ISSN: 2754-477X

Journal of Food Technology & Nutrition Sciences

SCIENTIFIC Research and Community

Research Article Open Access

Effect of Installation Depths and Emitter Spacing on Water Productivity and Yield of a Subsurface Drip Irrigated Sugarcane

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ABSTRACT

In the present investigation the effect of drip lateral installation depths and emitter spacing on sugarcane crop water productivity and yield was studied by installing laterals at 15, 20 and 30 cm depths from surface, while the emitters were spaced at 50, 60 and 75 cm. A factorial experiment in the form of randomized complete block design was carried out at the Sugarcane Research and Training Institute of Khuzestan in South-West of Iran. Sugarcane quantity specifications results showed there was significant difference between treatments in terms of drip emitter spacing and lateral installation depths and their interactions at 1% probability level. Similar trends were also observed in case of quality traits of sugarcane. Investigating the water productivity index for sugarcane and sugar yield it showed that treatments were significant in terms of the space between emitters at 1% probability level. The maximum sugarcane yield was observed in the treatment with a space between emitters of 50 cm, and 20 cm of installation depth. At 60 cm space the emitters of 60 cm and the installation depth of application of 20 cm, the highest water productivity was obtained, reaching 7.18 and 0.87 kg/m3 for produced sugarcane and sugar respectively.

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Received: August 07, 2021; **Accepted:** August 17, 2021; **Published:** August 23, 2021

Keywords: Emitters, Subsurface Drip Irrigation, Sugarcane, Water Productivity.

Introduction

Sugarcane fields of south west of Iran have heavy soil texture, high temperatures, and hot dry wind at spring and summer. Hydro-flume gated pipes were used for irrigation. Furrow irrigation were used in sugarcane fields. Due to a water crisis in Iran, Increasing the efficiency of irrigation and water productivity can be promising. Electrical Conductivity of irrigation water was considered about 1.1 dS/m, in basic designs of this irrigation method and for each unit increasing salinity more than this amount, sugarcane yield is reduced by 10%. The maximum EC of irrigation water on Karoon River reads to 4.5 dS/m in downstream. Electrical conductivity of water is about 2.5 dS/m (mean of it: 1.5-3 dS/m). Water Electrical Conductivity is an issue of importance to change from surface furrow irrigation to SDI [2]. Suarcane requires lots of water during the growing period, is sensitive to water stress, and is not compatible with long duration flooding. If groundwater level rises and covers the root zone, crop yield decreases due to root rot [16]. Subsurface drip irrigation (SDI) is an advanced irrigation system that minimizes water losses by evaporation from soil and weeds and by soil drainage below the root system [3]. Compared to other irrigation methods, drip irrigation systems provide the possibility to apply lower volumes of water, more frequently and efficiently. If well designed, these systems make it possible to apply slow, steady and uniform amounts of water and nutrients within the plant's root zone, while minimizing deep percolation and maintaining high productivity levels [12].

Recent research, assessed the performance of a citrus crop under surface and subsurface drip irrigation. They revealed that, water savings were 23% in the subsurface drip irrigation treatment compared to the surface irrigation treatment without significant differences in either yield or fruit composition [10]. Evaluated sugarcane yield and quality was evaluated to various irrigation regimes applied with subsurface drip irrigation and surface drip irrigation systems on eggplant and net profit generation in the Mediterranean Region of Turkey by [5]. The main advantages of SDI are related to water savings because water is applied directly to the crop's root zone, which prevents losses due to direct evaporation from the soil, deep drainage, and if properly managed, it allows the maintenance of appropriate levels of soil moisture [8]. Some studies, evaluated water storage in the soil profile when using a subsurface drip irrigation system at two emitter installation depths (0.2 or 0.4 m) and two water qualities (treated sewage effluent (TSE) and freshwater) in two crop cycles of sugarcane in Campinas SP (Brazil). They concluded that a 0.2 m depth drip tube proved to be an ideal solution for both environmental management and water-use efficiency [15].

