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VARIETAL VARIATION IN STOMATAL CONDUCTANCE, TRANSPIRATION AND PHOTOSYNTHESIS OF COMMERCIAL SUGARCANE VARIETIES UNDER TWO CONTRASTING WATER REGIMES

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ABSTRACT

The study was conducted to evaluate some physiological characters of commercial sugarcane varieties under different growing conditions in Sri Lanka. A field experiment was conducted at the Sugarcane Research Institute, Uda Walawe (6°21'N latitude, 80°48'E longitude and 76 m altitude) using eight sugarcane (*Saccharum* hybrid L.) varieties grown under irrigated and rainfed conditions in a split plot design. Stomatal conductance (g_s), instantaneous transpiration rate (E_1) and photosynthetic rate per unit leaf area (P_n) were measured. Canopy stomatal conductance (g_c), instantaneous canopy transpiration rate (E_c) and transpiration efficiency (P_n/E_1) was calculated. The behaviour of g_s in many respects to the moisture availability and growing stage was similar to the responses seen in P_n. Water deficit significantly reduced g_s, E_1 and P_n. Recovery of g_s and P_n from water stress with rainfall was quite rapid under rainfed conditions. The varieties Co775, SL8306, SL7103 and SL88116 which had higher P_n and P_n/E_1, and lower g_s, E_1, g_c and E_c showed comparatively superior physiological performances under rainfed conditions. Water conservation through lowering stomatal conductance, both at the individual leaf and canopy level, and higher photosynthetic rate were identified as some physiological mechanisms responsible for drought tolerance of sugarcane.

***Key words**: Sugarcane, Stomatal conductance, Transpiration, Photosynthesis, Water regimes*

INTRODUCTION

Sugarcane is one of the extreme types C_4 plant and it can have extraordinarily high rates of P_n, found in crop plants (Irvine 1967; 1975 and 1983). Moreover, P_n of sugarcane does not show light saturation even at full sunlight because of their CO_2 concentrating mechanism. Therefore, even under optimum conditions, the stomatal conductance (g_s) of sugarcane is lower than that of the C_3 crops. Therefore, sugarcane could maintain a higher rate of P_n under full sunlight with lower rates of canopy transpiration rate (E_c) to increase the water use efficiency (De Costa 2000). The light saturated maximum P_n in commercial varieties of sugarcane ranges from 31 to 53μmol $CO_2 m^{-2}s^{-1}$ (Irvine 1967 and Roberts *et al*. 1990). Moreover, it is at a maximum during the grand growth stage and tends to decrease during late grand growth and maturation phases of sugarcane (Gascho and Shih 1983).

However, water availability affects the rate of P_n. Gascho and Shih (1983) recorded that positive P_n occurs in leaves of sugarcane at or below the wilting point. However, the amount of P_n was much less than in plants with an adequate water supply. Moreover, Roberts *et al*. (1990) revealed that P_n, g_s and leaf extension growth of sugarcane were very low under rainfed conditions particularly during dry periods. However, differences in P_n and g_s between well watered and water stressed was not established early enough under stress and were not as consistent as for cell extension growth. Moreover, he pointed out that the effect of rainfall and recovery of P_n, g_s and leaf extension growth occurred rapidly in rainfed cane except in cases where cane had only senescing leaves. All the above physiological variables showed a greater level of activity than was observed in cane receiving regular irrigation.

The behaviour of g_s is in many respects was similar to the responses seen in P_n. The g_s responds to the onset of stress at about the same value of water stress as P_n and after prolonged stress very low g_s are observed. Maximum values of g_s of around 400mmol $m^{-2}s^{-1}$ were observed on well irrigated cane, in full radiation but with only moderate vapour pressure deficit (Roberts *et al*. 1990 and Grantz *et al*. 1987). Therefore, measurements of g_s made directly by porometers could be used as a means of selecting drought tolerant varieties (Roberts *et al*. 1990). This could apply to varieties which conserve water by stomatal closure or alternatively maintain a high g_s and moderate leaf water potential by more efficient or deeper rooting patterns. Bull and Glasziou (1975) recorded that in all cases investigated any reduction in P_n was accompanied by increased stomatal resistance. Moreover, the decrease of P_n in sugarcane under water stress was caused by both stomatal and non-stomatal fac-

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tors, initially mainly by stomatal closure, followed by non-stomatal factors as stress became severe (Du *et al*. 1996). Therefore, the objective of this study was to evaluate the stomatal limitation of P_n in commercial sugarcane varieties in Sri Lanka and thereby identifying high yielding varieties under well watered and water stressed conditions and as well as drought tolerant traits of sugarcane which could be used for the hybridization programme to produce better hybrids of sugarcane for different sugarcane growing environments in Sri Lanka.

