Sugar beet growth and yield as influenced by irrigation source as well as fertilization

M. S. El–Hadidy, A. M. Hagras, M. A. El-Hawary *, and M. M. Abo El- Enein

Department of Agronomy, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.

* Corresponding author E-mail: elhawary209@azhar.edu.eg (M. El–Hadidy)

ABSTRACT:

A trials laid out at Al- Amarna village, El-Manzala center, El- Dakahlia Governorate, Egypt during 2021/2022 and 2022/2023 seasons, to investigate sugar beet growth, yield and quality as influenced by water source) canal water 100%, canal 50% + drainage water 50%) and drainage water 100%) and fertilization treatments *i.e* Control**,** 90,120 Kg N / feddan**,** 24 and 48 Kg K_2 O / feddan and their combinations. A split plot design with three replications was used. Results showed that irrigation with drainage water significantly reduced relative growth rate, net assimilation rate, dry matter accumulation, fresh weight of root, root volume, percentage of purity, and yields of top, root and sugar / feddan, while sucrose% was raising compared to canal water in both seasons. Results exhibited that added 120 Kg N / feddan+ 48 Kg K_2O/ feddan had 81.81 and 72.60 % increase in root yield / feddan and 107.49 and6849% in sugar yield / feddan compared to control in 2021/202 and2022/2023 seasons, respectively. Results illustrated that the interaction between sources of irrigation water and treatment of fertilization on all measured characters was significant in both seasons. At all water sources plants treated by 120 Kg N / feddan plus 48 Kg K_2O/ feddan had the highest values of all traits measurements. Applied 120 Kg N + 48 Kg K_2O/ feddan could be alleviated the deleterious effect of drainage water and improvement sugar beet growth and productivity.

Keywords: sugar beet; water irrigation source; drainage water; nitrogen; potassium.

INTRODUCTION

Recently, sugar beet (*Beta vulgaris*, L.) has an important position in Egyptian crop rotation in winter and conceder cash crop, but it produced higher yield than sugar cane not only in the fertile soils also under soils had the different production problems *i.e.* poor, saline and alkaline soils. Moreover, it had short duration period than sugar cane, therefore need less water than sugar cane. The Government of Egypt encourages raise sugar production to less gap among production and consumption. This raise could be achieved with sowing newly reclaimed soils by sugar beet. Most of these areas face some stress problems, i.e. loss of irrigation water, soil salinity, saline water of irrigation and rare of nutrient elements. Great efforts are made to increasing productivity of sugar beet in newly reclaimed soils.

Recently, the decrease irrigation water most important factor constraining agricultural production in Egypt. Thus, the Egyptian strategy had attempts to increase productivity with the lowest quantity water of irrigation and saving the irrigation water. Applying good quality water to irrigation depressed. Thus, irrigation such as poor quality to provide population increasing with sugar. Some of these future water needs can be met by using drainage waters in irrigation. Omar *et al* (2006) found that the reduction of root yield of sugar beet was 18.93 and 26.24 % when drainage water was used by 50% with fresh water during the two successive seasons, respectively. Applying 25 to 50 % drainage water alternatively with fresh water caused a significant increase in sucrose percentage compared to control treatment in 1st season while in 2nd season sucrose percentage was significantly decreased with increasing number of irrigations with drainage water. Eid and Ibrahim (2010) showed that irrigated plants by drainage water significantly reduced root yield by about 21% relative to using fresh water. While drainage treatments caused high significant reduction in sugar yield. The lowest root quality recorded with drainage water. Rehab *et al.*(2022) found that irrigation by canal water had a significant increments in all traits *i.e.* yields, quality as well as gross. Oppositely, the lowest values were found with drainage and control treatments.

Sugar beet plants need the large amount of nitrogen element to give the highest growth and productivity. Application the adequate nitrogen fertilizer rate plays a main role in yield as well as quality. Pytlarz (2005) showed that raising 90 up to 180 kg N ha^{-1} significantly increased root yield, but sugar content decreased. Abdel-Motagally and Attia (2009) found that at the different K rates applying 285 kg N ha^{-1} significantly increased sugar loss ha-

[1]. Percentage of impurities significantly increased when added N rate up to 285 kg N ha^{-1} under 0.0 kg K2O ha^{-1}. Gharib and El-Henawy (2011) reported that dry weight, root length and weight, yields of top, root and sugar increased with increasing nitrogen rate up to 90 kg N/feddan. The oppositely true of sugar and juice purity %. Moustafa *et al* (2011) stated that adding dressing 100 Kg N /fed roots and sugar yield significantly increased, but sucrose % was significant decrease. Masri *et al* (2015) reported root weight, impurities percentage , root and sugar yield /feddan significantly increased as N rate increased up to 120 kg N/fed. Excessive of N caused reduction of beet quality i.e. sucrose and purity %.

