respectively. Maximum germination was recorded in variety CoJ 64 (64.6%) while minimum in CoH 128 (47.1%). Difference in germination count might be due to genetic makeup of each variety. These results are in accordance with the earlier reports in sugarcane (Ghaffar *et al*. 2013, Fiaz *et al*. 2013).

Stalk height is the most severely affected parameter under deficit soil moisture regimes. In the present investigation, 30% and 40% ASM levels significantly reduced the mean stalk height in the month of May, June and July. Among varieties at 30% ASM levels, higher reduction in stalk height was recorded in variety CoH 128 (33.6 and 85.96 cm) and CoJ 64 (36.33 and 83.03 cm) as compared to varieties CoS 767 (41.83 and 107.06 cm) and Co 0238 (50.6 and 122.76 cm) in the month of June and July, respectively (Table 1). Comparatively higher reduction in stalk height at 30% and 40% ASM levels in varieties CoH 128 and CoJ 64 might be due to more reduction in chlorophyll content,

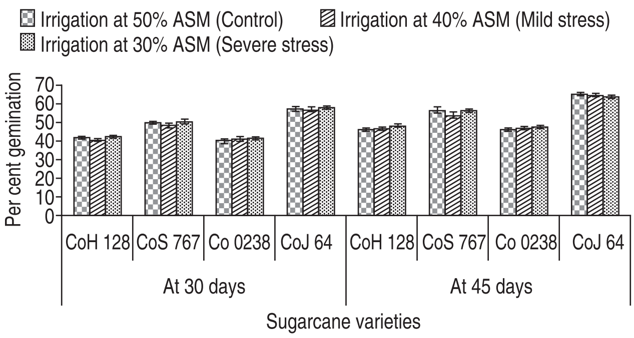

Fig 1 Effect of water deficit on germination (%) in sugarcane varieties differing in maturity duration.

leaf area and gas exchange characteristics as compared to varieties CoS 767 and Co 0238. Our results are also confirmatory with the earlier findings of Soares *et al*. (2004), Inman-Bamber and Smith (2005) and Gomathi *et al*. (2011) that stalk height is highly sensitive parameter under drought conditions causing significant reduction in commercial yield. Tillering ability and subsequent growth efficiency largely determine the yield of a cultivar by acting as a storage sink (Ramesh and Mahadevaswamy 2000). Higher tiller production, irrespective of environmental conditions or cultivar, leads to higher number of stalks at harvest, despite differences in tiller mortality (Joshi *et al*. 1996). CoJ 64 and CoS 767 being at par produced significantly higher number of tillers in April as compared to Co 0238 and CoH 128. In the present study total number of tillers was reduced by 12.99, 14.37 and 14.5% at 40% ASM level and 16.97, 24.29 and 20.04% at 30% ASM level as compared to irrigation at 50% ASM level May, June and July, respectively (Table 2). This might be due to the reduction of available soil moisture during formative phase because tillering together with early grand growth is known as the formative phase, and this has been identified as a critical water-demand period. However among varieties, maximum reduction in total number of tillers were recorded in varieties CoH 128 and CoJ 64 as compared to varieties Co 0238 and CoS 767. It may be due to the fact that varieties Co 0238 and CoS 767 maintained higher RWC content, water potential, photosynthetic rate and stomatal conductance at 40% (mild stress) and 30% (severe stress) ASM levels than CoH 128 and CoJ 64. Genotypic differences in relation to moisture stress condition have also been observed by Meena *et al*. (2013); Yadav and Prasad (1988).

