

Effect of Regime of Irrigation and Fertilization of Sugar Beet (*Beta vulgaris* L.) on Yield of Sugar

Zivko Jankuloski^{1*} Mila Arapcheska¹ Vjekoslav Tanaskovik² Nikolche Jankulovski¹
 Stojanche Nechkovski²

1.Faculty of Biotechnical Sciences, University "St. Kliment Ohridski", Bitola, Macedonia

2.Faculty of Agricultural Sciences and Food, University "Ss. Cyril and Methodius", Skopje, Macedonia

*E-mail of the corresponding autor: jankuloskiz@yahoo.com

Abstract

The aim of this research was to analyze the effects of different variants of irrigations and fertilization of sugar beet (*Beta vulgaris* L.) on the yield of total sugar. The study was performed in agro-ecological conditions in valley Pelagonija in R. of Macedonia in period from 2012 to 2014. The following different regimes of irrigation were applied: irrigation at 75% utilized available water (uAW); 50% uAW; 25% uAW; and irrigation on the basis of bioclimatic coefficient (BC). Control was a variant without irrigation. The fertilization was applied at three different levels: low, medium and high. Control was a non-fertilized variant. This study is very important because simultaneously supplying of sugar beet with water and mineral matters is required for achievement of high and quality yields. The highest yield of total sugar was obtained in a irrigation treatment with 50% uAW and medium dose of fertilization.

Keywords: sugar beet (*Beta vulgaris* L.); irrigation, fertilization; total sugar yield

Introduction

Sugar beet (*Beta vulgaris* L.) is plant species that is used as a raw material for obtaining sugar. This culture grows in area with temperate continental climate. Sugar beet accounted for 20% of the world's sugar production. In Europe it is widespread almost in all countries. In R. of Macedonia sugar beet grows in valley Pelagonija, where is located sugar factory, established in 1959 (Cukaliev, 1996).

Sugar beet belongs in group of plants which grow in more humid regions which impose requirement of irrigation. Knowing biology and agro technique sugar beet is plant which responds well on irrigation and fertilization and gives stable and high yields (FAO, 2009).

Getting high quality and yield of sugar beet largely depends on the optimal regime of irrigation and fertilization. Providing the sugar beets with water and nutrients is very important for achievement of high and quality yield of sugar. Supplying the land with water available for plants affect the availability and utilization of mineral substances, which contribute to the increase of plant productivity (Maritima, 2012)

Material and Methods

The main objective of this study was to analyze the effects of different variants of irrigation and fertilization of sugar beet (*Beta vulgaris* L.) on the yield of total sugar. The study was performed in agro-ecological conditions in valley Pelagonija in R. of Macedonia in period from 2012 to 2014. Experiments were Trials were set up on fields of Agricultural Complex "Pelagonija" - Bitola, at the locality "Novaci" on the soil type eugley. in the period of 2002 -2004. The experiment was set up according to the method split - plot, adapted to the conditions of irrigation. During the experiment duration previous crop of sugar beet was wheat (Chukaliev & Iljovski, 1993).

In research were used two very similar varieties of sugar beet AL-omona i AL-cermona.

The irrigation and fertilization were applied in the following variants:

I. Irrigation

1. Variant - irrigation at 75% utilized available water (uAW)
2. Variant - irrigation at 50% (uAW)
3. Variant - irrigation at 25% (uAW)
4. Variant - irrigation on the basis of bioclimatic coefficient (BC)
5. Variant - without irrigation –control (C)

Irrigation was done with artificial rain by Sprinkler systems with intensity 10 mm/h.

II. Fertilization with mineral fertilizers

- a) Variant – without fertilization – control
- b) Variant - (N₆₀:P₄₀:K₆₀) – low level of fertilization
- c) Variant - (N₁₂₀:P₈₀:K₁₂₀) – medium level of fertilization
- d) Variant - (N₁₈₀:P₁₂₀:K₁₈₀) – high level of fertilization

Results and Discussion

The yield of total sugar is determined through root yield and the percentage of the sugar in it. During the processing of crystalline sugar, almost never total amount of sugar is utilized. One part remains in the byproducts of processing such as what noodles, melasa, etc. Effects of applied variants of irrigation and fertilization on the yield of the total sugar are shown in Table 1 and Table 2.

Table 1. Mean values of total sugar yield (t/ha) at different variants of irrigation and fertilization

Variants	a	b	c	d	Mean	%
75 % uAW	11.66	12.71	13.31	14.01	12,92	269,73
50 % uAW	11.64	12.80	14.53	14.82	13,45	280,79
25 % uAW	10.71	12.24	12.42	13.84	12,30	256,78
BC	11.54	12.10	13.23	13.68	12,64	263,88
Control	4.02	4.49	5.38	5.26	4,79	100
Mean	9,91	10,87	11,77	12,32	11,22	
%	100	109,69	118,77	124,32		

Table 2. Comparison of mean value of sugar yield (t/ha) at different variants of irrigation and fertilization

Irrigation variant	75% uAW, 50% uAW, 25% uAW, BC			Mean	75% uAW, 50% uAW, 25% uAW, BK	Control	Control
Fertilization variant	b	c	d		a	b, c, d	a
Meanield	12.46	13.37	14.09	13.31	11.39	5.04	4.02
%	309,95	332,59	350,50	331,01	283,33	125,37	100
%	247,22	265,28	279,56	264,02	225,99	100	-
%	109,39	117,28	123,71	116,79	100	-	-