Potassium is regulate movement of water by stomata opening and closing, so that it maintains turgor and reduces water loss and wilting. It's involved with enzyme activation which affected production of starch and adenosine triphosphate (ATP). ATP can regulate the rate production of photosynthesis. Potassium reduces respiration, preventing energy losses. sugar and starch translocation enhancement by potassium. Potassium has enhancing photosynthetic rate, reducing Na^+ uptake, increasing K^+ uptake, improving crop biomass and yield under salt stress. If K is deficient or not supplied in adequate amounts growth and yield reduced. Therefore K addition of sugar beet exhibited positively affected almost physiological and agronomic traits. Many investigators reported that El-Hawary (1999) found that 48 kg K_2O/fed. Significantly increased root yield by 24.27 and 28.57% as well as sugar yield by 12.97 and 15.08% in both seasons, respectively. Abdel-Motagally and Attia (2009) found that 114 kg K_2O ha^{-1} increased sucrose contents, sugar yield ha^{-1} and some sugar beet quality. Mehrandish *et al* (2012) observed that potassium had a significant effect on all investigated characteristics. Potassium application of 100 kg K_2O ha^{-1}gave higher root, shoot and sugar yield than control treatments. Mubarak *et al* (2016) observed significant increase in growth, yield and sugar content with increasing level of K. Alla and Helmy (2022) showed significantly increases of photosynthetic pigments, root diameter, sucrose % and root K content , sucrose %, and yields of root, top, and sugar $ha^{-1}$with 238 kg K_2SO_4 ha^{-1} compared to the lower K levels, Therefore this investigation was carried out to study the effect of irrigation water source, nitrogen and potassium fertilizer rates on growth, yield and quality of sugar beet, variety (Melodia) at Al- Amarna village , El-Manzala center, El- Dakahlia Governorate, Egypt .

MATERIALS AND METHODS

Two field experiments were conducted at Al- Amarna village, El-Manzala center, El-Dakahlia Governorate, Egypt during 2021/2022 and 2022/2023 seasons, to study the effect of irrigation water source, nitrogen and potassium fertilizer rates on growth, yield and quality of sugar beet, variety (Melodia).

The experiment treatments were as follows:

Irrigation water source

Three irrigation water sources were used as follows:

A.1- Irrigation with canal water 100% (fresh water as a control)

A.2- Irrigation with drainage water (100 %)

A.3- Irrigation with mixed water (canal water 50% + drainage water 50%)

Fertilization treatments

B.1- Control (without any fertilization)

B.2- Fertilized plants with 90 Kg N / feddan

B.3- Fertilized plants with 120 Kg N / feddan

B.4- Fertilized plants with 24 Kg K_2O / feddan

B.5- Fertilized plants with 48 Kg K_2O / feddan

B.6- Fertilized plants with 90 Kg N / feddan+ 24 Kg K_2O / feddan

B.7- Fertilized plants with 90 Kg N / feddan+ 48 Kg K_2O / feddan

B.8- Fertilized plants with 120 Kg N / feddan+ 24 Kg K_2O / feddan

B.9- Fertilized plants with 120 Kg N / feddan+ 48 Kg K_2O/ feddan

The experiments were carried out in split plot design with three replications. The main plots were assigned to irrigation water source and the sub plots were devoted to fertilization treatments .The area of sub plot was 10.5 m^2 (6 rows x 0.5 m width x 3.5 m length).

Nitrogen fertilizer in the form of Urea (46%N) at the previously studied rates were splitted into two equal halves the first half was applied at 40 and the second once at 70 days after sowing. Also potassium fertilizer in the form of potassium sulphate (48 %K_2O) at the previously studied rates were splitted into two

equal halves the first half was applied at 40 and the second once at 70 days after sowing.

Soil samples were randomly taken from the experimental sites at depth of 0 to 30 cm from soil surface and were prepared for physical and chemical properties in 2021/2022 and 2022/2023 seasons. Physical and chemical properties of soil at the experimental sites in 2020/2021 and 2021/20202 seasons are shown in Table (1). Analysis of Irrigation water sources in 2021/2022 and 2022/2023 seasons are shown in Table 2.

Sowing took place on 9th and 13 October in 2021/2022 and 2022/2023 seasons, respectively. The preceding crop was rice and corn in 2021/2022 and 2022/2023 seasons, respectively. Seeds of multigerm sugar beet cultivar "Melodia" were hand sown in hills with approximately 3-4 seed balls/hill. Plants were thinned to one plants/hill after 35 days from sowing. All other cultural practices were done as recommended for sugar beet crop.

The collected data in the experiment involved the following traits:

Three guarded plants were taken randomly from the middle ridges at 90 , 111 and 132 days from sowing. The samples were carefully uprooted and the following data were recorded for each sample.

Relative growth rate (mg/day).It was measured as the following formula according to Watson (1958).

$$RGR = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1}$$

Net assimilation rate (g/cm²/ week).It was measured as the following formula according to Watson (1958).

$NAR = (W_2 - W_1)\, x(\log_e A_2 - \log_e A_1)/ (A_2 - A_1)x(t_2 - t_1)$

Dry matter accumulation (g/day), it was measured as the increase in dry weight between the first and second time.