Juice quality parameters

Juice quality parameters, viz. brix, pol, purity and commercial cane sugar (CCS)% are important ones because of their inter-relationships among themselves to contribute towards final sugar yields. Numerically higher values of brix (%) were recorded at 50% ASM level compared to both 40% and 30% ASM levels. CoJ 64 (19.3 and 20.5%) and Co 0238 (18.8 and 20.4%) exhibited significantly higher brix(%) as compared to CoS 767 (16.0 and 19.2%) and CoH 128 (15.4 and 19.3%) at 8^{th} and 10^{th} month, respectively. Similarly varieties Co 0238 (21.2%) and CoJ 64 (20.9%) were at par and recorded higher values of brix (%) as compared to CoS 767 (20.6%) and CoH 128 (20.0%) at 12^{th} month of sampling (Table 3). Data presented in Table 4 revealed that pol (%) in the tested varieties did not differ significantly with respect to irrigation at different ASM level irrespective of the stage of sampling. The highest pol (%) was recorded in CoJ 64 (16.3 and 17.4%) followed by Co 0238 (16.0 and 17.1%), CoS 767 (12.4 and 16.1%) and the lowest in CoH 128 (11.8 and 15.9%) at 8^{th} and 10^{th} months, respectively. Highest values of brix (%) and pol (%) were recorded in variety Co 0238 followed by CoJ 64, CoS 767 and lowest in case of CoH 128 at 12^{th} month stage of crop (Table 4).

Table 1 Effect of water deficit on stalk height (cm) at monthly intervals (April, May, June and July) in sugarcane varieties differing in maturity group

Irrigation at ASM level	Stalk height (cm)																			
	April					May					June					July				
	Varieties																			
	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
50% ASM	12.53	13.46	14.03	12.70	13.18	22.73	28.00	33.33	29.00	28.26	53.06	62.06	71.70	58.00	61.20	127.50	142.83	159.16	125.56	138.76
40% ASM	12.70	13.03	14.43	12.46	13.15	18.70	24.86	27.96	23.36	23.72	38.96	47.66	53.40	40.50	45.13	99.26	118.23	128.30	93.26	109.76
30% ASM	13.06	13.56	13.50	12.36	13.12	17.36	23.43	26.23	21.93	22.24	33.60	41.83	50.60	36.33	40.59	85.96	107.06	122.76	83.03	99.70
Mean	12.76	13.35	13.98	12.51		19.60	25.43	29.17	24.76		41.87	50.52	58.56	44.94		104.24	122.71	136.74	100.62	
LSD (P=0.05)	V – 0.93	T - NS	T×V - NS	V×T - NS		V – 1.19	T – 1.36	T×V - NS	V×T - NS		V – 1.15	T – 1.35	T×V – 2.17	V×T – 2.18		V – 2.40	T – 2.68	T×V – 4.49	V×T – 4.46	

Table 2 Effect of water deficit on number of tillers (000/ha) at monthly intervals (April, May, June and July) in sugarcane varieties differing in maturity group

Irrigation at ASM level	Number of tillers ('000/ha)																			
	April					May					June					July				
	Sugarcane varieties																			
	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
50% ASM	75.0	84.3	75.2	91.9	81.6	109.3	101.0	96.4	121.6	107.1	129.9	126.5	120.2	135.6	128.1	151.4	146.9	142.8	153.5	148.7
40% ASM	75.6	84.6	7500	91.3	82.0	93.9	91.3	86.1	101.4	93.2	108.1	111.7	106.5	112.2	109.7	127.4	130.6	124.5	125.9	127.1
30% ASM	74.8	85.0	74.7	90.1	81.1	88.3	90.7	81.7	94.9	88.9	96.0	101.5	99.1	91.3	97.0	116.7	123.9	119.8	115.2	118.9
Mean	75.1	84.6	75.0	91.1		97.2	94.3	88.0	106.0		111.4	113.2	108.6	113.0		131.8	133.8	129.0	131.6	
LSD (P=0.05)	V - 4.62	T - NS	T×V - NS	V×T - NS		V - 4.73	T - 5.42	T×V - NS	V×T - NS		V – 2.36		T – 3.41	T×V - 4.99	V×T - 5.17	V - NS	T – 3.0		T×V - 7.25	V×T - 6.71