The obtained results have shown higher yields of irrigated variants for 160-180% compared to the control which was not irrigated. Normally, this high distinction is not about the significance of differences, because all irrigated variants had statistically higher yields than variant that was not irrigated. However, more interesting is the comparison between the irrigated varieties. Total sugar yields of irrigated variants ranges in very small diapason from 12.30 to 13.45 t/ha, and expressed in percentages, this difference is 9.35%. Results of this study have shown increase of total sugar yield at optimal irrigation. At variant of irrigation 25% uAW total sugar yield is 12.30 t/ha or it is 156,78% higher compared with non-irrigated variant (4.79 t/ha). Total sugar yield at variant of irrigation 50% uAW was 13.45 t/ha or 180,79% higher than non-irrigated variant.

Among irrigated variants the highest yield was achieved at varant 50% uAW, which was 3.8-9.3% higher than other variants.

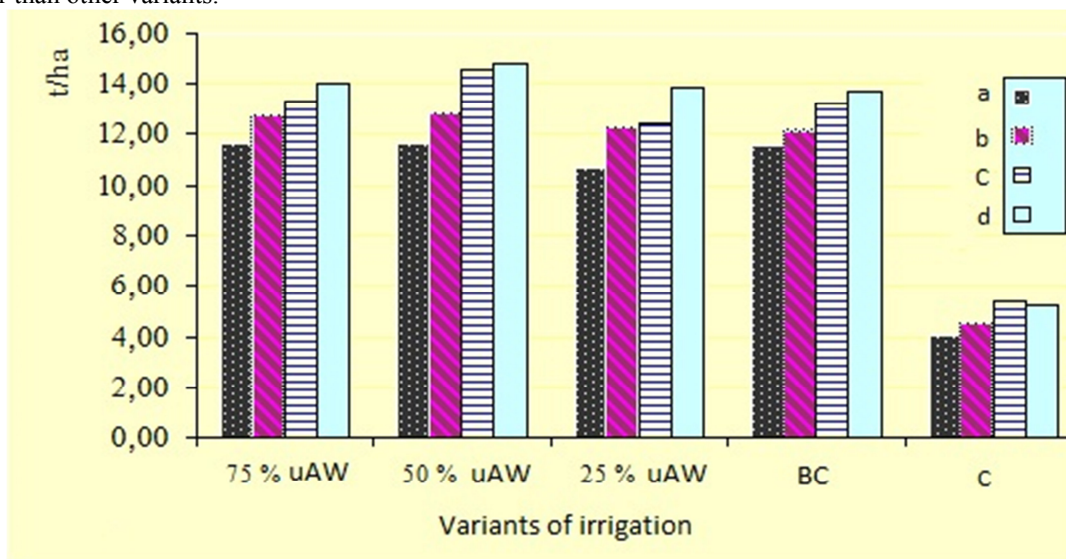


Figure 1. Effects of different variants of irrigation and fertilization on total sugar yield (t/ha)

Regarding the applied variants of fertilization, obtained results have shown more simple impact of factor fertilization compared with factor irrigation. Results of this study shown that any increase in dose of fertilizers has positively influence on the total sugar yield.

Effect of fertilization is smaller than effect of irrigation, but it is important for achievement of high yields. In this study, the obtained results indicate higher total sugar yields at variants with low and high levels of fertilization for 9,69% (10,87 t/ha) and 24,32% (12,32 t/ha) respectively, compared with control. Total sugar yield at fertilized variants is higher for 17,5% compared with fertilized variants.

According obtained results of this study, both analysed factors irrigation and fertilization have shown significant impact on total sugar yield.

Pelagonia region is characterized with soil and climatic conditions suitable for achievement of high and quality yields of sugar beet. Obtained results impose the requirements of future research on applying the different regimes of irrigation and fertilization according water and mineral matters available in the soil.

References

- Groves, S., Wells A. (1993): Sugar beet irrigation The cost and returns from irrigating sugar beet. *British Sugar Beet Review*. Vol. 61. No. 1., pp:21-22.
- Dunham, R. (1990): Irrigation of sugar beet. The benefits in 1989. *British Sugar Beet Review*. Vol.58. No.2., pp:15-18.
- Cukaliev, O. (1996). The Effect of Pulse Irrigation on Sugar Beet Yield and Quality in the Skopje Area, Ph.D. Thesis, Ss. Cyril and Methodius University, Faculty of Agriculture, Skopje
- FAO (2009): Agribusiness Handbook: Sugar beet white sugar".
- Maritima B (2012): *Beta Maritima: The Origin of Beets*. Springer.
- Metochis, C., Orphanos P.L. (1988): Irrigation and nitrogen requirements of sugar beet in Mediterranean environment. *Journal of Agricultural Sciences*. Vol. 110, pp: 387 -390.
- Chukaliev O., Iljovski I. (1993): Micro-sprinkler irrigation and its effects on sugar beet yield and sugar content. *Proceeding of the International Symposium "Integrated Resource Management & Landscape Modification for Environmental Protection"*, Chicago. pp: 248 - 253.

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