Whereas W_1, A_1 and W_2, A_2 respectively refer to dry weight and leaf area at time t_1 and t_2. $\log_e$ refer to natural logarithm

At harvest date (after 190 days from sowing), the three middle ridges of each plot were harvested to estimate the following characters:

Sucrose percentage, it was determined polarimeterically at harvest according to the method described by Le Docte (1927).

Juice purity percentage, it was determined at harvest according to the method of Silin and Silina (1977).

Purity % it was calculated as the following formula.

Purity = Sucrose %-/ Total soluble solids (TSS)x 100

Root fresh weight (g).

Root volume (cm³), it was determined by water volume displaced (cm³).

Top yield per feddan (ton).

Root yield per feddan (ton).

Sugar yield per feddan (ton), it was calculated from root yield feddan multiplied by sucrose percentage.

Statistical analysis

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-plot design by means of "MSTAT-C" Computer software package and least significant difference (LSD) method was used to test the differences between treatments means at 5 % level of probability as published by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

averages of relative growth rate (g/week), net assimilation rate (g/cm²/week), dray matter accumulation (g/week) ,root fresh weight (g), root volume (cm³) ,sucrose %, purity%, top, root and sugar yield (ton)/ feddan of sugar beet plants as affected by water sources, treatments of fertilization and their interaction in 2021/2022 and 2022/ 2023seasons are shown in Tables 3-12.

Results recorded in Tables 3-12 shows significant effect of irrigation sources on all studied traits in both seasons.

Drainage water reduced relative growth rate (g/week) by15.20 and 20.245 as well as 18.33 and 11.17%, net assimilation rate17.46 and 53.56% as well as 6.30 and 17.09% and dry matter accumulation 25.18 and 27.99% as wee as 13.21 and 23.76% as compared with irrigation by canal water at 90 to 111 and 111to 132 days from sowing respectively,in

2021/2022 as well as 2022/2023 seasons . plants irrigated with drainage water reduced root fresh weight by 16.76 and 22.80% , root volume by 31.40 and 30.36% , purity% by 3.80 and 2.49% , top yield / feddan by 13.55 and 10.40% , root yield / feddan 15.39 and 22.81% by and sugar yield / feddan by10.83 and 19.22% as compared with irrigation by canal water in 2021/2022 and 2022/2023 seasons , respectively. On the other hand , sucrose % increased by 6.38 and 4.20% when sugar beet plants irrigated by drainage water as compared with irrigation by canal water in 2021/2022 and 2022/2023 seasons , respectively.

The decrease in root yield /feddan owing to drainage water may be due to the deleterious effect on relative growth rate, net assimilation rate which reduced dray matter accumulation and translocate into roots, therefore root fresh weight and root volume were depressed which lead to decreased root yield. While the decrease in sugar yield /feddan due to drainage water might be attributed to decreasing root yield /feddan whereas it multiplied by sucrose percentage therefore, yield decreased owing to decreasing root yield.

These results are in the same line with those recoded by Omar *et al* (2006), Eid and Ibrahim (2010) and Rehab *et al*.(2022).

Tables 3-12 shows clearly that fertilized sugar beet plants by 120 Kg N + 48 Kg K_2O/ feddan higher relative growth rate 26.45 and 18.56 g/week as well as 25.76 and 18.54 g/week , net assimilation rate 58.15 and 31.25 g/cm^2/week as well as 45.90 and 30.32 g/cm^2/week and dray matter accumulation 9.91 and 6.47 g/week as well as 8.49 and 7.31 g/week than all fertilization treatments at growth periods 90 to 111 and 111 to 132 days after sowing in 2021/2022 and 2022/2023 seasons , respectively. Also this treatment (120 Kg N / feddan+ 48 Kg K_2O/ feddan) gave higher root fresh weight1769.11 and 1310.00 g, root volume 1069.50 and 981.50 cm^3 , top yield 16.67 and 16.38 (ton)/ feddan , root yield 35.38 and 26.20 ton/ feddan and sugar yield 7.20 and 5.24 ton/ feddan than all used fertilization treatments ,respectively in 2021/2022 and 2022/2023 seasons.

Added 120 Kg N + 48 Kg K_2O/ feddan had 81.81 and 72.60 % increase in root yield / feddan and 107.49 and 6849% in sugar yield/ feddan compared to control (no added any fertilization) in 2021/2022 and 2022/2023 seasons , respectively.

On the other hand , the lower values of all mentioned characters were recorded with control compared to all fertililsation treatments in both seasons, while sugar beet grown on the control treatment gave higher sucrose 19.36 and 20.53% as well as purity 89.06 and 84.31% compared to another treatments ,respectively in 2021/2022 and 2022/2023 seasons.

raising root and sugar owing to treatment of 120 kg N + 48K_2O/ feddan may be attributed application the optimum rate from nitrogen and potassium fertilizer plays an important roles in increment of photosynthesis, translocation of sucrose, thus this treatment raising dray matter accumulation, fresh weight of root, root volume and top yield (ton)/ feddan which lead to enhancement yields of root and sugar. El-Hawary (1999) Abdel-Motagally and Attia (2009) Gharib and El-Henawy (2011) Moustafa *et al* (2011) and Masri *et al* (2015) they found the same results.