Least significant difference test was applied at 5 per cent probability level to compare the mean differences. (ASM – Available Soil Moisture; V – Varieties; T – Treatments; T × V – Treatments at the same level of varieties; V × T – Varieties at the same level of treatments)

Table 3 Effect of water deficit on brix(%) (after different time intervals) in sugarcane varieties differing in maturity group

Treatment	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
	8th month of planting					10th month of planting					12th month of planting				
Irrigation at 50% ASM (Control)	15.61	16.08	18.93	19.38	17.5^{A}	19.35	19.19	20.41	20.52	19.87	20.27	20.67	21.27	20.98	20.80
Irrigation at 40% ASM (Mild stress)	15.35	16.02	18.8	19.25	17.35^{AB}	19.26	19.17	20.37	20.45	19.81	20.10	20.60	21.17	20.91	20.69
Irrigation at 30% ASM (Severe stress)	15.31	15.83	18.6	19.32	17.26^{B}	19.23	19.09	20.35	20.43	19.78	19.57	20.46	21.12	20.87	20.50
Mean	15.42^{D}	15.98^{C}	18.78^{B}	19.32^{A}		19.28^{B}	19.15^{C}	20.38^{A}	20.46^{A}		19.98^{D}	20.58^{C}	21.18^{A}	20.92^{B}	
CV	Varieties – 1.784; Treatments – 1.622					Varieties – 1.257; Treatments – 0.864					Varieties – 1.475; Treatments – 1.086				
LSD	V – NS	T – 0.27		T×V – NS	V×T – NS	V – NS	T – 0.16	T×V – NS		V×T – NS	V – NS		T – 0.21	T×V – 0.37	V×T – 0.46

Table 4 Effect of water deficit on Pol% (after different time intervals) in sugarcane varieties differing in maturity group

Treatment	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
	8th month of planting					10th month of planting					12th month of planting				
Irrigation at 50% ASM (Control)	11.98	12.46	16.02	16.38	14.21^{A}	15.95	16.08	17.21	17.46	16.68	17.01	17.99	18.25	18.35	17.9^{A}
Irrigation at 40% ASM (Mild stress)	11.78	12.41	15.94	16.33	14.11^{AB}	15.90	16.07	17.17	17.39	16.63	16.81	17.76	18.03	17.92	17.63^{B}
Irrigation at 30% ASM (Severe stress)	11.71	12.32	15.90	16.28	14.05^{B}	15.85	16.03	17.05	17.30	16.56	16.75	17.70	17.98	17.92	17.59^{B}
Mean	11.82^{D}	12.4^{C}	15.95^{B}	16.33^{A}		15.9^{C}	16.06^{C}	17.14^{B}	17.38^{A}		16.85^{C}	17.82^{B}	18.09^{A}	18.06^{A}	
CV	Varieties – 0.976; Treatments – 0.664					Varieties – 1.049; Treatments – 1.161					Varieties – 0.842; Treatments – 1.161				
LSD	V – 0.16	T – 0.09	T×V – NS	V×T – NS		V – NS	T – 0.25	T×V – NS	V×T – NS		V – 0.17	T – 0.19	T×V – NS	V×T – NS	

Least significant difference test was applied at 5 per cent probability level to compare the mean differences. (ASM – Available Soil Moisture; V – Varieties; T – Treatments; T × V – Treatments at the same level of varieties; V × T – Varieties at the same level of treatments)

Table 5 Effect of water deficit on purity (%) (after different time intervals) in sugarcane varieties differing in maturity group