Some researchers, evaluated irrigation water-use efficiency (WUE) for potatoes and soil moisture distribution uniformity for two drip tape installation depths (surface at 0.05 m and subsurface at

0.15 m depth) as an alternative method to seepage irrigation. By measuring the volume of water, water table, and soil volumetric water content for two seasons, 2011 and 2012, they concluded that drip irrigation reduced water use 48% and 88% in 2011 and 2012, respectively and higher WUE was obtained with drip compared to seepage irrigation for all varieties in 2012 [13,14]. Studied the evaluation of subsurface drip irrigation and sugarcane spacing on stem yields, sugarcane technological quality, and the theoretical recoverable sugar yields during four cycles of sugarcane cultivation. Irrigation increased stem yields in the ratoon sugarcane cycles and that the theoretical recoverable sugar yields increased in the last two ratoon sugarcane cycles. According to the row spacing, double row planting produced the greatest stem yields and theoretical recoverable yields in the plant sugarcane cycle and the second ratoon sugarcane cycle which showed the benefits to sugarcane properties of subsurface drip irrigation over the four years of this research [11].

Due to a water crisis in Iran, this study aimed to evaluate an irrigation method that can reduce the volume of consumed water for sugar yield by managing water consumption in the form of drip irrigation.

Material and Methods

The experiment was conducted at Sugarcane Research and Training Institute Ahvaz located in south west of Iran. Field experiment area was 1.2 ha with 9 treatments and 27 furrows measuring 238 m with a row spacing of 1.83m, the number of furrows for each treatment was 3 furrows. The experiment field is located in a warm and dry weather region at longitude 48° 33′ E, latitude 30° 59′ N and 7.6-meter height of sea level. Cultivar CP69-1062, the commercial cultivar of the area, cuttings were planted in a double row with 40 cm row spacing and handed straight to the stack. The tubes were placed in the middle of double rows. Before cultivating the fields, soil samples were collected at 0-30 cm, 30-60 cm, and 60-90 cm depths. Soil analysis was done to determine EC, pH, cations and anions, texture and bulk density. In order to measure the bulk density of soil, samples were collected from the distributed samples with sampler cylinders. Soil texture was determined by hydrometer method.

Soil bulk density increased with depth which indicated a higher density of soil at lower depths. Sodium adsorption ratio (SAR) from the surface to depth decreased and was subject to changes in the amount of sodium, the soil was sodic-saline in the surface layer and saline in lower layers. Pressure plate was used for determining soil moisture content in field capacity (FC) and permanent wilting point (PWP), the results were 25.1% and 12.9%, respectively. Some physical and chemical properties of soil before the experiment are presented in Table 1.

Table 1: Physical and Chemical Soil Characteristics of Experimental Field

Depth (cm)	EC ($dS.m^{-1}$)	pH	ρ_b ($gr.cm^{-3}$)	Soil texture	Caption’s(meq.l-1)				SAR
					Na^+	Ca^{2+}	Mg^{2+}	K^+	
0-30	6.97	7.19	1.5	Si.C.L	51.3	11.09	11.52	0.18	15.3
30-60	4.75	7.28	1.57	Si.C.L	35.6	7.82	8.04	0.12	12.64
12.64	4.73	7.29	1.61	Si.C.L	32.4	9.89	10.82	0.01	10.07

The experiments were carried out in a complete randomized block design with a factorial arrangement in both the depth and space between emitters. The treatments were arranged from the combination of three emitters spacing and three emitter depths as shown in Table 2.

Table 2: Planning Executive Treatments

D_3 = 15 cm	D_2 = 20 cm	D_1 = 30 cm	D_3 = 15 cm	D_2 = 20 cm	D_1 = 30 cm	D_3 = 15 cm	D_2 = 20 cm	D_1 = 30 cm
L_3 = 75 cm Q_3 = 2.2 l/hr			L_2 = 60 cm q_2 = 1.2 l/hr			L_1 = 50 cm q_1 = 1.2 l/hr		

The spaces between emitters on the tubes were 50 cm and 60 cm, for a discharge rate of 1.2 L/hr., and 75 cm, for a discharge rate of 2.2 L/hr. the depth of installation of emitters pipes were 15 cm, 20 cm, and 30 cm from the soil surface. Water used for irrigation was from the Karoon River, and the design of the pumping and filtration station was carried out with a preliminary analysis of irrigation water and TSS of 115 mg/L Results for analysis of irrigation water during planting period and region climate statistics are shown in Tables 3 and 4.