Results tabulated in Tables 3- 12 exhibited that there were a significant effects of interaction among water sources and fertilization on all traits in the two seasons. Irrigated sugar beet plants by drainage water and fertilized with 120 Kg N + 48 Kg K_2O/ feddan raising relative growth rate by 53.77 and 62.22 % as well as 58.91 and 59.74 %,net assimilation rate by 66.78 and 154.67% as well as 58.42 and 83.07% and dray matter accumulation by 456.28 and 380.93% as well as 455.62 and 273.50 % as compared with irrigation with drainage water and without any fertilization (control) treatment at growth periods 90 to 111 and 111 to 132 days from sowing date in 2021/2022as well as 2022/2023 seasons , respectively. In the same respect irrigated sugar beet plants by drainage water and fertilized plants with 120 Kg N / feddan+ 48 Kg K_2O/ feddan increasing root fresh weight by 68.66 and71.42 %, root volume by 147.90 and 174.00 %, top yield / feddan by 128.46 and 111.43 %, root yield / feddan by 68.68 and 71.42 % and sugar yield / feddan by 85.00 and 68.13% as compared with control treatment, respectively in 2021/2022and 2022/2023 seasons. While , higher sucrose 20.37 and 21.39 % recorded with drainage and 48kg K_2O / feddan as compared with all treatments, respectively in 2021/2022and 2022/2023 seasons. These results suggested that applied 120 Kg N / feddan+ 48 Kg K_2O/ feddan treatment alleviated the deleterious effect of irrigation with drainage water and improvement productivity.

It could be recommended that applied 120 Kg N plus 48 Kg K_2O/ feddan enhancement productivity of sugar beet plants when irrigated by drainage at North Delta in Al-

Amarna village, El-Manzala center, El-Dakahlia Governorate, Egypt.

REFERENCES

Alla, H.N., Helmy, S.A.M. 2022: Response of sugar beet to sandy soil amended by zeolite and potassium sulfate fertilization. Sabrao J. of Breeding and Genetics, 54(2), 447-457.

Abdel-Motagally, F.M., Attia, K.K. 2009: Response of sugar beet plants to nitrogen and potassium fertilization in sandy calcareous soil. Int. J. Agric. Biol, 11(6), 695-700.

Eid, S.M., Ibrahim, M.M 2010: Irrigation water salinity and irrigation inter-vals effects on growth, yield and quality of the sugar beet, in saline soil, at middle north Nile delta. J. of Soil Sci. and Agric. Engineering, 1(8), 789-800.

El-Hawary, M.A. 1999: Influence of nitrogen, potassium and boron fertilizer levels on sugar beet under saline soil condition. J. Agric. Sci. Mansoura Univ., 24(4): 1573-1581.

Gharib, H., El-Henawy, A.S. 2011: Response of sugar beet (Betavulgaris, L) to irrigation regime, nitrogen rate and micronutrients application. Alexandria Scie. Exchange J., 32(April-June), 140-156.

Gomez, K.A., Gomez, A.A. 1984: Statistical procedures for agricultural research. John wily & sons.

Le Docte, A. 1927: Commercial determination of sugar in the beet root using the Sacks-Le Docte process. Int. Sug. J, 29, 488-492.

Mubarak, M.U., Zahir, M., Ahmad, S., Wakeel, A. 2016: Sugar beet yield and industrial sugar contents improved by potassium fertilization under scarce and adequate moisture conditions. J. of Integrative Agric., 15(11), 2620-2626.

Masri, M.I., Ramadan, B.S.B., El-Shafai, A.M.A., El-Kady, M.S. 2015: Effect of water stress and fertilization on yield and quality of sugar beet under drip and sprinkler irrigation systems in sandy soil. Int. J. Agric. Sci, 5(3), 414-425.

Mehrandish, M., Moeini, M.J., Armin, M. 2012: Sugar beet (Beta vulgaris L.) response to potassium application under full a deficit irrigation. Eur. J. Exp. Biol, 2(6), 2113-2119.

Moustafa, Z.R., Soudi, A.M., Mohamed, K.E. 2011: Productivity and quality of sugar beet as influenced by nitrogen fertilizer and some micronutrients. Egyptian J. of Agric. Res., 89(3), 1005-1018.

Omar, E.H., El-Aziz, A., Ragab, M.M., Abd Allah, M.A.A. 2006: Effect of alternative irrigation with fresh and drainage water on sugar beet yield, soil salinity and some water relations at north Nile delta, Egypt. J. of Soil Sci. and Agric. Engineering, 31(12), 8119-8130.

Pytlarz-Kozicka, M. 2005: The effect of nitrogen fertilization and anti- fungal plant protection on sugar beet yielding. Plant, Soil Environ. 51(5), 232-236.

Rehab, I.F., El Maghraby, S.S., Ibrahim, N.Y., Kandil, E.E. 2022: Reducing the Effect of Agricultural Drainage Water Salinity on Sugar Beet Productivity and Quality by Some Soil Amendments Egyptian Academic J. of Biol. Sci., H. Bot., 13(2), 207-216.

