STUDY OF EFFECT OF ALTERNATE FURROW IRRIGATION IN SUGARCANE (VAR CP69-1062) AT DIFFERENT GROWTH STAGES ON QUALITY AND QUANTITY OF YIELD

ETUDE DE L'EFFET D'IRRIGATION PAR SILLONS ALTERNES SUR LA QUALITE ET LA QUANTITE DU RENDEMENT DE CANNE À SUCRE (VAR CP69-1062) A DIFFERENTES ETAPES DE CROISSANCE

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ABSTRACT

Sugarcane is one of the important crops in Khuzestan province. It consumes large amount of water, specially in the warm season. In this study in order to optimize water consumption by sugarcane, five treatments with three replications using randomized complete block design were applied in Karun Agro Industry, Inc. The 1st treatment was conventional irrigation; the 2nd was alternate furrow irrigation during the growth season and the 3rd, 4th and 5th treatments were irrigation in alternate furrow for a part of the growing season, followed by conventional irrigation for the remaining part. These treatments were sequentially included with the alternate furrow irrigation method, at the beginning of the growing season, during the mid-stage growing season and finally at the late stage of growing season. The results indicated that there were no significant differences among the treatments, but the 3rd treatment showed an increase of 8.02 tons/ha of sugarcane and 2.08 tons/ha sugar more than the conventional irrigation. In terms of per cent of recovery sugar, 3rd, 4th and 5th treatments showed about 5% better performance in comparison with the conventional method. The results also, indicated that water use efficiencies of 1st and 2nd treatments were 0.51 kg/m^3 and 0.38 kg/m^3, respectively. Therefore, it can be concluded that the alternate furrow irrigation system in general can increase cane yield and water productivity.

Key words: *sugarcane, alternate furrow irrigation, water use efficiency.*

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RESUME

La canne à sucre est une culture importante de la province de Khuzestan. Il consomme la grande quantité d'eau, particulièrement dans la saison chaude. Dans cette étude, ont été utilisés cinq traitements avec trois répétitions utilisant la conception continue randomisée dans l'Industrie agricole Inc. de Karun pour optimiser la consommation d'eau par la canne à sucre. Le premier traitement était par l'irrigation classique; le 2ème par l'irrigation par sillons alternés lors de la saison de croissance et les 3ème, 4ème et 5ème traitements pour une partie de la saison de croissance par l'irrigation par sillons alternés et pour le reste de saison par l'irrigation classique.

Ces traitements séquentiels ont compris la méthode d'irrigation par sillons alternés au début de la saison de croissance, au milieu de cette saison et à la dernière partie de cette saison. Les résultats ont indiqué qu'on n'avait rencontré aucune différence significative entre les traitements, mais que le 3ème traitement a montré une augmentation du rendement de 8,02 tonnes/ha de canne à sucre et de 2,08 tonnes/ha de sucre plus que le rendement obtenu par l'irrigation classique. En termes de pourcentage de rendement réalisé de sucre, les 3ème, 4ème et 5ème traitements ont montré meilleure performance de l'ordre de 5% par rapport à la méthode classique. Les résultats ont indiqué que l'efficience d'utilisation d'eau dans les 1e et 2ème traitements était de 0,51 kg/m^3 et 0,38 kg/m^3 respectivement. Donc, il est conclu que le système d'irrigation par sillons alternés augmente le rendement de canne à sucre et la productivité de l'eau.

Mots clés: *Canne à sucre, irrigation par sillons alternés, efficience d'utilisation de l'eau.*

1. INTRODUCTION

In view of the limited fresh water available in the arid and semi-arid country Iran, it is important that irrigation water is utilized efficiently. Sugarcane is grown over a wide range areas of the Khuzestan province and is irrigated by furrow irrigation method. This plant needs a large amount of water, especially during the warm season. It is a crop, which is sensitive to stress due to limited water. At the same time, it is susceptible to excess water in the root zone. If the groundwater table rises and encroaches in the root zone, the roots suffocate. This causes the leaves to turn yellow, the plant growth suffers and productivity is drastically reduced.

In order to achieve an optimized water use efficiency it is advisable to use the deficit irrigation method, to allow producing agricultural crops under the soil moisture deficiency conditions. The net water requirement of sugarcane in Karun Agro- Industry, Inc. regional has been estimated as 21280 m^3/ha, of which about 3010m^3/ha is provided by rainfall (Farshi and et al 1997).

(Sepaskhah,1996), by using alternate furrow irrigation method for sugar beet plant, under the conditions of shallow groundwater table, showed that, this irrigation method could result in an overall high usage of applied water. Therefore, the sugar beet productivity under alternate furrow irrigation at 6 days interval could be the same as the productivity under conventional irrigation method with an irrigation interval of 10 days. Besides, the alternative furrow irrigation at 6 days interval reduced water consumption by about 23%.

(Sheyni Dasht-e-gol et al,2006), at the Keshta-e- sanat-e- Amir Kabir, had conducted a research project with the treatments: alternate furrow irrigation, regular furrow irrigation and conventional irrigation in sugarcane. There was no replication. Based on the observations, the reported results indicated that the treatment of alternate furrow irrigation had consumed the least amount of water. It had also shown that the highest WUE was 0.72kg/m^3 of white sugar and cane production.

