Irrigation management based on reference evapotranspiration for pre-sprouted plantlets of sugarcane cultivars

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ABSTRACT: The pre-sprouted sugarcane plantlets (PSP) system aims the production of healthy and vigorous plants in reduced time, reducing the number of stalks needed for planting. Irrigation is used in all PSP system stages and water management plays an important role. Stage 1 acclimation follows the budding stage and lasts for approximately 21 days. At this stage the plantlets are grown within an agricultural greenhouse to improve initial development. The objectives of this trial were: to identify the irrigation management which results in highest plantlet growth; to evaluate if responses to irrigation management depends on the cultivar; to evaluate water consumption and water use efficiency at early stage under PSP system; and to assess the water management effect on substrate water matrix potential and stomatal conductance in the cultivar IACSP95-5000. The experimental design was a split-plot randomized block design with four replications. Treatments applied in the plots were different irrigation depths based on daily reference evapotranspiration (ETo): 96, 80, 64 and 48%, estimated by Penman–Monteith method. In the subplots, there were sugarcane cultivars IAC91-1099, IACSP95-5000 and IACSP97-4039. Irrigation management based on 80% ETo resulted in higher growth, dry mass accumulation and greater leaf area. Water use efficiency was not influenced by irrigation management. IAC91-1099 presented higher overall growth, leaf area and dry mass accumulation. Water consumption was cultivar-dependent in irrigation managements using 80 and 96% of ETo. Water use efficiency was higher in IAC91-1099 and lower in IACSP95-5000. Lower substrate water matrix potential reduced leaves stomatal conductance, impairing IACSP95-5000 plantlet growth.

Key words: evapotranspiration, greenhouse, water management, *Saccharum* spp., substrate, water use efficiency.

INTRODUCTION

The pre-sprouted sugarcane plantlets (PSP) sugarcane system aims to produce healthy and vigorous plantlets in short time, and also to decrease the number of stalks needed for planting. The plantlets are produced in small plastic tubes containing agricultural substrate and, after budding, the plantlets undergo two stages of acclimation under irrigation. Acclimation 1 is carried out inside greenhouse in order to allow the rapid plantlet growth (Landell et al. 2012).

Water availability and adequate temperature are prerequisites for sugarcane budding, although studies have shown that either water deficit or water excess are detrimental to budding (Yang and Chen 1980). Moreira and Cardoso (1998) reported that not only budding was soil moisture-dependent, but also the budding curves were different among seasons. However, information about early sugarcane plantlet development is scarce. Then, criteria for water use efficiency are needed to obtain vigorous plantlets in short time under PSP system, in which irrigation is essential.

Inman-Bamber and Smith (2005) presented a review on water relations of sugarcane crop under field conditions and pointed out the need for studies in different sites, management and cultivars. Some studies noticed different responses to the water deficit among cultivars (Machado et al. 2009; Ribeiro et al. 2013; Boaretto et al. 2014). These results show the importance of studies considering variation in both water management and cultivars.

The PSP system, as a new production system, lacks information related to irrigation management and differential sensitivity of sugarcane cultivars. Libardi et al. (2019) determined the crop coefficient for three cultivars in PSP system, however there is still no data about how irrigation managements on PSP system affect plantlet growth and water use efficiency.

Herein, the hypotheses were: a) that there is an ideal water management based on evapotranspiration (ETo), which promotes both plantlet growth and water use efficiency; b) plantlet growth, water consumption and water use efficiency differ among cultivars; and c) irrigation management affects the substrate water matrix potential and consequently the growth of plantlets in the cultivar IACSP95-5000 due to the reduction of stomatal conductance. The objectives of this research were: to identify the irrigation management which results in highest plantlet growth, to evaluate if responses to irrigation management depends on the cultivar, to evaluate water consumption and water use efficiency at early stage under PSP system, and to assess the water management effect on substrate water matrix potential and stomatal conductance in 'IACSP95-5000'.

MATERIAL AND METHODS

Growth conditions

The protected environment for stage 1 acclimation was a greenhouse with 67.5 m length, 8.2 m width, 4.5 m right-foot, 6.5 m high in the roof center and east-west orientation. The greenhouse cover was a transparent polystyrene film Ginegar Polysack, with 150 μm thickness, ultraviolet protection and 85% transmission of photosynthetically active radiation. There was also a 50% shading screen and the sides were closed with anti-aphid net.