Treatment	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
	8th month of planting					10th month of planting					12th month of planting				
Irrigation at 50% ASM (Control)	77.39	78.22	84.81	85.17	81.40	82.60	84.17	84.60	85.26	84.16	86.63	87.80	86.77	88.47	87.42^{A}
Irrigation at 40% ASM (Mild stress)	77.06	77.66	84.52	85.02	81.07	82.34	83.87	84.24	85.19	83.91	84.58	86.81	85.99	86.08	85.87^{B}
Irrigation at 30% ASM (Severe stress)	76.16	77.41	84.40	84.49	80.61	82.08	83.64	83.57	84.52	83.45	86.12	85.75	85.42	85.98	85.82^{B}
Mean	76.87^{C}	77.76^{B}	84.58^{A}	84.89^{A}		82.34^{C}	83.89^{B}	84.14^{AB}	84.99^{A}		85.77^{C}	86.79^{AB}	86.06^{BC}	86.84^{A}	
CV	Varieties – 2.082; Treatments – 1.53					Varieties – 1.69; Treatments – 1.613					Varieties – 0.789; Treatments – 1.336				
LSD	V – NS		T – 1.17	T×V – NS	V×T – NS	V – NS		T – 1.23	T×V – NS	V×T – NS	V – 0.77		T – 1.09	T×V – NS	V×T – NS

Table 6 Effect of water deficit on CCS (%) (after different time intervals) in sugarcane varieties differing in maturity group

Treatment	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean	CoH 128	CoS 767	Co 0238	CoJ 64	Mean
	8th month of planting					10th month of planting					12th month of planting				
Irrigation at 50% ASM (Control)	7.71	8.02	10.83	11.12	9.42^{A}	10.63	10.85	11.65	11.86	11.25	11.67	12.37	12.60	12.59	12.31
Irrigation at 40% ASM (Mild stress)	7.59	7.98	10.77	11.06	9.35^{AB}	10.59	10.82	11.60	11.82	11.21	11.26	12.13	12.25	12.15	11.95
Irrigation at 30% ASM (Severe stress)	7.49	7.94	10.61	11.01	9.26^{B}	10.57	10.80	11.47	11.71	11.13	11.21	12.06	12.20	12.13	11.90
Mean	7.59^{D}	7.98^{C}	10.74^{B}	11.06^{A}		10.6^{D}	10.82^{C}	11.57^{B}	11.79^{A}		11.38^{B}	12.19^{A}	12.35^{A}	12.29^{A}	
CV	Varieties – 1.566; Treatments – 1.634					Varieties – 1.98; Treatments – 2.414					Varieties – 3.806; Treatments – 2.267				
LSD	V – 0.17	T – 0.14	T×V – NS	V×T – NS		V – NS	T – 0.26	T×V – NS	V×T – NS		V – NS	T – 0.26	T×V – NS	V×T – NS	

Least significant difference test was applied at 5 per cent probability level to compare the mean differences. (ASM – Available Soil Moisture; V – Varieties; T – Treatments; T × V – Treatments at the same level of varieties; V × T – Varieties at the same level of treatments)

Varieties CoJ 64 (84.89%) and Co 0238 (84.58%) being at par recorded higher purity (%) as compared to CoS 767 (77.76%) and CoH 128 (76.87%) and later two being at par at 8th month of sampling. With advancement of sampling stage, purity (%) increased in all the varieties (Table 5). However at harvest, maximum purity (%) was recorded in CoS 767 followed by CoJ 64, Co 0238 and lowest in CoH 128. Fiaz *et al*. (2013) had also suggested the interdependence of sugar recovery in the genetic makeup of the varieties. Though non-significant differences in CCS (%) were observed due to variable ASM levels, however, 50 (%) ASM resulted in numerically higher values of CCS (%) compared to 40% and 30% ASM levels. This might be due to the fact that irrigations were restricted only during the formative phase of the sugarcane crop. With the crop advancement, the negative effect of water stress may be nullified and no significant differences were observed on juice quality parameters at the time of maturity. The results are in consonance with Singh *et al*. (2001), Singh *et al*. (2006) and Fiaz *et al*. (2013) who reported that sugar recovery in sugarcane was not affected due to different levels of irrigation applied during pre-monsoon/formative period of growth.