METHODOLOGY

A field experiment was conducted at the Sugarcane Research Institute (*SRI*), Uda Walawe (6°21'N latitude, 80°48'E longitude and 76 m altitude) where the annual average rainfall is about 1450 mm with a distinctly bimodal distribution (Panabokke 1996). The mean annual temperature ranges from 22^0C - 32^0C. The average evaporation from a free water surface is about 5mm per day (Sanmuganathan 1992). The soil has been classified as Ranna series of *Reddish Brown Earth* (*RBE*), great group of Rhodustalfs (order Alfisols, suborder Ustalfa), sandy clay loam texture (De Alwis and Panabokke 1972; Anon 1975), and moderately well drained with a pH of 6.5 - 6.7. The bulk density of the soil ranges from 1.59 – 1.85gcm^{-3} (Sithakaran 1987). The respective soil water contents at saturation, field capacity and permanent wilting point are 30%, 20% (10kPa) and 8% (1500kPa), respectively (Sanmuganathan 1992).

The experiment was conducted as a two-factor factorial with 16 treatment combinations, composed of two main plot treatments as 'irrigated' ('well-watered') and 'rainfed' ('water-stressed') and eight commercial sugarcane (*Saccharum* hybrid L.) varieties (i.e. SL7103, SL7130, SL8306, SL8613, SL88116, SLI121, M438/59 and Co775) as subplot treatments, in a split plot design. The irrigated treatment received 2m^3 of water per irrigation at 5-10 day intervals to maintain the soil water potential in the top 1m above -0.05MPa. One meter deep trenches were made between irrigated and rainfed plots to avoid the lateral movement of water. Each treatment combination was replicated thrice. Plot size was 9m x 8.22m, containing 6 furrows at 1.37m spacing. The sugarcane was planted and maintained under recommended procedures (Anon 1991).

Stomatal conductance (g_s) and instantaneous transpiration rate (E_l) per unit leaf area were measured in leaves of top, middle and bottom parts of the canopy layers using a steady-state porometer (LI-1600, *LI-COR*, Inc. LTD., Lincoln, USA) at 6 and 9 months after planting (*MAP*). The measurements were done between 09:30 and 14:30h. Canopy stomatal conductance (g_c) and instantaneous canopy transpiration rate (E_c) were computed by summing the products of mean leaf g_s and partial leaf area index in the three canopy layers (Squire and Black 1981).

Gas exchange studies were carried out using a portable photosynthetic system (LI –6400 and LI –6200, *LI-COR*, Inc. LTD., Lincoln, Nebraska, U.S.A.) comprising a LI 6200 gas analyser with a LI 6250 computer software. The apparatus was calibrated prior to measurements as described by Welles (1986). Leaf chamber in one litre capacity was adjusted to expose an area of 20cm^2 of the leaf. Atmospheric air was drawn into the system, by keeping the leaf chamber open. Then, a portion of sugarcane leaf was clamped into the leaf chamber. Measurements were taken when a steady decline in CO_2 concentration in the chamber was observed. CO_2 assimilation rate, stomatal conductance, transpiration rate, internal leaf CO_2 concentration, air CO_2 concentration and photosynthetically active radiation (*PAR*) were monitored. The relative humidity (RH%) of the system was maintained at 65-70% during the measurement by adjusting the air flow rate through the magnesium perchlorate desiccant.

Measurements were taken at 6 *MAP*, 8 *MAP* and 11 *MAP* on six days and two sessions per day. Photosynthetic (CO_2 assimilation) rate in all the leaves from top to bottom of the stalk in each variety was measured to identify the potential photosynthetic capacity and effective and ineffective leaves in the stalk. Transpiration efficiency (P_n/E_l) of each and every experimental plot was calculated as the ratio between instantaneous photosynthetic rate (P_n) and transpiration rate (E_l) to determine the efficiency of water transpire through the stomata while photosynthesizing.