Table 3: Karoon river irrigation water quality for sugarcane (September 2016 to December 2017)

EC($dS.m^{-1}$)		pH		TDS ($mg.l^{-1}$)		TH ($mg.l^{-1}$)		Ave. Cation ($meq.l^{-1}$)			SAR	Class.
Ave.	range	Ave.	range	Ave.	range	Ave.	range	Na+	Ca2+	Mg2+		
2.2	1.6-2.8	7.5	7 -8.2	1560	1100-2042	603	325-865	14.8	5.3	6.9	6	C_3S_2

Table 4: Average of Meteorology Parameters (1998-2018)

Ave. Temperature (°C)	Ave. Humidity (%)	Max absolute Temperature (°C)	Min absolute Temperature (°C)	Ave. yearly Precipitation (mm)	Ave. yearly evaporation (mm)	Max daily evaporation (mm)	Ave. wind speed ($m.s^{-1}$)
25	45	52*	- 4.5**	157	3218	32***	2.4

*This is happened in June 1999
** This is happened in February 2011
*** This is happened in June 2006

The measuring of soil moisture was done in root zone during growth and sampling, soil acidity, electrical conductivity of soil around the emitters and crop log operations (length of stem, water table, nitrogen, leaf area index and leaf moisture content were measured weekly), were measured in plant duration. In order to control the soil moisture content in sugarcane growth period, a number of moisture probes were installed in the field and by using time domain reflectometry (TDR), moisture content of the emitters and its distribution were controlled. Depending on irrigation frequencies and irrigation water acidity, acid was injected into the irrigation water to prevent clogging of the emitters, and after a specified time it was discharged from the network. Regarding the presence of algae in irrigation water, chlorine gas was used in acid filtration before irrigation in field capacity. [7]. The schematic pumping and filtration station is shown in Figure 1.

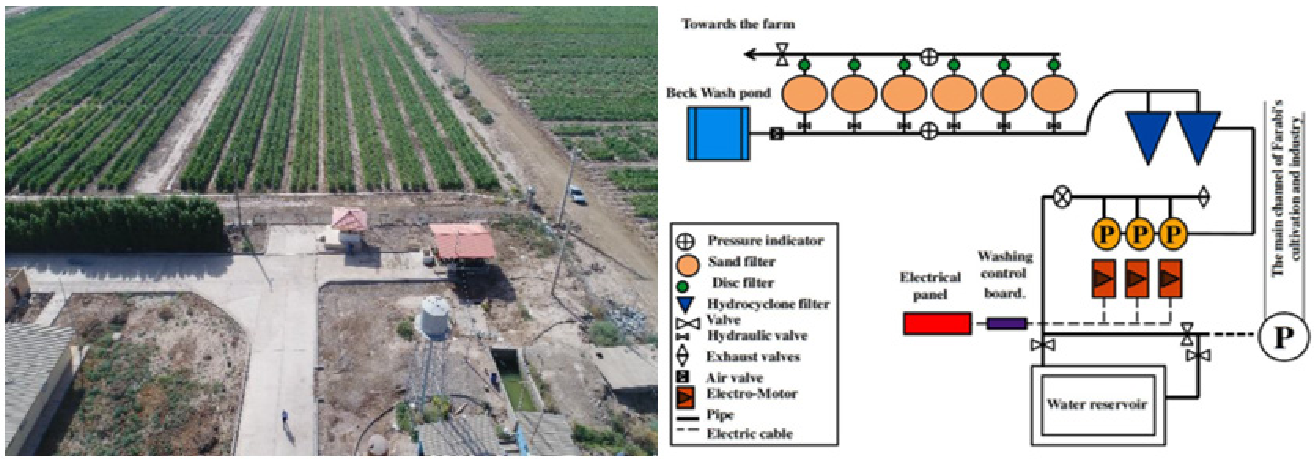

Figure 1: Schematic of Pumping and Filtration Station and Experimental Farm in Subsurface Drip Irrigation