Silin, P.M., Silina, N.P. 1977: Chemical control in sugar technology. Food Technol., pub. USSR, 120-126.

Watson, D.J. 1958: The dependence of net assimilation rate on leaf area index. Ann. Bot. London, N.S. 22: 37- 45.

Table 1: Physical and chemical analysis of soil at the experimental sites in 2021/2022 and 2022/2023 seasons.

Variable	Seasons	
	2021/2022	2022/2023
Physical analysis		
Sand %	14.04	15.20
Silt %	23.16	21.19
Clay %	62.60	63.37
Gipsium %	0.20	0.24
Chemical analysis		
Soil reactions pH (1:7.5)	7.68	7.44
EC dS/m in soil paste	0.57	0.50
Soluble Cations meq/L:		
Ca^{++}	0.64	0.66
K^{+}	1.32	1.25
Na^{+}	2.92	2.33
Mg^{++}	0.81	0.76
Soluble anions meq/L		
HCO_3-	2.09	1.78
Cl-	1.22	1.12
SO_4-	2.23	2.10

Table 2: Analysis of irrigation water at the experimental sites in 2021/2022 and 2022/2023 seasons.

Irrigation water analysis		Canal water	Mixed water	Drainage water
PH		7.02	7.66	8.34
EC dS/m		0.45	0.84	1.24
cations	Na^{+}	2.01	3.80	5.6
	K^{+}	1.12	2.39	3.67
	Ca^{++}	0.74	1.19	1.65
	Mg^{++}	0.81	1.17	1.53
Anions	$H_2CO_3^{--}$	2.15	2.29	2.44
	Cl^{-}	1.06	3.46	5.87
	SO_4^{--}	1.33	2.97	4.62

Table 3: Average relative growth rate (mg/day) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction at 90 to 111 and 111 to 132 days from sowing in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season								2022/2023 season							
	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means
	Irrigation water source				Irrigation water source				Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	17.78	16.43	15.64	16.62	12.50	11.16	9.69	11.12	16.59	14.56	14.75	15.30	12.48	11.92	11.03	11.81
90 Kg N	19.51	20.96	18.80	19.75	14.32	12.04	11.62	12.66	19.84	17.21	16.42	17.82	15.61	13.80	12.75	14.05
120KgN	23.59	21.65	19.96	21.73	14.67	12.97	12.57	13.40	21.06	19.05	17.35	19.15	16.71	14.95	13.98	15.21
24Kg K2 O	18.75	18.01	15.79	17.52	13.28	11.76	10.58	11.88	17.20	14.83	15.46	15.83	12.65	12.54	12.13	12.44
48Kg K2 O	20.53	19.65	17.04	19.07	13.78	12.00	10.79	12.19	20.86	17.14	15.90	17.97	15.08	12.81	13.58	13.82
90KgN+24Kg K2O	23.41	22.31	21.07	22.26	15.80	13.70	12.82	14.11	22.89	19.95	17.49	20.11	17.77	16.65	15.18	16.53
90KgN+48Kg K2O	26.41	23.29	22.50	24.07	16.86	14.48	13.80	15.04	23.92	22.46	18.37	21.58	17.99	17.17	16.89	17.35
120KgN+24Kg K2O	28.26	24.07	22.34	24.89	17.43	14.83	14.83	15.70	24.82	23.76	20.05	22.88	18.69	17.18	17.13	17.67
120KgN+48Kg K2O	30.74	24.54	24.05	26.45	22.30	17.67	15.72	18.56	27.79	26.04	23.44	25.76	19.74	18.27	17.62	18.54
Means	23.22	21.21	19.69		15.66	13.40	12.49		21.66	19.44	17.69		16.30	15.03	14.48	
L.S.D at 5% Level																
Irrigation	2.49	1.94	2.20	1.85												
fertilization	2.50	2.93	2.74	3.02												
Irrigation x Fertilization	4.33	5.09	4.74	5.24												

Table 4: Average net assimilation rate (g/cm²/w) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction at 90 to 111 and 111 to 132 days from sowing in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season								2022/2023 season							
	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means
	Irrigation water source				Irrigation water source				Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	43.08	35.70	32.82	37.20	14.40	12.49	8.87	11.92	33.94	29.09	27.95	30.33	17.32	18.58	15.42	17.11
90 Kg N	45.09	36.30	36.93	39.44	16.16	13.29	9.55	13.00	34.87	30.72	29.97	31.86	19.28	19.34	16.12	18.25
120KgN	47.04	43.72	41.84	44.20	26.31	13.80	9.63	16.58	36.06	33.31	31.73	33.70	19.37	20.73	17.62	19.24
24Kg K2 O	46.16	39.19	38.32	41.22	30.94	15.21	10.54	18.90	37.95	35.79	33.88	35.87	20.23	21.83	17.51	19.86
48Kg K2 O	50.84	47.96	42.91	47.24	31.86	15.98	14.40	20.75	39.09	36.27	34.35	36.57	22.50	22.24	18.54	21.09
90KgN+24Kg K2O	52.28	49.43	44.99	48.90	34.86	22.44	14.51	23.94	40.38	39.65	36.45	38.83	26.30	22.39	21.33	23.34
90KgN+48Kg K2O	56.98	52.36	46.41	51.91	35.89	22.60	18.38	25.62	43.56	41.75	39.65	41.65	28.95	27.17	22.00	26.04
120KgN+24Kg K2O	61.45	53.83	47.07	54.12	37.55	23.82	19.03	26.80	46.30	44.94	42.08	44.44	30.33	27.79	23.99	27.37
120KgN+48Kg K2O	64.67	55.05	54.74	58.15	39.31	31.84	22.59	31.25	47.80	45.62	44.28	45.90	33.77	29.54	28.23	30.52
Means	51.96	45.95	42.89		30.51	19.05	14.17		37.98	37.46	35.59		24.23	23.29	20.09	