Significance of treatment differences was tested by analysis of variance (*ANOVA*). Means were separated by the least significant difference (*LSD*). Correlations between variables were determined by simple linear correlation analysis. The *SAS* statistical computer package was used to analyse the data.

RESULTS AND DISCUSSION

Impacts of variation in water regimes on stomatal conductance and transpiration

There were significant water regime x variety interaction effects on stomatal conductance and instantaneous transpiration rate in terms of both individual leaves in the top leaf layer (g_s, E_l) and the whole canopy (g_c, E_c). Measurements taken from 159 and 167 *DAP* in Septem-

Table 1 Mean stomatal conductance (g_s) and instantaneous transpiration rate (E_l) ± standard error per unit leaf area at 159 and 167 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	g_s (cm s^{-1})		E_l (µg cm^{-2} [leaf area] s^{-1})	
	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	0.299± 0.03	0.119±0.02	6.062±0.36	2.185±0.27
Co775	0.225±0.02	0.117±0.03	4.298±0.14	2.068±0.30
SL8306	0.233±0.02	0.068±0.01	4.508±0.23	1.374±0.19
SL8613	0.188±0.02	0.079±0.02	3.699±0.25	1.454±0.22
SL7130	0.243±0.02	0.064±0.02	4.488±0.23	1.381±0.20
M438/59	0.212±0.02	0.072±0.01	4.601±0.33	1.527±0.22
SL7103	0.233±0.02	0.063±0.01	4.854±0.43	1.401±0.26
SLI121	0.294±0.04	0.064±0.01	5.608±0.56	1.442±0.21
Mean	0.241±0.01	0.081±0.01	4.765±0.13	1.604±0.09
LSD_v	0.067	0.044	0.955	0.663
LSD_w	0.013		0.233	

Note: LSD_v = *LSD* (p=0.05) for varietal comparisons within a water regime; LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

ber 2002, which fell within the period when the crops were experiencing a prolonged and continuous soil moisture depletion, showed the significant varietal variation of g_s and E_l within and between water regimes (Table 1). Moreover, soil water deficits significantly ($p<0.001$) reduced g_s and E_l in all varieties tested during prolonged and continuous soil moisture depletion from 159 and 167 *DAP*. It reduced the average g_s to the lowest value of 0.8mm s^{-1}, which confirmed the findings of Inman-Bamber and De Jager (1986) that the g_s of sugarcane reached a minimum of about 0.5 to 1.0mm s^{-1} when midday leaf water potential decreased by about -1.3 to -17 MPa at different water stress cycles. In the present study, the lowest g_s and E_l under rainfed conditions were observed in SL7103 and SL8306 respectively which conserving moisture during the drought. The variety SL88116 which had the highest biomass production showed the highest g_s and E_l under both irrigated and rainfed conditions (Table 1).

Measurements taken at 322 *DAP* during the short dry spell in February 2003 after the *Maha* season rainfall, show the varietal variation on g_s, E_l, g_c and E_c within and between water regimes and the interaction effect of water regime x variety (Tables 2 and 3). Moreover, at 322 *DAP*, soil water deficit significantly reduced g_s, E_l, g_c and E_c in a majority of varieties. Notably, SL8613 and SL7130 showed significantly greater g_s and E_l under rainfed conditions. The variety SL88116 which had the highest biomass production under both conditions (De Silva 2007) showed the highest g_s, E_l, g_c and E_c under

Table 2 Mean stomatal conductance (g_s) and instantaneous transpiration rate of top leaves (E_l) ± standard error at 322 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	Mean stomatal conductance of top leaves, g_s, (cm s^{-1})		Instantaneous transpiration rate of top leaves, E_l, (µg cm^{-2} [leaf area] s^{-1})	
	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	0.195± 0.06	0.069±0.01	6.163±1.16	1.798±0.31
Co775	0.142±0.04	0.057±0.01	5.028±1.70	1.765±0.41
SL8306	0.173±0.02	0.103±0.02	4.387±1.10	3.498±0.11
SL8613	0.079±0.03	0.108±0.03	2.793±0.66	3.912±0.10
SL7130	0.072±0.01	0.132±0.02	1.792±0.13	4.588±1.29
M438/59	0.177±0.01	0.095±0.02	4.178±0.18	1.992±0.21
SL7103	0.172±0.04	0.077±0.02	4.647±0.88	2.183±0.52
SLI121	0.147±0.03	0.112±0.03	4.457±0.68	2.613±0.76
Mean	0.145	0.094	4.181	2.794
LSD_v	0.100	0.060	2.706	1.885
LSD_w	0.028		0.814	