Experimental procedures

Ministalks from the three sugarcane cultivars were obtained from upright stalks from sugarcane plants at eight months after planting. The plantlets production procedures were based on sugarcane PSP system developed by Landell et al. (2012). Thus, ministalks were obtained on September 14th, 2015 by removing old leaves from stalks, extracting 3.0 cm length ministalks and selecting those with visually undamaged buds. Chemical treatment was made using Azoxystrobin (0.1%) to prevent fungi diseases. Ministalks were planted in a well-drained box filled with substrate. The boxes were put inside a temperature-controlled greenhouse (34±2 °C) and high air humidity during seven days for the budding process (Landell et al. 2012). Thereafter, the budded ministalks were transplanted into 180 cm³ tubes, filled with the same substrate. The tubes were arranged in plastic trays (0.47 × 0.63 m), each one with 63 tubes. The plastic trays were put on a 0.85 m height stand, hence at 0.65 m below the irrigation bar.

A commercial substrate based on mix of pinus bark and coconut fiber was used. Substrate dry density, aeration space and readily available water (RAW) was 0.23 g·cm⁻³, 23.8% and 25.3%, respectively. These data were obtained according to substrate physical analysis methodology (Zorzeto et al. 2014) and were adequate to plant propagation in cells and trays (Berjón et al. 2004; Zorzeto et al. 2014). The substrate water retention curve was done using tension table and Richards' pressure chamber with four replications (Fig. 1).
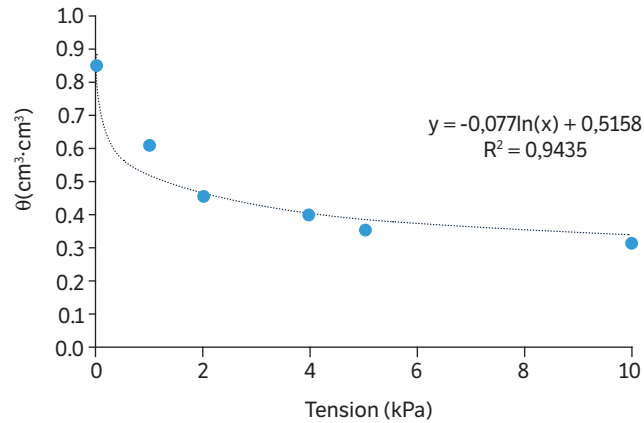
Figure 1. Water retention curve of the substrate used for pre-sprouted sugarcane plantlets procution

Weather monitoring and irrigation

The meteorological elements relative air humidity, air temperature, wind speed and net solar radiation were monitored inside and outside the greenhouse by automatic weather station (AWS). Evapotranspiration was estimated by the Penman-Monteith method (Allen et al. 1998) using outside AWS. GDD (°C) was estimated according to Ometto (1981) using inside AWS data and following Eqs. 1 to 5:

$$\text{If Tm > Tb and TM < TB, then: GDD} = \left(\frac{TM - Tm}{2} \right) + (Tm - Tb) \tag{1}$$

or

$$\text{if Tm} \leq \text{Tb < TM and TM < TB, then: GDD} = \frac{(TM - Tb)^2}{2 (TM - Tm)} \tag{2}$$

or

$$\text{if TM < Tb and TM < TB then: GDD} = 0 \tag{3}$$

or

$$\text{if Tm > Tb and TM > TB then: GDD} = (Tm - Tb) + \frac{1}{2} \frac{(TM - Tm)^2 - (TM - TB)^2}{2 \, TM - Tm} \tag{4}$$

or

$$\text{if Tm < Tb and TM > TB then: GDD} = \frac{1}{2} \frac{(TM - Tb)^2 - (TM - TB)^2}{2 \, TM - Tm} \tag{5}$$

where: GDD: growing degree-day, $°C \cdot d^{-1}$; TM: maximum daily temperature, °C; Tm: minimum daily temperature, °C; TB: superior basal sugarcane temperature, °C; Tb: inferior basal sugarcane temperature, °C; TB and Tb were 38 and 20 °C, respectively, according to Libardi et al. (2019) and considered inside greenhouse temperatures.