According to the design calculations, irrigation intervals in the peak period is calculated daily and in other periods calculated from equations 1 and 2:

$$I = d_n / ET_C \quad (1)$$

$$ET_C = ET_0 . K_c \quad (2)$$

I: maximum irrigation period; dn: irrigation requirement;
ETc: real evapotranspiration of sugarcane;
ET_0: reference evapotranspiration which calculated by Meteorology data [1]
Kc: sugarcane crop coefficient which determined by lysimeter

Irrigation is based on sugarcane allowable depletion and irrigation period.
Irrigation net depth, Irrigation gross depth, leaching fraction and irrigation volume are calculated by equation 3 to 6:

$$d_n = (\theta_{fc} - \theta_{pwp}). D_{rz}. \rho_b. MAD. P_w \quad (3)$$

d_n: irrigation net depth

θ_{fc}: mass moisture in field capacity (%)
θ_{pwp}: mass moisture in permanent wilting point (%)
D_{rz}: root depth (mm); ρb: soil bulk density ($gr.cm^{-3}$); Ps: wetted percentage (%).
MAD: management allowable depletion (%), which was considered to be about 0.6 according to the warm and dry area.

Gross irrigation depth is calculated from equation 4:

$$d_g = \frac{dn}{(1-LF).\ Ea} \quad (4)$$

d_g: gross irrigation depth (mm); Ea.: irrigation efficiency (%);
LF: leaching fraction (%), which calculated by equation 5:

$$LF = \frac{ECiw}{2\ ECe\ max} \quad (5)$$

EC_{iw}: electrical conductivity of irrigation water ($dS.m^{-1}$)
EC_{emax}: electrical conductivity of saturated soil juice ($dS.m^{-1}$)

$$V_g = d_g. A. P_s \quad (6)$$

V_g: gross volumetric of water requirement (lit);
A: plot area (m^2);

After irrigation and drought stress, the process of sugarcane treatment started. Twenty sugarcane stems randomly were selected from each treatment on a weekly basis. The quality of juice was measured until the process of completion was completed and then the harvest was carried out. Some researchers, stated that under drought stress and end of growing season, due to water crisis less sucrose produced but at the end sugar content of sugarcane increases [4]. In this experiment three repetitions of each 10 m experimental treatment were selected and the number of tillers were counted and 20 stems were weight stem density, total yield, yield of sugarcane (ton. ha-1) and Tiller number per hectare were measured and after calculation of yield, Water Productivity (yield ratio to volume of intake) calculated based on the volume of water consumed during the growth period of sugarcane (irrigation and rainfall).

Al so in each treatment in three length repetitions, 60 stems were selected randomly, weight and height of stems were measured and quality and quantity factors were measured in the lab. These operations were performed for surface irrigation too. After sugarcane extraction, for determining sugarcane quality factors, sucrose content in the juice (Polarization measurement) and soluble solid particles in cane juice (Brix) were measured. POL content was measured by Saccharimeter and by applying POL number modified coefficient from related tables, the real POL number was calculated. Brix was measured by Reflectometer. By dividing POL in Brix juice, purity (PTY) was calculated. Quality Ratio (Q.R) was calculated from equation [9] which P.F was modification coefficient of purity percentage and extracted from related tables. Yield (Y), Recovery Sugar (R.S) and Sugar Yield (S.Y) were calculated from equation, 9 to 11 [17]:

%POL = Saccharimeter Reading. Pool Factor (7)

QR = (P.F)/(Pol) (8)

Yield = 100/(Q.R) (9)

RS = Yield. 0.83 (10)

$SY = Y.RS$ (11)

Finally, the average of quantity and quality functions and Water Productivity in subsurface drip irrigation was compared with compression irrigation. For data fitting and curves, EXCEL software was used and SAS statistical software was used for statistical analysis.

Results and Discussion

Considering the cultivar studied comparing with hectare production values and quality of sugarcane that is ideal for the crop, if there is no data for irrigated sugarcane, quote values for sugarcane in production system without irrigation. This comparison helps to see the importance of irrigating the crop under study in cases of water deficit. Average compression of space depth and interaction of spaces depth of emitters for different quantitative traits of the crop is presented in table 5.