L.S.D at 5% Level

Irrigation	1.78	1.88	1.74	0.79
fertilization	3.57	3.87	5.21	4.17
Irrigation x Fertilization	6.34	6.72	8.03	5.23

Table 5: Average dry matter accumulation rate (g/day) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction at 90 to 111 and 111 to 132 days from sowing in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season								2022/2023 season							
	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means	At 90 to 111 day from sowing			Means	At 111to132 day from sowing			Means
	Irrigation water source				Irrigation water source				Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	3.01	1.96	1.67	2.21	2.15	1.33	1.26	1.58	1.87	1.78	1.51	1.72	3.39	2.68	1.51	2.53
90 Kg N	3.76	4.66	3.87	4.10	4.08	2.34	2.64	3.02	6.52	6.50	5.58	6.20	5.89	4.09	5.20	5.06
120KgN	6.60	5.10	7.20	6.30	4.17	3.17	2.79	3.38	7.16	6.70	6.52	6.79	5.96	4.30	5.21	5.16
24Kg K2 O	2.44	2.19	2.06	2.23	2.44	1.36	1.41	1.73	5.67	5.12	4.54	5.11	5.21	3.71	4.31	4.41
48Kg K2 O	5.83	3.44	3.60	4.29	2.82	1.38	1.77	1.99	5.77	5.39	4.98	5.38	5.54	3.73	4.92	4.73
90KgN+24Kg K2O	10.27	8.69	4.48	7.81	5.40	3.69	3.87	4.32	7.83	7.56	6.61	7.34	6.19	4.56	5.23	5.32
90KgN+48Kg K2O	10.46	9.60	7.25	9.10	6.42	4.97	4.21	5.20	8.19	7.59	6.90	7.56	6.51	5.70	5.32	5.84
120KgN+24Kg K2O	9.49	6.61	7.40	7.84	7.82	5.40	4.71	5.97	8.32	7.70	7.04	7.69	7.95	5.71	5.39	6.35
120KgN+48Kg K2O	10.73	9.71	9.29	9.91	8.76	5.59	5.06	6.47	8.62	8.44	8.39	8.49	9.46	6.82	5.64	7.31
Means	6.95	5.77	5.20		3.93	3.25	2.83		6.66	6.31	5.78		6.23	4.82	4.75	

L.S.D at 5% Level

Irrigation	0.50	0.21	0.28	0.58
fertilization	3.03	0.70	0.91	0.96
Irrigation x Fertilization	4.25	1.22	1.59	1.66

Table 6: Average sucrose percentage of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	18.89	19.17	20.03	19.36	20.07	20.41	21.11	20.53
90 Kg N	17.27	18.04	19.12	18.14	19.95	20.19	20.39	20.18
120KgN	17.03	17.95	18.60	17.86	19.92	19.76	20.02	19.90
24Kg K_2O	19.88	20.00	20.32	20.06	20.49	20.42	21.30	20.74
48Kg K_2O	20.10	20.56	20.37	20.34	20.95	20.45	21.39	20.93
90KgN+24Kg K_2O	18.42	19.06	19.71	19.06	19.66	19.41	20.84	19.97
90KgN+48Kg K_2O	18.76	19.15	19.98	19.30	19.76	19.84	20.98	20.19
120KgN+24Kg K_2O	17.63	18.20	19.36	18.40	19.14	19.94	20.47	19.85
120KgN+48Kg K_2O	18.32	18.78	19.69	18.93	19.46	19.98	20.67	20.04
Means	18.50	18.99	19.68		19.99	20.04	20.83	

L.S.D at 5% Level

Irrigation	0.41	0.46
fertilization	0.58	0.31
Irrigation x Fertilizaion	0 .61	0.55

Table 7: Average purity percentage of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	88.29	89.14	89.76	89.06	85.37	83.84	83.73	84.31
90 Kg N	88.21	87.03	88.91	88.05	84.66	83.61	83.33	83.86
120KgN	87.94	85.24	85.06	86.08	84.64	83.43	83.16	83.74
24Kg K_2O	87.68	84.88	83.11	85.22	84.60	83.36	83.00	83.65
48Kg K_2O	87.23	84.72	83.23	85.06	84.35	83.17	82.46	83.32
90KgN+24Kg K_2O	86.92	83.12	81.79	83.94	83.99	82.41	81.95	82.78
90KgN+48Kg K_2O	86.11	82.09	81.00	83.07	83.43	81.86	81.57	82.28
120KgN+24Kg K_2O	84.72	80.71	78.39	81.27	83.30	81.23	80.74	81.76
120KgN+48Kg K_2O	80.67	80.51	76.91	79.36	82.17	81.17	79.76	81.03
Means	86.42	84.16	83.13		84.29	82.67	82.19	

L.S.D at 5% Level
Irrigation: 1.65, 0.40.
Fertilization:2.07, 0.82
Irrigation x Fertilizaion: N.S., N.S.