Minimum, maximum and average air temperature were, respectively, 19.5, 34.8 and 26.5 °C (Fig. 2) inside greenhouse. Minimum temperature was slightly lower than inferior basal temperature (20 °C) in 15 days, and the lowest value was 16.8 °C at 13 days after transplanting (DAT). Maximum temperature exceeded superior basal temperature (38 °C) in five days and the highest value was observed in the last day (22 DAT). Average air relative humidity was 57.1%, varying from 35.5 to 80.3%. Average net solar radiation was 3.7 $MJ \cdot m^{-2} \cdot d^{-1}$ and it ranged from 1.6 $MJ \, m^{-2} \, d^{-1}$ in the coldest day to 6.5 $MJ \cdot m^{-2} \cdot d^{-1}$ in the hottest day.
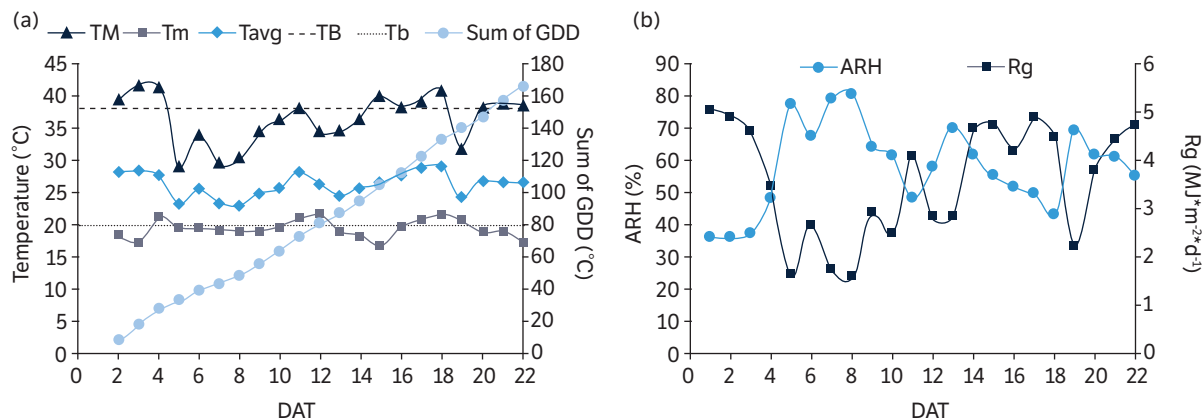
Figure 2. Maximum (TM), minimum (Tm), average (Tavg) daily temperature, maximum (TB) and minimum (Tb) sugarcane basal temperature and sum of growing degree-days (GDD) (a), air relative humidity (ARH) and global solar radiation (Rg) (b) inside the greenhouse during the experimental period.

Irrigation was performed using a mobile sprinkler irrigation bar at 1.5 m height from the ground. Its estimated Christiansen's uniformity coefficient was higher than 90% for all bar speed tested.

Experimental design and treatments

The experimental design was in split-plot randomized block with four replications. Each plot was formed by five plastic trays with 63 plantlets. Two trays in both plot borders were buffers and the three internal trays formed each one a subplot. There was also a two-trays-wide space between the border of a plot and the next one border to enable the irrigation bar speed to change for irrigation depth variation according to each irrigation treatment.

The primary treatments (plots) were 120, 100, 80 and 60% of ETo. However, as the PSP system takes place inside a greenhouse, which reduces both the radiation factor and the aerodynamic factor (Fernandes et al. 2003), the correction factor of 80% was applied in the aforementioned values (Braga and Klar 2000). Thus, the primary treatments applied were 96, 80, 64 and 48% of mean three-previous-day ETo. Irrigation was done three times a day considering the irrigation depth in each treatment, by changing the irrigation bar speed.

The secondary treatments (subplots) were the plastic trays containing one cultivar each: IAC91-1099, IACSP95-5000 and IACSP97-4039. 'IACSP95-5000' is recommended for fertile soils and some studies reported results that suggest it is susceptible to water deficit when compared to others (Machado et al. 2009; Ribeiro et al. 2013; Boaretto et al. 2014), although Marchiori et al. (2017) verified that it has some resistance to mild water stress. 'IAC91-1099' has higher plasticity than 'IACSP95-5000' concerning crop environment and it is suited for planting in regions with higher water deficit compared to 'IACSP95-5000' (Landell et al. 2007). 'IACSP97-4039' is the most indicated to restrictive environments with poor soils and water deficit (Gomes 2013). Marchiori et al. (2017) verified that morphological and physiological traits are both cultivar- and drought-dependent. Thus, it is important to understand cultivar response to different water deficit intensities.

Evaluations

Plantlets height and diameter evaluations were performed at 23 DAT. Six plantlets from the center of the tray were measured and the mean value was considered as the height and diameter replication value in each subplot. At the end of the experiment, 15 plantlets from the center of each tray were sampled. Shoot dry mass (SDM) and root dry mass (RDM) were evaluated by drying separately 15 shoots and roots at 65 °C until constant weight. The mean value of 15 shoots and roots was considered as the SDM and RDM replication value in each subplot. Total dry mass (TDM) was calculated by the sum of SDM and RDM.

Plantlet leaf area (PLA) was estimated using five plantlets per subplot, randomly selected among the 15 sampled for the dry mass analysis. Leaves were separated and scanned on LI-3100 benchtop scanner (LI-COR Inc., Lincoln, NE - USA). The mean value of the five plantlets was considered as the PLA value of each subplot replicate.