Table 5: Average Compression of Space Depth of Emitters for Different Quantitative

Parameter	df	Cane yield (ton.ha^{-1})	Number of tiller (in ha)	Sugarcane Length (cm)	WP for sugar (kg.m^{-3})	WP for sugarcane (kg.m^{-3})
Interaction	3	7.81 $^{n.s}$	36871811 **	4.34*	0.044**	0.024 $^{n.s}$
Space	2	540.7 **	998639860 **	44.78 **	0.12 **	7.59 **
Depth	2	58.92 **	74084178 **	727.11 **	0.0022 **	0.15**
Interaction	4	46.48 **	277592773 **	583.22 **	0.00026 $^{n.s}$	0.11 **
Error	16	3.43	5211093	4.67	0.0001	0.011
Coefficient of variation (1%)		1.53	1.31	1.07	1.7	1.63

Traits in sugarcane

Experimental treatments have significant differences at 1% probability level (table 5). Water Productivity of produced sugarcane and sugar showed that experimental treatments have significant difference in space of emitters and depth of emitters but interaction of space and depth of emitters have no significance difference. Mean variance analysis of interaction for space and depth of emitters for different qualities of the crop is given in table 5. The data in (table 5), reveals that all treatments have significant difference at 1% probability level comparing with space of emitters, except sucrose (Pol) percentage of cane juice. Depth of emitters have significance difference at 5% probability level for soluble solid particles of cane juice (Brix), purity percentage (PTY) of cane juice and recovery sugar (RS), have significant difference at 1% probability level. Sucrose percentage of cane juice did not have significant difference comparing with space and depth of emitters and interaction of them. But sugar yield has significant difference at 1% probability level comparing with space of emitters and have no significant difference comparing with depth of emitters and interaction of both depth and space of emitters. Results of mean square of variance analysis of sugarcane quantitative traits (table 6) showed that the highest sugarcane yield was in 50 cm space and 15 cm, 20 cm depth of emitters (were in one group and have no significant difference) and this group have significant difference with 30cm depth of emitters. Al so highest stem length was in 50 cm space of emitters and 20 cm depth of emitters which have no significant difference with 15 cm and 30 cm depth of emitters.

Table 6: Mean Square Variance Analysis of Qualitative and Quantitative Characteristics of Sugarcane

Treatment		Quantitative Traits			Qualitative Traits				Sugar Yield (ton.a^{-1})
Space (cm)	Depth (cm)	Length (cm)	Number of tiller (per hectare)	Cane Yield (ton.ha^{-1})	Brix (%)	Pol (%)	PTY (%)	RS (%)	
L_{50}	D_{30}	179^{d}	184601^{b}	123^{b}	21.7^{ab}	18.9^{ab}	87^{b}	11.6^{d}	14.27^{a}
	D_{20}	202^{c}	191333^{a}	134^{a}	20.1^{c}	18.3^{b}	90^{a}	11.1^{f}	14.87^{b}
	D_{15}	210^{b}	178599^{c}	132^{a}	20.5^{b}	18.6^{ab}	90.7^{a}	11.5^{e}	15.18^{b}
L_{60}	D_{30}	190^{e}	184002^{b}	113^{d}	22.2^{ab}	19.5^{a}	87.8^{b}	12^{b}	13.56^{C}
	D_{20}	181^{f}	170020^{d}	116^{dc}	22.2^{ab}	19.2^{ab}	86.9^{b}	11.8^{c}	13.69^{C}
	D_{15}	225^{a}	163623^{e}	115^{dc}	22.5^{a}	19.7^{a}	87.7^{b}	12.2^{a}	14.03^{a}
L_{75}	D_{30}	195^{d}	162366^{e}	117^{c}	21.8^{ab}	18.7^{ab}	86.9^{b}	11.5^{e}	13.46^{C}
	D_{20}	209^{b}	156969^{f}	114^{dc}	22^{ab}	19.1^{ab}	86.8^{b}	11.8^{c}	13.45^{C}
	D_{15}	198^{d}	172310^{d}	122^{b}	21.5^{b}	18.7^{ab}	87^{b}	11.5^{e}	14.03^{a}
Surface irrigation (Controlled)		223	143807	95	22	19.3	87	12	11.4