Note: LSD_v = *LSD* (p=0.05) for varietal comparisons within a water regime; LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

Table 3 Canopy stomatal conductance (g_c) and instantaneous canopy transpiration rate (E_c) ± standard error at 322 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	g_c (cm s^{-1})		E_c (µg cm^{-2} [land area] s^{-1})	
	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	1.251±0.35	0.279±0.06	37.93±8.70	10.25±3.82
Co775	0.941±0.19	0.344±0.10	32.53±9.26	9.78±2.15
SL8306	0.899±0.14	0.420±0.07	31.19±5.50	12.28±1.74
SL8613	0.719±0.44	0.500±0.11	18.49±10.62	15.79±3.39
SL7130	0.559±0.17	0.669±0.12	14.04±3.92	22.65±7.75
M438/59	0.624±0.11	0.328±0.07	17.41±2.70	7.59±1.29
SL7103	0.704±0.14	0.296±0.05	18.40±3.76	7.75±0.94
SLI121	1.090±0.35	0.349±0.10	34.93±7.56	8.32±2.55
Mean	0.838	0.386	25.21	11.33
LSD_v	0.673	0.256	19.743	8.620
LSD_w	0.189		5.379	

Note: LSD_v = *LSD* (p=0.05) for varietal comparisons within a water regime; LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

Table 4 Mean net photosynthetic rate (P_n) and stomatal conductance (g_s) ± standard error of all leaves in the canopy during the period from 180 – 183 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	P_n (µmol m^{-2} s^{-1})		g_s (mol m^{-2} s^{-1})	
	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	24.7±3.1	16.7±2.5	0.775±0.12	0.541±0.10
Co775	26.5±4.4	20.9±2.5	0.639±0.08	0.407±0.03
SL8306	28.1±3.4	27.3±2.0	0.726±0.06	0.373±0.03
SL8613	25.1±3.2	15.5±2.2	0.783±0.15	0.378±0.03
SL7130	26.0±3.9	21.1±3.1	0.531±0.06	0.370±0.03
M438/59	27.2±3.4	10.4±1.9	0.763±0.11	0.336±0.02
SL7103	25.5±2.7	15.2±2.4	0.695±0.07	0.428±0.05
SLI121	23.0±5.3	17.2±3.4	0.490±0.12	0.329±0.07
Mean	26.0	18.1	0.69	0.40
LSD_w	2.90		0.06	

Note: LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

irrigated conditions and the lowest g_c and the second lowest g_s and E_l under rainfed conditions. The variety Co775 which had second highest biomass production under both conditions recorded lowest g_s and E_l under rainfed conditions whereas lowest E_c was recorded in M438/59. SL7103 observed second lowest g_c and E_c under rainfed conditions (Table 2 and 3).

When yields under both water regimes were considered, cane yield of this experiment showed significant positive correlations with g_s (r = 0.49 with p=0.05), E_l (r = 0.51 with p=0.04), g_c (r = 0.80 with p=0.0002) and E_c (r = 0.74 with p=0.0001). This indicated that greater stomatal opening and efficient water use are pre-requisites for increasing overall sugarcane yields in this environment. On the other hand, cane yield under rainfed conditions showed moderate negative correlations with g_s (r = -0.53 with p=0.18), El (r = -0.30 with p=0.47) and g_c (r = -0.22 with p=0.60). This indicated that water conservation mechanisms (i.e. lowering of g_s and El) are needed in a variety to achieve higher yields under rainfed conditions. For example, the variety SL88116 which showed the highest rainfed cane yield had the second lowest g_s and El and lowest g_c under rainfed conditions at 322 *DAP*. Conversely, SL8613 which had the lowest rainfed cane yield had the second highest E_l, g_c and E_c under rainfed conditions. Moreover, the present study confirmed that water conservation under drought conditions is of major importance in obtaining a satisfactory yield of sugarcane (De Silva 2007). As drought is common in many sugarcane growing areas and irrigation is often not possible, it is important to consider reducing transpiration and thereby reducing consumptive water use.