Leaf area index (LAI) was obtained by Eq. 6:

$$LAI = \frac{PLA \times 63}{0.296} \qquad (6)$$

where: LAI: leaf area index ($cm^2 \cdot cm^{-2}$); LA: plantlet leaf area (cm^2); 63 is the number of plantlets in the subplot; 0.296 is the subplot area (cm^2);

A drainage collector was installed below each subplot in order to measure water loss after irrigation. Water consumption was calculated by Eq. 7:

$$Water\ consumption\ (mm) = AD - PD \qquad (7)$$

where: AD: applied irrigation depth (mm); PD: percolated depth (mm).

The percolated depth was measured 30 min after irrigation and water use efficiency (WUE) was calculated by Eq. 8:

$$WUE = \frac{TDM \times 63}{Water\ cons.} \qquad (8)$$

where: WUE: water use efficiency ($g \cdot mm^{-1}$); TDM: plantlet total dry mass (g); 63 is the number of plantlets in the subplot; Water cons.: subplot water consumption (mm);

Stomatal conductance (g_s) was measured at 14 DAT during the following intervals: between 8:00 and 8:30 AM, between 2:30 and 3:00 PM and between 4:00 and 4:30 PM. The dynamic equilibrium porometer model AP4 (Delta-T Devices Ltd., Cambridge, UK) was used, with four replications per treatment (irrigation management) in 'IACSP95-5000'. The measurements were taken only in this cultivar due to the time interval in order to collect all replications in all four irrigation managements. It was stablished 30 min as maximum time interval between first and last measurement, hence preventing environmental effect influence on g_s. 'IACSP95-5000' was chosen because it has been used in previous studies.

Substrate water matrix potential (SWP) was monitored by MRI gas tensiometers (Hidrosense, Jundiaí, SP, Brazil). These tensiometers use pressurized gas inside ceramic capsule pores, which allows the monitoring of the substrate water matrix potential. The sensors were installed at middle height of plastic tube in 'IACSP95-5000' plots in different irrigation depth with six capsules per treatment. Due to limited number of sensors, the authors of this study chose to install it in 'IACSP95-5000' for the same reason aforementioned, added to the fact of obtaining these data in the same cultivar in which the stomatal resistance was measured, making it possible to know the relationship between these important factors.

Statistical analysis

The data were statistically analyzed using the software R (R Core Team 2018). The analysis of residues normality was performed by Shapiro–Wilk test. Analysis of variance (ANOVA) was done applying the F test and Tukey's test ($p < 0.05$) to cultivars and irrigation management. The package used in the R software was the "ExpDes" (Ferreira et al. 2014).

RESULTS AND DISCUSSION

Substrate water matrix potential

Irrigation managements resulted in different substrate matrix potential values (Fig. 3), which remained higher in the treatments with 80 and 96% ETo than the others.

The SWP was less negative in the treatment with 64% ETo than that verified in 48% ETo, in which SWP was around –4 kPa up to 16 DAT and thereafter reached values as negative as –10 kPa. Considering substrate water retention curve (Fig. 1), it was observed that in the three last days there was no RAW to plantlets submitted to 48% ETo, as its SWP was below –5 kPa (Fig. 3), according to Zorzeto et al. (2014). A similar but less pronounced trend was observed in 64% of ETo. Thus, it can be argued that irrigation depths were not enough to balance water demand by 'IACSP95-5000' plantlets in 48 and 64% ETo, especially in the former.
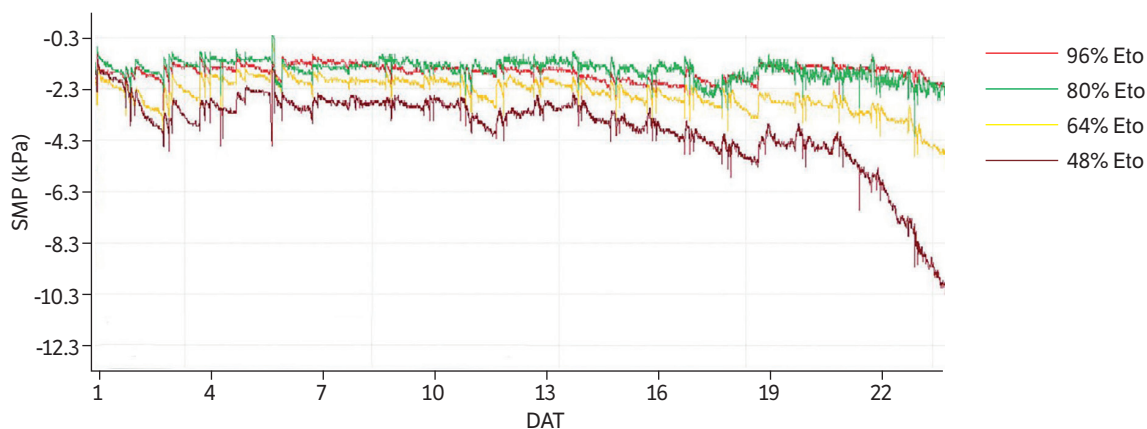

Figure 3. Substrate water potential (SWP) in each irrigation treatments (percentages of reference evapotranspiration – ETo) during 22 experimental days in IACSP95-5000 cultivar. DAT = days after transplanting.