Table 7: Average Compression of Space and Depth of Emitters for Different Quality Traits in Sugarcane

Parameter	Degree of freedom	Brix	Pol	Purity	RS	S.Y (ton.ha^{-1})
Iteration	3	5.58 **	0.61 n.s	9.6 **	9 **	15.4 **
Space	2	5.05 **	1.89 n.s	0.6 **	0.84 **	3.05 **
Depth	2	0.63 *	0.13 n.s	0.72 **	0.07 **	0.83 **
Interaction	4	0.88 **	0.318 n.s	0.18 n.s	0.164 **	0.103 n.s
Error	16	0.15	0.49	0.84	0.00	0.052
Coefficient of Variation (%)		1.8	3.69	0.3	0.14	1.62

Highest Sugarcane stem length was in 60 cm space and 15 cm depth of emitters. The results are in conlirmity with (8 and 12). Results of mean square variance analysis for quality characteristics of sugarcane show that the highest productivity Brix, pol and RS, was in 60 cm space and 15 cm depth of emitters and have significant difference with other depths and the highest purity, was in 50 cm space and 15 and 20 cm depth of emitters and have significant difference with other depths. Some studies, revealed that under drought condition and stress of the ending growing season, amount of sugar, sugarcane and number of tiller quality will increase [4]. Highest sugar yield was in 50 cm space and 15 and 20 cm depth of emitters (which were in the same group and have no significant difference) and have significant difference with 30 cm depth of emitters. According to designing computations, irrigation water requirement at 50 cm space of emitters was 18318 (m3 ha-1), for 60cm space irrigation was less than 15-20% of the water requirement and for 75 cm space irrigation was 15-20% more than water requirement (table 8). Less consumption of water lead to high sugarcane quality. Due to low consumption water, Water Productivity for produced sugar and sugarcane increased which was in 60 cm space and 20, 15 cm depth of emitters will highest Water Productivity for produced sugarcane and sugar about 7.18 and 0.87 kg.m-3, respectively and has no significant difference for other depths.

Table 8: Water Productivity and Volume of Consumed Water Under Different Space and Depth Treatments

Treatment		Volume of consumed water(m^{3}/ha)			Water Productivity(kg.m^{-3})	
Space	Depth	Irrigation water	Rainfall water	Total volume	For produced sugarcane	For produced sugar
L50	D_{30}				6.41^{ab}	0.74^{ab}
	D_{20}	18318	883	19201	6.98^{ab}	0.77^{ab}
	D_{15}				6.88^{ab}	0.79^{ab}
L60	D_{30}				6.99^{ab}	0.84^{a}
	D_{20}	15277	883	16160	7.18^{a}	0.85^{a}
	D_{15}				7.12^{a}	0.87^{a}
L75	D_{30}				5.31^{b}	0.61^{b}
	D_{20}	21149	883	22032	5.17^{b}	0.61^{b}
	D_{15}				5.54^{b}	0.64^{b}
Surface irrigation (control)		36000	883	36883	2.58	0.31

Qualitative and quantitative characteristics of subsurface drip irrigation and conventional irrigation were compared in charts 1 to 3.