Khoramiyan (2001), at the Agricultural Research Center of Safi Abad Dezful (in the Khuzestan province, Iran), conducted a research project on corn in silty clay loam soil. He used the alternate furrow irrigation method for this project. He concluded that the corn productivity under alternate furrow irrigation until starting of the flowering stage could be much higher in comparison with all other irrigation treatments. Also, the total amount of water saved in this method of treatment was about 49.8% in comparison with the conventional furrow irrigation.

In order to verify and to study the effect of the alternate furrow irrigation method on the sugarcane productivity, and to reach to an optimum level of water use efficiency, we conducted a study by using a randomized complete block design for irrigation management of cp69-1062 variety of sugarcane in the Karun Agro- Industry, Inc. Iran.

2. MATERIALS AND METHODS

In order to carry out this research project, a field having silty clay soil was selected. Upon completing land preparation, preparation procedures on it, sugarcane was planted at the bottom of furrows. The furrow depth and spacing was 35 cm and 153 cm, respectively. The land slope was about 0.0007 and the furrow length was 240m. After applying the first round of irrigation during end of September to end of March, the subsequent irrigations were as follows:the same regular irrigation method, were applied for all treatments.

With the beginning of the growing season of the sugarcane plants which was around of the end of March, we were applied the following treatments:

1. Control: Conventional irrigation from the end of March to end of September (AFI).
2. Alternate furrow: From the end of March to end of September (AFAI).
3. Alternate furrow: From the end of march to end of may (DFAI).
4. Alternate Furrow: From the end of may to end of July (MFAI).
5. Alternate furrow: From the end of July to end of September (LFAI).

All these five above mentioned treatments were carried out with three replications in a randomized complete block experimental design. The total numbers of furrows in each treatment were six. The Type 3 of WSC flume was used to measure water flow into each furrow. The flow was set at 2 l/s. Soil samples for determining soil moisture levels till 100cm depth were taken before and two days after each round of irrigation. These soil samples were taken from three depths: 0-33cm, 33-66cm, 66-100cm and were analyzed in the laboratory. The field capacity and wilting point were also determined. The plant length was measured every week. The sugarcane was harvested from sample areas of 90 m2 from the 3rd and the 4th furrow in each experimental plot to estimate the sugarcane productivity and also to estimate the sugar recovery. The software SAS was used for statistical analysis of the data.

3. RESULTS AND DISCUSSION

The total amount of consumptive water used, at the beginning of the planting season until the harvesting season; and with the consideration of all rounds of the irrigation periods,(27 rounds in all) are shown in Table1. The total amounts of consumptive water used during the growing season and the total amounts of water consumption for the whole project are also shown in Table1.

Sugarcane yield did not show significant differenced among the treatments at 5% level, perhaps because lateral flow of water from the irrigated furrows to the adjacent non-irrigated furrows (Table 2).

Sugar yield, however showed significant differences among treatments at 5% level according to Duncan's New Multiple Range Test (Table 2).

Table 1. The total amounts of consumptive water use for each of the experimental treatments in cubic meter in per hectare (m^3/ha).

Month	AFI	AFAI	DFAI	MFAI	LFAI
April	1350	750	750	1300	1300
May	2800	1550	1550	3100	3100
June	5800	4000	5600	3500	5800
July	5120	3725	5600	3600	5760
August	3900	2175	4200	3900	2250
September	4200	2325	4350	4350	2400
Total	22870	14525	22050	19750	20610
Total from start #	36910	27035	35050	33750	34610

Irrigation started at September end and continued till March end.

Table 2. Treatment-wise comparison of sugarcane and sugar yield and the WUEs.

Description of Treatment	Sugarcane yield(t/ha)	Sugar yield (t/ha)	Refined * sugar (%)	Volume of water used (m^3/ ha)	Water use Efficiency (Kg/m^3)	Water saved in comparison with control (%)
AFI	137.84	14.05	10.2 c	36910	0.38	-
AFAI	132.04	13.73	10.4 b c	27035	0.51	27
DFAI	145.86	16.03	11.06 a b c	35050	0.46	5
MFAI	137.45	15.53	11.3 a	33750	0.46	8.5
LFAI	140.54	15.74	11.2 a b	34610	0.45	6.2

Treatments: 4 (MFAI), 5 (LFAI), and 3 (DFAI) recorded superior sugar recovery. Treatment 2 (AFAI) least amout of water and had the highest water use efficiency. The control treatment (AFI) was the poorest performer in respect of sugarcane yield, sugar recovery and water use efficiency. However, (Pandian et al, 1992) found 43-46% of water saving in comparison with the conventional furrow irrigation method. Also Samadi and Sepaskhah (1984) had reported 29% saving of water in the alternate furrow irrigation in comparison with the regular furrow irrigation in bean crop.

Regardless of the results, it is advisable to adopt alternate furrow (MFAI) irrigation from end of May to end of July (the mid-stage of growing season) if water shortage is not a serious problem. Under deficit water situation, adopting AFAI (Alternate furrow irrigation from end of March to end of September) is suggested, as it gives 27% water saving as compared to control (regular furrow irrigation), without any significant reduction in sugarcane yield.

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