Stomatal conductance

Irrigation managements had effect on IACSP95-5000 g_s, as observed at 14 DAT (Fig. 4). Plantlets submitted to 48% ETo irrigation management had lower g_s values than 80% ETo at two out of three times when g_s was measured and in all three compared to 96% ETo (Fig. 4). The 64% ETo treatment had similar g_s values to 80% ETo at morning, although its g_s decreased as low as 48% ETo during afternoon.

The g_s data show that applying 80% ETo had similar effect to 96% ETo with saving 20% of irrigation depth. When using 48% ETo, g_s was significantly reduced even at early morning, which indicates that plantlets could not restore its water status during night (Fig. 4). The 64% ETo management could restore its water status at morning, as it had similar g_s to 80% ETo, however during day it could not maintain g_s as high as observed 80 and 96% ETo.

The SWP at 14 DAT corroborates the g_s values (Fig. 4b), as 48% of ETo had lower SWP values than the others, hence indicating that water was strongly retained, which reduced plantlets g_s.

Although SWP values were apparently similar between 64 and 96% of ETo, in the two first measurements there was less than 50% of RAW in the 64% of ETo (Fig. 4c), whereas the 96% ETo still had around 60% of RAW, which did not restricted g_s.

In the measurement at 4:00 PM, after third and last daily irrigation, substrate RAW was increased in 64% of ETo treatment to around 55% (Fig. 4c). However, this RAW increase did not improved g_s, showing that plantlets in this treatment still did not have recovered g_s up to the values observed at 8:00 (Fig. 4a).
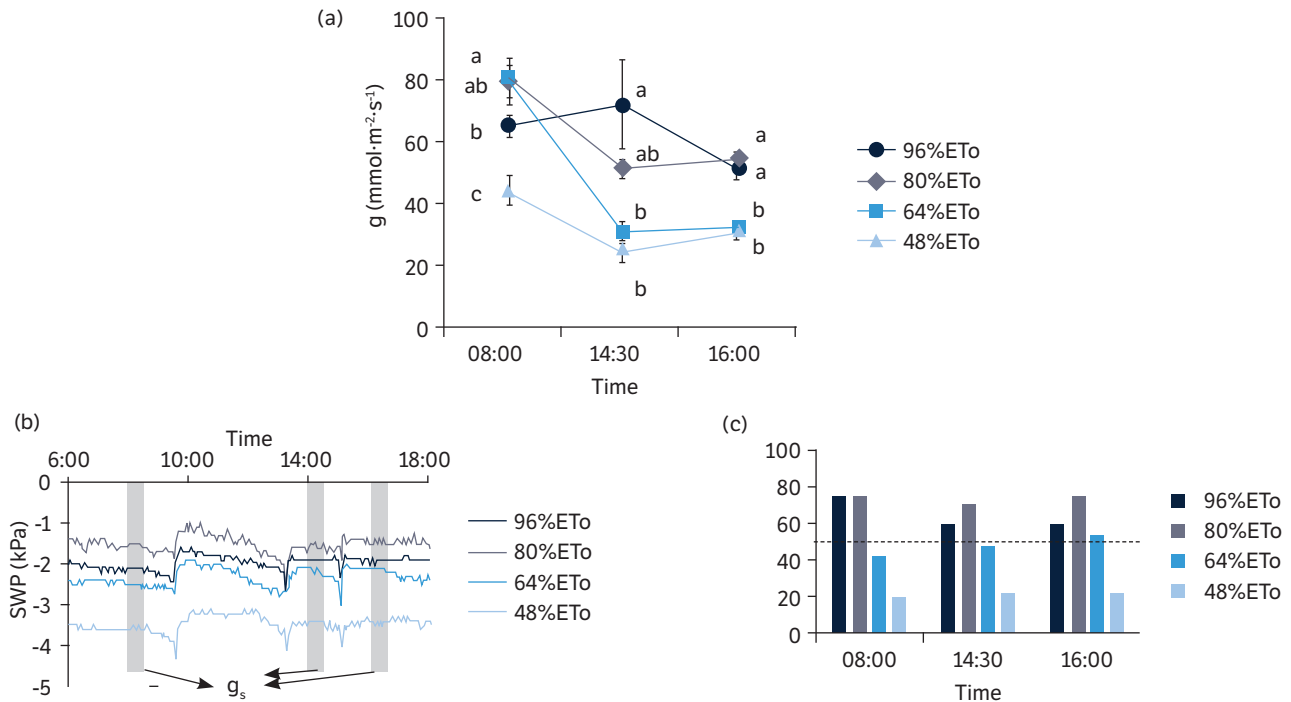
Figure 4. Plantlet stomatal conductance (g_s) (a), substrate water matrix potential (SWP) (b) and readily available water (RAW) (c) in irrigation managements based on percentage of reference evapotranspiration (ETo) for cultivar IACSP95-5000 in three times during 14th day after transplanting. Bars represent mean error. Grey bars in (b) represents the time interval in which g_s was assessed at 14 days after transplanting.