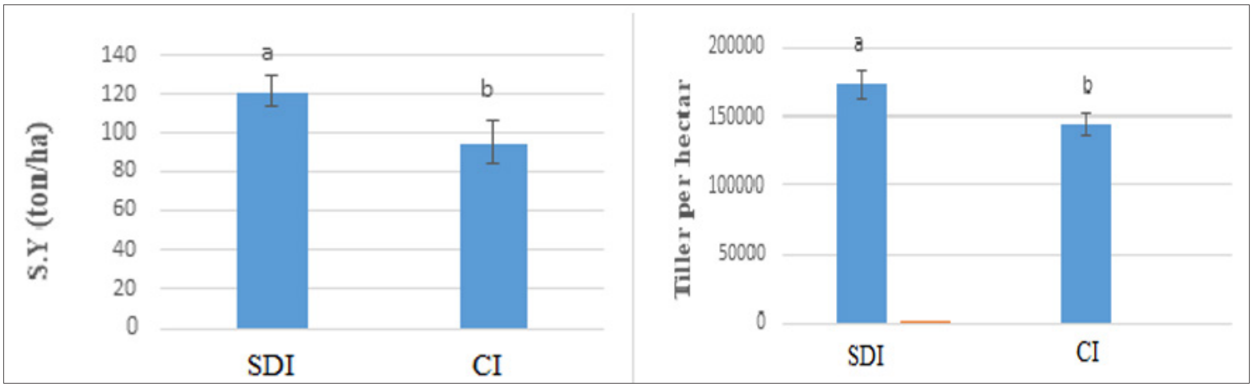

Chart 1: Number of Tiller Per Hectare and Sugarcane Yield in The Subsurface Drip Irrigation and Conventional Irrigation

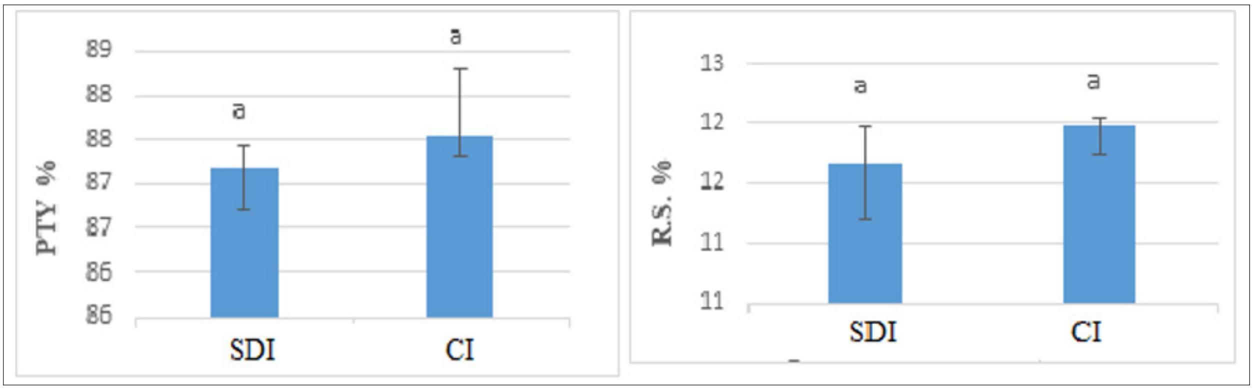

Chart 2: Recovery Sugar and Purity in The Subsurface Drip Irrigation and Conventional Irrigation.

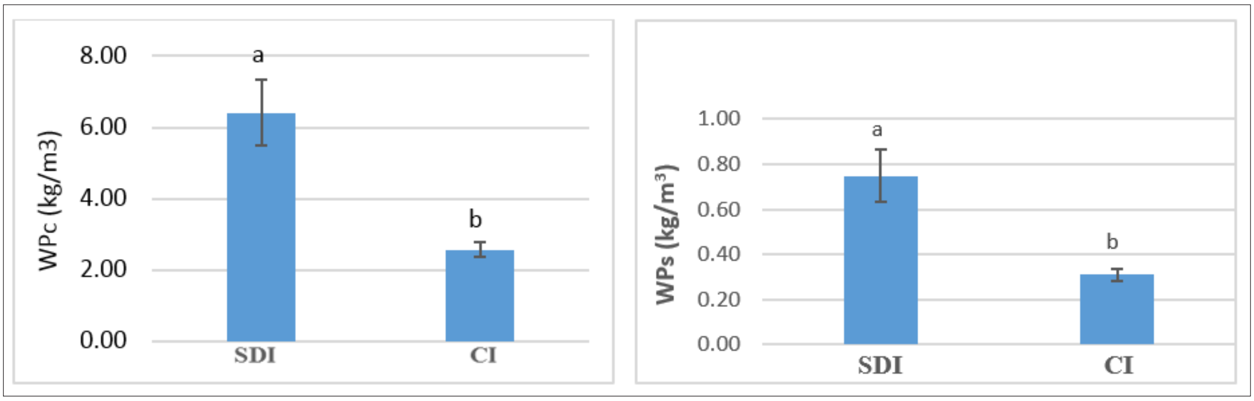

Chart 3: Water Productivity for Sugarcane and Sugar Production in The Subsurface Drip and Conventional Irrigation