Sucrose synthase (SS, EC 2.4.1.13)

Specific activity of sucrose synthase (SS) was not significantly different under all the studied ASM levels (30%, 40% and 50% ASM) and varieties during 10th month of study (Fig 2). Therefore, no significant relationship was observed between activity of sucrose synthase and maturity behaviour of varieties. Our results are confirmatory with the earlier findings of Zhu *et al*. (1997), Lingle (1998), Batta *et al*. (2008) that no relationship was observed between the activity of sucrose synthase and maturity behaviour of the genotype.

Sugar yield

Sugar yield is the product of cane yield and sugar recovery. Irrespective of varieties, significant yield reduction was observed under mild stress (31.09%) and severe stress (40.47%) compared to 50% ASM level. Significantly higher

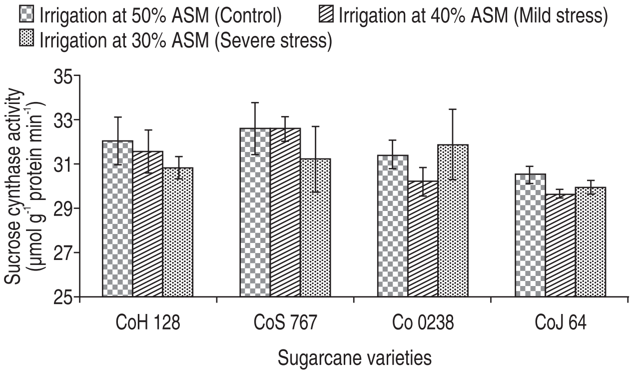

Fig 2 Effect of water deficit on sucrose synthase activity (µmol/g protein min) in sugarcane varieties differing in maturity group.

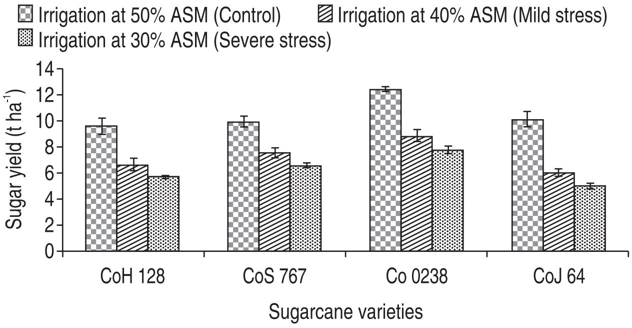

Fig 3 Effect of water deficit on sugar yield (t/ha) in sugarcane varieties differing in maturity group.

sugar yield (9.70 t/ha) was recorded with Co 0238 followed by CoS 767 (8.05 t/ha), CoH 128 (7.31 t/ha) and least with CoJ 64 (7.06 t/ha). Interaction between ASM levels and varieties was also found significant**.**

Co 0238 (7.81 and 8.85 t/ha) produced highest sugar yield followed by CoS 767 (6.60 and 7.57 t/ha), whereas lowest sugar yield was recorded in varieties CoH 128 (5.70 and 6.62 t/ha) and CoJ 64 (5.00 and 6.05 t/ha) at 30% and 40% ASM level, respectively. However at 50% ASM level varieties Co 0238 (12.44 t/ha) produced highest cane yield followed by CoJ 64 (10.15 t/ha), CoS 767 (9.98 t/ha) and CoH 128 (9.62 t/ha) and later two were statistically at par. It might be due to that reduction in sugar yield contributing factors, viz. cane length, single cane weight, NMC and cane yield were less affected in these varieties (Co 0238 and CoS 767). Similar findings of reduction in sugar yield of different sugarcane varieties under water stress conditions had been reported by da Silva and de Costa (2004) present findings are also in conformity with the findings of Khan *et al*. (2013) that highest sugar yield was observed in AEC 81-0819 and lowest in L116 under drought condition as well as normal condition.

Conclusion

Sugarcane varieties Co 0238 and CoS 767 have better adaptive capacity to moisture stress conditions in terms of growth behavior, juice quality and total sugar yields. The reduction percentage was highest at 30% ASM level (40.56%) followed by 40% ASM level (31.09%) as compared to 50% ASM level.

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