Silveira et al. (2017) evaluated sugarcane plantlets submitted to cultivation in nutrient solution and under controlled conditions for 21 days. They obtained values of g_s between 100 and 150 mmol·m^{-2}·s^{-1} for cultivar IACSP94-2094 between 11:00 AM and 1:00 PM, which may indicate that during plantlet stage the g_s is lower than in field cultivation conditions. In fact, the observed values of g_s by Silveira et al. (2017) are slightly higher to those observed in this experiment at 2:30 PM in treatments with higher percentages of ETo. This difference could be due to plantlets used by Silveira et al. (2017) were around 30 days older than the plantlets used in this study. However, the average g_s in irrigation management with 48% of the ETo was only 9.7 mmol·m^{-2}·s^{-1}, (Fig. 4) which shows the effect of water stress on the plantlets.

Water consumption

Irrigation managements had effect on plantlets water consumption and this effect was cultivar-dependent. Daily irrigation depth in 96 and 80% ETo was always higher than daily plantlet water consumption (Fig. 5a and b), hence there was no water deficit. On the other hand, daily irrigation depth and daily plantlet water consumption were equivalent in 48% ETo (Fig. 5d), which means that plantlet under this treatment could be under water deficit. In fact, water consumption, regardless cultivar, was lower in 48% ETo (Table 1). However, differences among cultivars water consumption in the other water managements were observed. Daily irrigation depth and daily plantlet water consumption in 64% ETo were close, especially after 7 DAT (Fig. 5c), hence resulting in water deficit in 'IAC91-1099' and 'IACSP97-4039' due to the fact that their water consumption was lower than observed in 80% ETo (Table 1). 'IACSP95-5000', however, had the same water consumption than 80 and 96% ETo, which implies that 64% ETo did not resulted in overall water deficit for this cultivar. Nevertheless, 'IACSP95-5000' experienced water deficit during experimental period, as the observed g_s reduction under 64% ETo at 14 DAT compared to 80% ETo (Fig. 4).