Impacts of variation in water regimes on stomatal conductance, transpiration and photosynthesis

During prolong dry period from 180-183 *DAP*, soil water deficits significantly (p<0.05) reduced P_n and g_s in all varieties tested except in SL8306 (Table 4). The behaviour of g_s in majority of tested varieties was similar to the responses seen in P_n. However, SL8306 recorded the highest P_n under both water regimes and the lowest reduction of P_n due to water stress among all varieties tested under rainfed conditions. SL88116 had the second highest and the highest g_s within the irrigated and rainfed regimes respectively. The P_n varied among tested varieties from 23-28μmol $m^{-2}s^{-1}$ and 10-27μmol $m^{-2}s^{-1}$ under irrigated and rainfed conditions respectively (Table 4).

At 256 *DAP*, P_n/E_l showed significant varietal variation under rainfed conditions and water regime x variety interaction (Table 5). Both at 256 *DAP* (during the *Maha* season rainfall) and at 340 *DAP* [(end of the *Maha* season rainfall) (late grand growth and maturation stages)], a majority of varieties tested recorded greater P_n, E_l and g_s, and lower P_n/E_l under rainfed conditions than irrigated conditions with the few exceptions (Tables 5 and 6). The difference in these variables between irrigated and rainfed conditions at these stages are due to the different developmental stages of the crops in spite of differential water availability under the two conditions. Because of the delayed development of the rainfed crops (De Silva and De Costa 2004 and De

Table 5 Mean net photosynthetic rate (P_n), instantaneous transpiration rate (E_l) and transpiration efficiency (P_n/E_l) ± standard error at 256 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	P_n (μmol CO_2 m^{-2} s^{-1})		E_l (mol H_2O m^{-2} s^{-1})		P_n/E_l (μmol CO_2 mol^{-1} H_2O transpired)	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	22.4±3.4	20.4±0.5	1.8±0.3	2.4±0.1	12.3±0.2	8.7±0.4
Co775	28.3±2.7	21.7±0.5	3.3±0.1	1.8±0.3	8.6±0.6	13.4±2.9
SL8306	17.9±1.5	24.2±1.3	1.9±0.0	2.1±0.2	9.6±1.0	11.7±0.5
SL8613	8.4±1.5	23.3±1.4	0.9±0.0	2.5±0.1	9.6±1.6	9.1±0.2
SL7130	17.5±0.8	28.4±0.6	1.4±0.4	2.4±0.1	14.0±4.0	12.0±0.7
M438/59	12.0±0.9	27.6±0.3	0.8±0.1	3.2±0.1	16.5±3.0	8.5±0.3
SL7103	21.1±1.8	23.8±1.7	1.5±0.3	2.6±0.0	15.2±2.4	9.0±0.6
SLI121	18.7±3.1	26.9±0.7	2.2±0.3	2.7±0.1	8.4±1.2	10.0±0.6
Mean	18.3±1.3	24.5±0.6	1.7±0.2	2.5±0.1	11.8±0.9	10.3±0.5
LSD_v	6.0	3.0	0.6	0.4	6.1	3.3
LSD_w	1.7		0.2		1.7	

Note: LSD_v = *LSD* (p=0.05) for varietal comparisons within a water regime; LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

Table 6 Mean net photosynthetic rate (P_n), instantaneous transpiration rate (E_l) and transpiration efficiency (P_n/E_l) ± standard error at 340 *DAP* in different sugarcane varieties under irrigated and rainfed conditions.