Table 8: Average root fresh weight (g) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	1063.33	940.00	915.00	972.78	818.33	758.33	700.00	758.89
90 Kg N	1306.67	1118.33	1096.67	1173.89	1062.00	1001.67	781.67	948.44
120KgN	1663.33	1298.33	1248.33	1403.33	1093.17	1071.67	808.33	991.06
24Kg K_2O	1210.00	970.00	951.67	1043.89	1073.33	1051.67	848.33	991.11
48Kg K_2O	1360.00	1123.33	1075.00	1186.11	1111.67	1086.67	900.00	1032.78
90KgN+24Kg K_2O	1381.67	1313.33	1286.67	1327.22	1250.00	1173.33	903.33	1108.89
90KgN+48Kg K_2O	1606.67	1573.33	1448.33	1542.78	1313.33	1256.67	961.67	1177.22
120KgN+24Kg K_2O	1703.33	1615.00	1496.67	1605.00	1353.33	1311.67	983.33	1216.11
120KgN+48Kg K_2O	1993.33	1770.67	1543.33	1769.11	1400.00	1330.00	1200.00	1310.00
Means	1476.48	1302.48	1229.07		1163.91	1115.74	898.52	

L.S.D at 5% Level Irrigation: 125.90, 189.10
Fertilization:142.78, 132.82 Irrigation x Fertilizaion: 247.30, 230.06

Table 9: Average root volume (cm3) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	573.67	409.17	379.17	454.00	517.00	405.83	322.50	415.11
90 Kg N	791.67	600.00	575.33	655.67	735.00	543.33	518.67	599.00
120KgN	1001.67	890.00	870.00	920.56	945.00	833.33	713.00	830.44
24Kg K_2O	606.67	446.33	426.00	493.00	550.00	441.33	369.33	453.56
48Kg K_2O	955.83	610.00	581.67	715.83	775.83	553.33	525.00	618.06
90KgN+24Kg K_2O	1035.00	743.33	700.00	826.11	978.33	686.67	643.33	769.44
90KgN+48Kg K_2O	1193.33	816.67	760.33	923.44	1070.00	760.00	703.67	844.56
120KgN+24Kg K_2O	1315.00	839.17	827.50	993.89	1125.00	842.50	770.83	912.78
120KgN+48Kg K_2O	1361.67	987.50	940.33	1096.50	1130.00	930.83	883.67	981.50
Means	981.61	704.69	673.37		869.57	666.35	605.56	

L.S.D at 5% Level Irrigation: 93.07, 82.63
Fertilization:19.09 120.25 Irrigation x Fertilizaion: 209.12, 199.08

Table 10: Average top yield (ton/fed) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	9.30	7.20	6.85	7.78	8.42	8.14	7.26	7.94
90 Kg N	11.55	10.80	9.85	10.73	12.53	12.25	11.69	12.16
120KgN	15.55	14.95	14.25	14.92	13.47	13.08	12.69	13.08
24Kg K_2O	9.70	7.25	6.85	7.93	9.19	10.19	8.86	9.42
48Kg K_2O	10.30	8.55	8.25	9.03	9.42	10.61	10.05	10.02
90KgN+24Kg K_2O	12.20	11.95	11.60	11.92	14.44	13.42	11.38	13.08
90KgN+48Kg K_2O	13.10	12.40	11.70	12.40	15.69	14.03	13.42	14.38
120KgN+24Kg K_2O	16.00	15.30	14.90	15.40	16.69	16.19	14.61	15.83
120KgN+48Kg K_2O	17.90	16.45	15.65	16.67	17.35	16.45	15.35	16.38
Means	12.84	11.65	11.10		13.02	12.71	11.70	

L.S.D at 5% Level Irrigation: 1.22, 1.20
Fertilization: 1.29, 2.26 Irrigation x Fertilizaion: 2.13 3.50