Average daily water consumption under 80% ETo ranged from 2.9 ('IACSP95-5000') to 3.2 mm ('IAC91-1099'). Under 96% ETo, mean daily consumption was 2.8 mm in 'IACSP95-5000', 3.0 mm in 'IACSP97-4039' and 3.3 mm in 'IAC91-1099'.
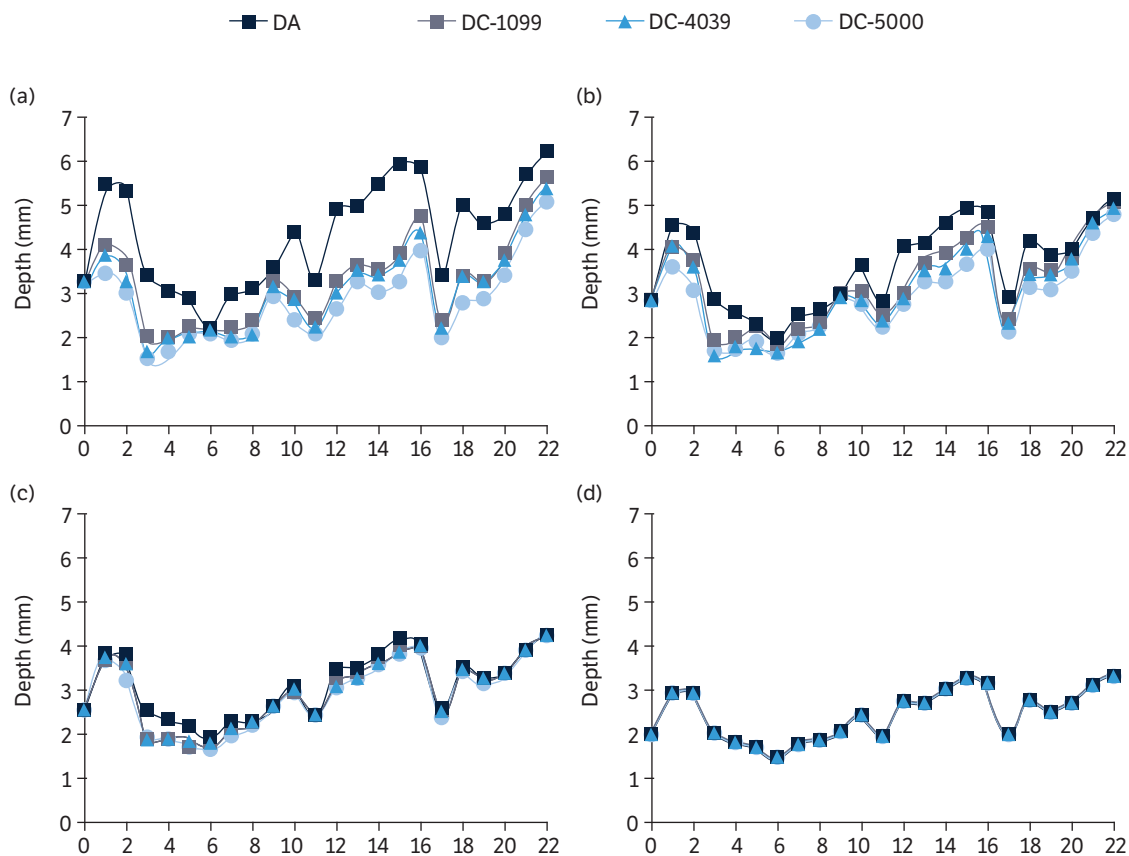
Figure 5. Irrigation depth applied (DA) and daily plantlet water consumption (DC) in irrigation management based on 96% (a), 80% (b), 64% (c) and 48% (d) of ETo for cultivars IAC91-1099, IACSP95-5000 and IAC97-4039 during experimental days. DAT = days after transplanting.

Table 1. Total plantlet water consumption considering irrigation managements and cultivars. Means followed by the same capital letter in the row and lowercase in the column do not differentiate according to the Tukey's test (p < 0.05).

%ETo	'IACSP95-5000' (mm)	'IACSP97-4039' (mm)	'IAC91-1099' (mm)
96	65.3 Ca	69.8 Ba	74.8 Aa
80	66.0 Ba	70.3 Aa	73.3 Aa
64	60.5 Aa	62.3 Ab	62.6 Ab
48	49.6 Ab	49.7 Ac	49.8 Ac
F (%ETo)		47.05 **	
F (Cultivar)		17.50 **	
F (%ETo × Cultivar)		3.70 *	
CV% (%ETo)		6.65	
CV% (Cultivar)		3.15	

*significant value (p < 0.05), **significant value (p < 0.01).

Water consumption data for PSP system are scarce in literature. Libardi et al. (2019) measured crop evapotranspiration using weighing lysimeters and the mean daily value was approximately 3.9 mm for 'CTC9005HP', 'RB966928' and 'SP87365'. This slightly higher value of water consumption reported by Libardi et al. (2019) may be justified by higher temperatures and different cultivars.

Plantlet growth and water use efficiency

There was no significant interaction between irrigation management and cultivar, but both affected plantlet height, diameter, SDM, TDM and PLA. Irrigation with 48% ETo resulted in lower height, diameter, SDM, TDM and PLA. Among the cultivars, there was a different response for height and diameter. Although presenting lower height, 'IACSP95-5000' had larger diameter when compared to 'IACSP97-4039' (Table 2). 'IAC91-1099' presented higher plantlet height and diameter, matching the height of 'IACSP97-4039' and the diameter of 'IACSP95-5000'. 'IAC91-1099' presented higher PLA, SDM and TDM than the other cultivars, while 'IAC91-1099' and 'IACSP97-4039' had higher RDM than 'IACSP95-5000'. Data concerning PSP growth are scarce, hence there are no other published studies that could be used to compare the results of this study. Nevertheless, this lack of studies highlights this data novelty about PSP growth and how it was affected by irrigation management.