Variety	P_n (μmol CO_2 m^{-2} s^{-1})		E_l (mol H_2O m^{-2} s^{-1})		P_n/E_l (μmol CO_2 mol^{-1} H_2O transpired)	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
SL88116	21.2±2.3	32.0±2.2	4.3±0.4	5.8±0.1	5.0±0.7	5.5±0.5
Co775	29.5±1.1	22.8±1.6	5.0±0.4	4.5±0.6	5.9±0.3	5.1±0.3
SL8306	21.4±0.3	29.3±1.3	4.3±0.1	5.8±0.1	5.0±0.1	5.1±0.2
SL8613	17.8±0.6	27.2±3.5	3.2±0.1	5.6±0.6	5.5±0.3	4.9±0.1
SL7130	15.0±2.8	30.4±0.9	3.5±0.4	5.7±0.2	4.2±0.3	5.4±0.3
M438/59	19.0±1.2	22.9±2.3	3.6±0.3	4.4±0.4	5.3±0.1	5.2±0.5
SL7103	22.0±2.3	14.2±1.6	4.3±0.2	3.1±0.1	5.2±0.8	4.5±0.4
SLI121	17.9±1.2	27.3±2.7	4.3±0.2	5.0±0.4	4.2±0.5	5.4±0.1
Mean	20.5±1.0	25.8±1.3	4.1±0.1	5.0±0.2	5.0±0.2	5.1±0.1
LSD_v	5.1	6.9	0.8	1.2	1.4	1.0
LSD_w	2.0		0.4		0.4	

Note: LSD_v = *LSD* (p=0.05) for varietal comparisons within a water regime; LSD_w = *LSD* (p=0.05) for comparison of mean values between water regimes.

Silva 2007), at the time of measuring photosynthesis, leaves of the rainfed crop were probably at a more metabolically active stage than the leaves of the irrigated crop, which were near maturation. P_n is at a maximum during the grand growth stage and tends to decrease during late grand growth and maturation phases (Gascho and Shih 1983).

In agreement with current findings, Roberts *et al*. (1990) pointed out that the effect of the rainfall and recovery of all above physiological variables show a greater level of activity under rainfed conditions than observed in cane receiving regular irrigation. In the present study, Co775 recorded the highest $P_{n,}$ E_l and g_s both at 256 and 340 *DAP* and highest P_n/E_l at 340 *DAP* under irrigated conditions whereas it had the lowest g_s and E_l, and the highest P_n/E_l under rainfed conditions at 256. At 340 *DAP*; SL88116 recorded the highest $P_{n,}$ $E_{l,}$ g_s and P_n/E_l under rainfed conditions. The lowest E_l and g_s were observed in SL7103 under rainfed conditions. Moreover, varieties SL8306 (both at 256 and 340 *DAP*), Co775 (at 256 *DAP*) and SL88116 (at 340 *DAP*) showed greater P_n/E_l under rainfed conditions than irrigated conditions [(Tables 5 and 6) (Data of simultaneous measurements of g_s at 256 and 340 *DAP* are not shown)].

Greater P_n/E_l could be an important trait in drought resistant varieties. The g_s is a key parameter that control both P_n and E_l because of the central position of stomata in the leaf gas exchange pathway (De Costa 2000). Sensitivity of stomata to water stress contributes to drought tolerance of a variety. More sensitive stomata could conserve more water until yield formation. Varieties with less sensitive stomata may be able to maintain P_n at a higher rate and may produce a higher yield under intermittent drought but it does not persist for a long period (Ludlow and Muchow 1990). However, accurate determination of P_n, E_l, g_s and P_n/E_l under field conditions are difficult because it is difficult to impose a specific level of water stress on plants under open field conditions. Above variables in sugarcane respond quickly to unpredictable rainfall that occurs at any time during the dry spells as it is an indeterminate type long duration crop.

CONCLUSIONS

The study showed that there is adequate varietal variation in the evaluated physiological characters under the different growing conditions. Great differences existed between irrigated and rainfed conditions in the characters and varied significantly with the time and stage of crop growth. Therefore, it is required to evaluate above characters at varying levels of water stress on plants during grand growth stage in accurate determination of physiological response of determining yield and drought resistance. Among the eight varieties tested, there was no single variety in which all above characters performed at favourable levels under different conditions. Different characters were responsible for higher performances in different varieties under different conditions. Therefore, we recommend to use above characters which have shown significant correlations with cane yield under different conditions for hybridisation programmes to produce hybrids in which several characters are combined at favourable levels for different sugarcane growing conditions in Sri Lanka.

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