Average sugarcane yield was 26 tons/ha less in conventional irrigation and both have significant difference. Chart 1 shows that in subsurface drip irrigation tiller (stem. ha-1) was 30000 more than conventional irrigation system and have significant difference. Recovery Sugar and purity of subsurface drip irrigation and conventional irrigation were in same group and have no significant difference. Water Productivity of produced sugarcane and sugar for subsurface irrigation was 3.84 kg.m-3 and 0.44 kg.m-3 higher than the surface irrigation system and have significant difference. Some researchers, showed that subsurface drip irrigation can increase the quantity and quality of sugarcane and is considered a good method for sugarcane cultivation [6].

Conclusion

According to recent droughts and severe water crisis in Iran, subsurface drip irrigation was implemented in sugarcane for the first time. Results of this experiment showed that the highest sugarcane yield was in 50 cm space of the emitters, 15 and 20 cm depth of emitters and in 30 cm depth there was a significant difference in sugarcane yield. Also, highest Number of tiller density was in 50 cm space of emitters and 20 cm depth which did not have significant difference with 15 and 30 cm depth. Highest qualitative yield was in 60 cm space of the emitters and 15 cm depth of the emitters which has significant difference with other depths. Highest sugar yield was in 50cm space of the emitters, 15 and 20 cm depth of emitters which has significant difference with 30 cm depth of emitters. Sugarcane quality increased by decreasing water consumption and this is caused due to high Water Productivity for produced sugar and sugarcane, so that in 60 cm space of the emitters, 15 and 20 cm depth of the emitters higher Water Productivity of produced sugarcane and sugar was 7.18 and 0.87 kg.m-3, respectively. Comparing results of quality and quantity yields of subsurface drip irrigation and conventional irrigation show that most quantity and quality factors of subsurface drip irrigation were higher than the surface irrigation. According to the results and with considering uniform distribution of wetting pattern, salinity of the soil, no runoff, protecting the discharge pipe, no surface evaporation and the development of sugarcane root, 20cm depth for discharge pipe and 50 cm space of emitters on the lateral pipe is suggested. But due to high evaporation in some days and long duration of one irrigation period, 2 lit.hr-1 discharge is suitable for emitters in this condition. Due to the continuation of this experiment and the change in the distances and discharges of the emitters, for regions with similar characteristics to this experiment, 20cm depth for discharge pipe and 50 cm space (2.2 lit.hr-1 discharge) of emitters on the lateral pipe are suggested.

Acknowledgement
We wish to extend our cordial thanks to Mr. Eng. A. Derakhshanzadeh, CEO of the Khuzestan Sugarcane Research and Training Institute and staff of the institute for their help and support to undertake this study.

Contributions
A. Sheini- dashtghol, wrote the main manuscript text and prepared all figures and A. Sheini- dashtghol, did all of expriments consist of sampling, water and soil analysis and statistic report. A.A. Naseri and S. Boroomand Nasab, oversaw the project and assisted with the writing of the manuscript. All authors reviewed the manuscript.

Competing Interests
The authors declare no competing financial interests and the authors emphasize that they intend never to advertise the equipment were user in this experiment and the main goal of this study is only the expression of investigation. Someone or company in this study and its results are not shareholders. Dr Ali Sheini Dashteghol work had been funded by sugarcane research and training institute. Abd-Ali Naseri and Saeed Boroomand Nasab also has consulted for Ali Sheini Dashteghol and received compensation from Shahid Chamran University of Ahvaz. This study was conducted in sugarcane research and training institute. This article is a part of student thesis and there are no competing financial and non-financial interests between the authors and sugarcane research and training institute (for establishment of experiment site) and Shahid Chamran University (for Guide and consultant of its professors). The university has no financial affiliation with this research and was only a scientific advisor. Consultants and institutions are also not expecting to receive funding. University and Institute do not want any share of its results and financial benefits. The advisers of this research are from University and have no financial or non-financial expectations. So they are a faculty member and academic advisor.

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