Table 11: Average root yield (ton/fed) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	21.27	18.80	18.30	19.46	16.37	15.17	14.00	15.18
90 Kg N	26.13	22.37	21.93	23.48	21.24	20.03	15.63	18.97
120KgN	30.93	25.97	24.97	27.29	21.86	21.43	16.17	19.82
24Kg K_2O	24.20	19.40	19.03	20.88	21.47	21.03	16.97	19.82
48Kg K_2O	27.20	22.47	21.50	23.72	22.23	21.73	18.00	20.66
90KgN+24Kg K_2O	27.63	26.27	25.73	26.54	25.00	23.47	18.07	22.18
90KgN+48Kg K_2O	32.13	31.47	28.97	30.86	26.27	25.13	19.23	23.54
120KgN+24Kg K_2O	34.07	32.30	29.93	32.10	27.07	26.23	19.67	24.32
120KgN+48Kg K_2O	39.87	35.41	30.87	35.38	28.00	26.60	24.00	26.20
Means	29.27	26.05	24.58		23.28	22.31	17.97	

L.S.D at 5% Level Irrigation: 2.51, 3.78
Fertilization: 2.85 2.65 Irrigation x Fertilizaion: 3.90 3.60

Table 12: Average sugar yield (ton/fed) of sugar beet as affected by irrigation water source, fertilization treatments and their interaction in 2021/2022 and 2022/2023 seasons.

Fertilization treatments (Kg/fed)	2021/2022 season			Means	2022/2023 season			Means
	Irrigation water source				Irrigation water source			
	Canal water	Mixed water	Drainage water		Canal water	Mixed water	Drainage water	
control	3.61	3.39	3.40	3.47	3.29	3.09	2.95	3.11
90 Kg N	4.52	4.04	4.24	4.27	4.24	4.05	3.21	3.83
120KgN	5.45	4.72	4.77	4.98	4.35	4.23	3.24	3.94
24Kg K_2O	4.42	3.63	3.75	3.93	4.40	4.30	3.62	4.10
48Kg K_2O	5.10	4.30	4.29	4.56	4.66	4.45	3.85	4.32
90KgN+24Kg K_2O	5.08	5.01	5.07	5.05	4.91	4.56	3.78	4.42
90KgN+48Kg K_2O	6.07	6.03	5.80	5.97	5.19	4.99	4.04	4.74
120KgN+24Kg K_2O	6.77	6.46	6.08	6.44	5.19	5.23	4.03	4.81
120KgN+48Kg K_2O	8.02	7.29	6.29	7.20	5.46	5.31	4.96	5.24
Means	5.45	4.99	4.86		4.63	4.47	3.74	

L.S.D at 5% Level
Irrigation: 0.45 0.60
Fertilization:0.56 0.54
Irrigation x Fertilizaion: 0.95 0.89

تأثير مصدر مياه الري والتسميد على نمو وانتاجية بنجر السكر

محمد السيد الحديدى, احمد مصطفى هجرس، محمد الآسمر الهوارى * ، مؤمن مصطفى ابو العنين

قسم المحاصيل, كلية الزراعة, جامعة الازهر, القاهرة, مصر.

* البريد الإلكتروني للباحث الرئيسي: elhawary209@azhar.edu.eg

الملخص العربي:

أجريت تجربتان حقليتان بقرية العمارنة مركز المنزلة بمحافظة الدقهلية بمصر خلال موسمي 2022/2021 و 2023/2022 لدراسة تأثير مصدر مياه الري (مياه الترعة ،ومخلوط من مياه الترعة 50٪ + مياه الصرف 50٪، ومياه الصرف) ، والتسميد بالنيتروجين والبوتاسيوم كما يلى الكنترول ، 90 ، 120 كجم نيتروجين/فدان ، 24 ، 48 كجم بو$_2$أ / فدان وتوافقاتهم على نمو ومحصول وجودة بنجر السكر . نفذت التجربة فى تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات. أدى الرى بمياه الصرف الزراعى إلى انخفاض معنوي في معدل النمو النسبي ،صافي معدل التمثيل الضوئي ، معدل تراكم المادة الجافة ، وزن الجذر غض ، حجم الجذر ، النسبة المئوية للنقاوة، محصول العرش/ فدان ، محصول الجذر / فدان ، محصول السكر / فدان .بينما زادت نسبة السكروز مقارنة بالري بمياه الترعة في كلا الموسمين. اعطى التسميد بمعدل 120 كجم نيتروجين + 48 كجم بو$_2$أ / فدان أعلى قيم لجميع الصفات المدروسة سابقة الذكر في كلا الموسمين. كان تأثير التفاعل بين مصدر مياه الري ومعاملات التسميد معنويا على جميع الصفات المدروسة في كلا الموسمين . أعطى التسميد بمعدل 120 كجم ن / فدان + 48 كجم بو$_2$أ / فدان عند الرى بماء الصرف الزراعى زيادة معنوية في جميع الصفات المدروسة سابقة الذكر فى كلا الموسمين. توصى الدراسة أن تسميد نباتات بنجر السكر بمعدل120 كجم ن / فدان + 48 كجم بو$_2$أ / فدان عند الرى بماء الصرف الزراعى أدى الى تقليل التأثير الضار لماء الصرف الزراعى مما أدى الى زيادة محصول الجذور والسكر فى شمال الدلتا بمحافظة الدقهلية بمصر.

الكلمات الاسترشادية: بنجر السكر, مصدر ماء الرى, ماء الصرف الزراعى, النيتروجين, البوتاسيوم.