Plantlet leaf area had slightly different response according to irrigation management as it was the only characteristic in which 64% ETo treatment had lower values than 80 and 96% (Table 2). Libardi et al. (2019) evaluated LAI of plantlets of three cultivars and obtained values between 2.4 and 3.3 at approximately 20 DAT. Treatment with 64% of ETo resulted in mean LAI of 2.4 (Table 2), which was similar to that obtained by Libardi et al. (2019) to the cultivar CTC9005HP. However, it should be noted that this cultivar was conducted without water restriction by Libardi et al. (2019), which differs from this study when applying only 64% of ETo. The treatments in which 80 and 96% of ETo were applied presented LAI of 3.0 and 2.7, respectively. These data indicate that some value difference can be also associated to cultivars and show the necessity to consider these differences.

The water deficit effect on plantlet height, diameter and TDM presented herein, as well as IACSP95-5000 g_s data corroborate literature results observed in other plant species (van den Driessche 1991; Bañon et al. 2006; Díaz-Lópes et al. 2012). These results evidenced that water stress decreased plantlets stomatal conductance, growth and dry mass accumulation even in a short time period. However, despite the difference observed in water consumption and TDM (Table 2), there was no difference in WUE regarding irrigation management, which indicates that plantlets growth is water-regulated and WUE was maintained under water deficit due to morphological, such as reducing LA, and physiological, such as stomatal conductance, changes in sugarcane plantlets when submitted to water deficit. This water conservation strategy was also observed by Díaz-López et al. (2012) to *Jatropha curcas* L. seedlings and it was similar to that reported by van den Driessche (1991) to tree species seedlings and by Bañon et al (2006) to *Nerium oleander* L.

Table 2. Plantlet height (H), diameter (∅) leaf area (LA), leaf area index (LAI), leaf area index (LAI) shoot dry mass (SDM), root dry mass (RDM), plantlet dry mass (TDM) and water use efficiency (WUE) for irrigation managements and cultivars.

%ETo	H	∅	LA	LAI	SDM	RDM	TDM	WUE
	cm	cm	cm²	cm²·cm⁻²	g	g	g	g mm⁻¹
96	12.4 a	0.69 a	130.5 a	3.3	1.012 a	0.137 a	1.15 a	1.07 a
80	12.6 a	0.70 a	143.6 a	3.6	1.059 a	0.136 a	1.19 a	1.03 a
64	11.6 a	0.64 ab	112.2 b	2.8	0.925 a	0.139 a	1.06 a	1.09 a
48	9.2 b	0.57 b	85.2 c	2.1	0.728 b	0.133 a	0.86 b	1.09 a
Cultivar								
IAC91-1099	12.4 a	0.68 a	136.1 a	3,4	1.040 a	0.155 a	1.20 a	1.16 a
IACSP97-4039	11.6 a	0.60 b	116.4 b	2,9	0.865 b	0.140 a	1.00 b	1.05 ab
IACSP95-5000	10.3 b	0.68 a	101.0 b	2,5	0.888 b	0.113 b	1.00 b	1.00 b
F (%ETo)	33.91**	8.22*	40.3**	-	19.15**	0.09 ns	13.53**	0.52 ns
F (Cultivar)	14.01**	7.92**	14.1**	-	10.71**	15.71**	10.85**	5.73**
F (%ETo × Cultivar)	1.48 ns	1.24 ns	1.3 ns	-	1.85 ns	1.84 ns	1.70 ns	0.96 ns
CV% (%ETo)	7.16	9.32	11.7	-	12.43	20.84	13.03	12.03
CV% (Cultivar)	8.72	8.70	15.9	-	12.53	15.52	12.64	12.57

*significant value (p < 0.05), **significant value (p < 0.01).

Considering that the water use efficiency is estimated by the correlation between total dry matter and water consumption, it should be noted that there was interaction between irrigation management and cultivars factors for water consumption (Table 1). On the other hand, this interaction did not occur for total dry mass. According to Table 2, there was difference between WUE and TDM between 'IACSP95-5000' and 'IAC91-1099'. It is noticed that in treatments where there was no water deficit, 'IAC91-1099' showed significantly higher water consumption than 'IACSP95-5000'. However, TDM of 'IAC91-1099' was also higher. Thus, despite the higher water consumption of this cultivar, it was more efficient to use water for dry mass production, hence presenting higher WUE.

CONCLUSIONS

Irrigation management based on 80% of the reference evapotranspiration resulted in higher growth, dry mass accumulation and greater leaf area. Water use efficiency was not influenced by irrigation management.

'IAC91-1099' presented higher overall growth, leaf area and dry mass accumulation. Water consumption was cultivar-dependent in irrigation managements using 80 and 96% of the reference evapotranspiration. Water use efficiency was higher in 'IAC91-1099' and lower in 'IACSP95-5000'.

Lower substrate water matrix potential reduced leaves stomatal conductance, impairing 'IACSP95-5000' plantlet growth.

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AUTHOR'S CONTRIBUTION

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